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AUTHORIZATION TO PERMIT ACCESS TO APPLICATION BY PARTICIPATING OFFICES	<i>COMPLETE IF KNOWN</i>	
	Application Number	New
	Filing Date	Herewith
	First Named Inventor	David Birnbaum
	Attorney Docket Number	IMM389C1
Send completed form to: Commissioner for Patents P.O. Box 1450, Alexandria, VA 22313-1450	Title (Required)	METHOD AND APPARATUS FOR PRODUCING A DYNAMIC HAPTIC EFFECT

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/Thomas A. Hassing/

Signature

2012-05-16

Date

Thomas A. Hassing

Printed or Typed Name

408-467-1900

Telephone Number

36,159

Registration Number, if applicable

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FOR
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ORIGINAL
DECLARATION

RULE 63 (37 C.F.R. 1.63)
DECLARATION AND POWER OF ATTORNEY
FOR PATENT APPLICATION
IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

As a below named inventor(s), I/we hereby declare that:

This declaration is directed to:

- The attached application, or
- United States application or PCT international application number _____ filed on 02/15/2012
- As amended on _____ (if applicable);

I/we believe that I/we am/are the original and first inventor(s) of the subject matter which is claimed and for which a patent is sought;

I/we have reviewed and understand the contents of the above-identified application, including the claims, as amended by any amendment specifically referred to above. I acknowledge the duty to disclose to the Office all information known to me to be material to patentability as defined in 37 C.F.R. 1.56. Except as noted below, I hereby claim foreign priority benefits under 35 U.S.C. 119(a)-(d) or 365(b) of any foreign application(s) for patent or inventor's certificate, or 365(a) of any PCT International Application which designated at least one other country than the United States, listed below and have also identified below any foreign application for patent or inventor's certificate, or PCT International Application, filed by me or my assignee disclosing the subject matter claimed in this application and having a filing date (1) before that of the application on which priority is claimed, or (2) if no priority claimed, before the filing date of this application:

PRIOR FOREIGN APPLICATION(S)

<u>Number</u>	<u>Country</u>	<u>Filed</u>	<u>Date First Laid Open Or Published</u>	<u>Date Patented or Granted</u>	<u>Priority Claimed</u>

Except as noted below, I hereby claim domestic priority benefit under 35 U.S.C. 119(e) or 120 and/or 365(c) of the indicated United States applications listed below and PCT international applications listed above or below and, if this is a continuation-in-part (CIP) application, insofar as the subject matter disclosed and claimed in this application is in addition to that disclosed in such prior applications, I acknowledge the duty to disclose to the Office all information known to me to be material to patentability as defined in 37 C.F.R. 1.56 which became available between the filing date of each such prior application and the national or PCT international filing date of this application:

PRIOR U.S. PROVISIONAL, NONPROVISIONAL AND/OR PCT APPLICATION(S)

<u>Application Number</u>	<u>Filed</u>	<u>Status</u>	<u>Priority Claimed</u>
61/599,145	2/15/2012	pending, abandoned, patented	yes

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

And I/we hereby appoint Immersion, (to whom all communications are to be directed), and persons of that firm who are associated with USPTO Customer No. 103772 individually and collectively my/our attorneys to prosecute this application and to transact all business in the Patent and Trademark Office connected therewith and with the resulting patent, and I/we hereby authorize them to delete from that Customer No. names of persons no longer with their firm, to add new persons of their Firm to that Customer No., and to act and rely on instructions from and communicate directly with the person/assignee/attorney/firm/ organization who/which first sends/sent this case to them and by whom/which I/we hereby declare that I/we have consented after full disclosure to be represented unless/until I/we instruct the above Firm and/or an attorney of that Firm in writing to the contrary.

Power of Attorney to Customer Number

103772

INVENTOR'S SIGNATURE:

Date:

Name	David		BIRNBAUM
	First	Middle Initial	Family Name
Residence			
	City	State/Foreign Country	Country of Citizenship
Mailing Address			

INVENTOR'S SIGNATURE:

Date:

Name	Juan	Manuel	CRUZ-HERNANDEZ
	First	Middle Initial	Family Name
Residence			
	City	State/Foreign Country	Country of Citizenship
Mailing Address			

INVENTOR'S SIGNATURE:

Date:

Name	Danny		GRANT
	First	Middle Initial	Family Name
Residence			
	City	State/Foreign Country	Country of Citizenship
Mailing Address			

INVENTOR'S SIGNATURE:

Date:

Name	Chris		ULLRICH
	First	Middle Initial	Family Name
Residence			
	City	State/Foreign Country	Country of Citizenship
Mailing Address			

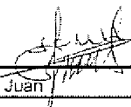
INVENTOR'S SIGNATURE:

Date:

Name	David		BIRNBALM
	First	Middle Initial	Family Name
Residence			
	City	State/Foreign Country	Country of Citizenship
Mailing Address			

INVENTOR'S SIGNATURE:

Date: May-11-2012

Name	Juan 	Manuel	CRUZ-HERNANDEZ
	First	Middle Initial	Family Name
Residence	Montreal	Canada	Canada/Mexico
	City	State/Foreign Country	Country of Citizenship
Mailing Address	4840 Ste-Catherine west, Montreal, Qc, H3Z-1T7 Canada		

Date:

INVENTOR'S SIGNATURE:

Name	Danny		GRANT
	First	Middle Initial	Family Name
Residence			
	City	State/Foreign Country	Country of Citizenship
Mailing Address			

INVENTOR'S SIGNATURE:

Date:

Name	Chris		ULLRICH
	First	Middle Initial	Family Name
Residence			
	City	State/Foreign Country	Country of Citizenship
Mailing Address			

INVENTOR'S SIGNATURE:

Date:

Name	David			BIRNBAUM
	First	Middle	Initial	Family Name
Residence				
	City	State/Foreign	Country	Country of Citizenship
Mailing Address				

INVENTOR'S SIGNATURE:

Date:

Name	Juan			GRUZ-HERNANDEZ
	First	Middle	Initial	Family Name
Residence				
	City	State/Foreign	Country	Country of Citizenship
Mailing Address				

Date:

INVENTOR'S SIGNATURE:

Name	Danny			GRANT
	First	Middle	Initial	Family Name
Residence				
	City	State/Foreign	Country	Country of Citizenship
Mailing Address				

INVENTOR'S SIGNATURE:

Date:

5-15-12

Name	Chris			ULLRICH
	First	Middle	Initial	Family Name
Residence	Ventura		CA	CANADA
	City	State/Foreign	Country	Country of Citizenship
Mailing Address	227 Palomares Ave Ventura CA 93003			

INVENTOR'S SIGNATURE:

David Birnbaum

Date:

5/8/12

Name	David		BIRNBAUM
	First	Middle Initial	Family Name
Residence			
	City	State/Foreign Country	Country of Citizenship
Mailing Address			

INVENTOR'S SIGNATURE:

Date:

Name	Juan	Manuel	CRUZ-HERNANDEZ
	First	Middle Initial	Family Name
Residence			
	City	State/Foreign Country	Country of Citizenship
Mailing Address			

Date:

INVENTOR'S SIGNATURE:

Name	Danny		GRANT
	First	Middle Initial	Family Name
Residence			
	City	State/Foreign Country	Country of Citizenship
Mailing Address			

INVENTOR'S SIGNATURE:

Date:

Name	Chris		ULLRICH
	First	Middle Initial	Family Name
Residence			
	City	State/Foreign Country	Country of Citizenship
Mailing Address			

Electronic Patent Application Fee Transmittal

Application Number:				
Filing Date:				
Title of Invention:	METHOD AND APPARATUS FOR PRODUCING A DYNAMIC HAPTIC EFFECT			
First Named Inventor/Applicant Name:	David Birnbaum			
Filer:	Catherine C. Maresh/Dawn Rose			
Attorney Docket Number:	IMM389C1			
Filed as Large Entity				
Track I Prioritized Examination - Nonprovisional Application under 35 USC 111(a) Filing Fees				
Description	Fee Code	Quantity	Amount	Sub-Total in USD(\$)
Basic Filing:				
Utility application filing	1011	1	380	380
Utility Search Fee	1111	1	620	620
Utility Examination Fee	1311	1	250	250
Request for Prioritized Examination	1817	1	4800	4800
Pages:				
Claims:				
Claims in excess of 20	1202	10	60	600
Miscellaneous-Filing:				

Description	Fee Code	Quantity	Amount	Sub-Total in USD(\$)
Publ. Fee- early, voluntary, or normal	1504	1	300	300
Processing Fee, except for Provis. apps	1808	1	130	130
Petition:				
Patent-Appeals-and-Interference:				
Post-Allowance-and-Post-Issuance:				
Extension-of-Time:				
Miscellaneous:				
Total in USD (\$)				7080

Electronic Acknowledgement Receipt

EFS ID:	12790702
Application Number:	13472698
International Application Number:	
Confirmation Number:	6404
Title of Invention:	METHOD AND APPARATUS FOR PRODUCING A DYNAMIC HAPTIC EFFECT
First Named Inventor/Applicant Name:	David Birnbaum
Customer Number:	103772
Filer:	Catherine C. Maresh/Dawn Rose
Filer Authorized By:	Catherine C. Maresh
Attorney Docket Number:	IMM389C1
Receipt Date:	16-MAY-2012
Filing Date:	
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Application Type:	Utility under 35 USC 111(a)

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Payment was successfully received in RAM	\$7080
RAM confirmation Number	10379
Deposit Account	
Authorized User	

File Listing:

Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
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1		IMM389C1FINAL.pdf	967757	yes	55
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Multipart Description/PDF files in .zip description					
		Document Description	Start	End	
		Specification	1	34	
		Claims	35	40	
		Abstract	41	41	
		Drawings-only black and white line drawings	42	55	
Warnings:					
Information:					
2		IMM389C1filetransmittals.pdf	623119	yes	16
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Multipart Description/PDF files in .zip description					
		Document Description	Start	End	
		Application Data Sheet	1	5	
		Transmittal Letter	6	7	
		TrackOne Request	8	9	
		Authorization to access Appl. by Trilateral Office	10	11	
		Oath or Declaration filed	12	16	
Warnings:					
Information:					
3	Fee Worksheet (SB06)	fee-info.pdf	41840	no	2
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Total Files Size (in bytes):			1632716		

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New International Application Filed with the USPTO as a Receiving Office

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Docket No: IMM389C1

UNITED STATES PATENT APPLICATION

FOR

**METHOD AND APPARATUS FOR PRODUCING A DYNAMIC HAPTIC
EFFECT**

INVENTOR:

DAVID BIRNBAUM
JUAN MANUEL CRUZ-HERNANDEZ
DANNY GRANT
CHRIS ULLRICH

PREPARED BY:

IMMERSION CORPORATION

ASSIGNEE: IMMERSION CORPORATION
30 RIO ROBLES
SAN JOSE, CA 95134

METHOD AND APPARATUS FOR PRODUCING A DYNAMIC HAPTIC EFFECT

CROSS-REFERENCE TO RELATED APPLICATION

[0001] This application claims the benefit of priority under 35 USC § 120 to copending application 61/599,145, filed February 15, 2012.

FIELD OF THE INVENTION

[0002] One embodiment is directed generally to a user interface for a device, and in particular to producing a dynamic haptic effect using two or more gesture signals or real or virtual device sensor signals.

BACKGROUND INFORMATION

[0003] Electronic device manufacturers strive to produce a rich interface for users. Conventional devices use visual and auditory cues to provide feedback to a user. In some interface devices, kinesthetic feedback (such as active and resistive force feedback) and/or tactile feedback (such as vibration, texture, and heat) is also provided to the user, more generally known collectively as “haptic feedback” or “haptic effects”. Haptic feedback can provide cues that enhance and simplify the user interface. Specifically, vibration effects, or vibrotactile haptic effects, may be useful in providing cues to users of electronic devices to alert the user to specific events, or provide realistic feedback to create greater sensory immersion within a simulated or virtual environment.

[0004] In order to generate vibration effects, many devices utilize some type of actuator or haptic output device. Known haptic output devices used for this purpose include an electromagnetic actuator such as an Eccentric Rotating Mass (“ERM”) in which an eccentric mass is moved by a motor, a Linear Resonant Actuator (“LRA”) in

which a mass attached to a spring is driven back and forth, or a “smart material” such as piezoelectric, electro-active polymers or shape memory alloys. Haptic output devices also broadly include non-mechanical or non-vibratory devices such as those that use electrostatic friction (ESF), ultrasonic surface friction (USF), or those that induce acoustic radiation pressure with an ultrasonic haptic transducer, or those that use a haptic substrate and a flexible or deformable surface, or those that provide projected haptic output such as a puff of air using an air jet, and so on.

[0005] Traditional architectures that provide haptic feedback only with triggered effects are available, and must be carefully designed to make sure the timing of the haptic feedback is correlated to user initiated gestures or system animations. However, because these user gestures and system animations have variable timing, their correlation to haptic feedback may be “static” and inconsistent and therefore less compelling to the user. Further, device sensor information is typically not used in combination with gestures to produce haptic feedback.

[0006] Therefore, there is a need for an improved system of providing a dynamic haptic effect that includes multiple gestures or animations. There is a further need for providing haptic feedback with gestures in combination with device sensor information.

SUMMARY OF THE INVENTION

[0007] One embodiment is a system that produces a dynamic haptic effect and generates a drive signal that includes two or more gesture signals. The haptic effect is modified dynamically based on the gesture signals. The haptic effect may optionally be modified dynamically by using the gesture signals and two or more real or virtual device sensor signals such as from an accelerometer or gyroscope, or by signals created from processing data such as still images, video or sound.

BRIEF DESCRIPTION OF THE DRAWINGS

[0008] FIG. 1 is a block diagram of a haptically-enabled system according to one embodiment of the present invention.

[0009] FIG. 2 is a cut-away perspective view of an LRA implementation of a haptic actuator according to one embodiment of the present invention.

[00010] FIG. 3 is a cut-away perspective view of an ERM implementation of a haptic actuator according to one embodiment of the present invention.

[00011] FIGs. 4A-4C are views of a piezoelectric implementation of a haptic actuator according to one embodiment of the present invention.

[00012] FIG. 5 is a view of a haptic device using electrostatic friction (ESF) according to one embodiment of the present invention.

[00013] FIG. 6 is a view of a haptic device for inducing acoustic radiation pressure with an ultrasonic haptic transducer according to one embodiment of the present invention.

[00014] FIG. 7 is a view of a haptic device using a haptic substrate and flexible or deformable surface according to one embodiment of the present invention.

[00015] FIG. 8 is a view of a haptic device using ultrasonic surface friction (USF) according to one embodiment of the present invention.

[00016] FIGs. 9A-9C are screen views of a user initiated dynamic haptic effect according to one embodiment of the present invention.

[00017] FIGs. 10A-10B are screen views of example dynamic effects according to one embodiment of the present invention.

[00018] FIGs. 11A-11F are screen views of a physics based dynamic effect according to one embodiment of the present invention.

[00019] FIG. 12 is a diagram showing an example free space gesture according to one embodiment of the present invention.

[00020] FIGs. 13A-13B are graphs showing a grid size variation as a function of velocity according to one embodiment of the present invention.

[00021] FIG. 14 is a graph showing an effect period value as a function of velocity according to one embodiment of the present invention.

[00022] FIG. 15 is a graph showing an animation duration as a function of a distance from center according to one embodiment of the present invention.

[00023] FIG. 16 is a graph showing an animation duration as a function of a fling velocity according to one embodiment of the present invention.

[00024] FIG. 17 is a graph showing a haptic effect magnitude as a function of a velocity according to one embodiment of the present invention.

[00025] FIG. 18 is a graph showing an animation trajectory for a fall into place effect according to one embodiment of the present invention.

[00026] FIG. 19 is a flow diagram for producing a dynamic haptic effect according to one embodiment of the present invention.

DETAILED DESCRIPTION

[00027] As described below, a dynamic haptic effect refers to a haptic effect that evolves over time as it responds to one or more input parameters. Dynamic haptic effects are haptic or vibrotactile effects displayed on haptic devices to represent a change in state of a given input signal. The input signal can be a signal captured by sensors on the device with haptic feedback, such as position, acceleration, pressure, orientation, or proximity, or signals captured by other devices and sent to the haptic device to influence the generation of the haptic effect.

[00028] A dynamic effect signal can be any type of signal, but does not necessarily have to be complex. For example, a dynamic effect signal may be a simple sine wave that has some property such as phase, frequency, or amplitude that is changing over time or reacting in real time according to a mapping schema which maps an input parameter onto a changing property of the effect signal. An input parameter may be any type of input capable of being provided by a device, and typically may be any type of signal such as a device sensor signal. A device sensor signal may be generated by any means, and typically may be generated by capturing a user gesture with a device. Dynamic effects may be very useful for gesture interfaces, but the use of gestures or sensors are not necessarily required to create a dynamic signal. In the context of dynamic effects, a mapping is a method to convert the sensed information into a haptic effect by modifying one or several haptic effect parameters.

[00029] One common scenario that does not involve gestures directly is defining the dynamic haptic behavior of an animated widget. For example, when a user scrolls a list, it is not typically the haptification of the gesture that will feel most intuitive, but instead the motion of the widget in response to the gesture. In the scroll

list example, gently sliding the list may generate a dynamic haptic feedback that changes according to the speed of the scrolling, but flinging the scroll bar may produce dynamic haptics even after the gesture has ended. This creates the illusion that the widget has some physical properties and it provides the user with information about the state of the widget such as its velocity or whether it is in motion.

[00030] A gesture is any movement of the body that conveys meaning or user intent. It will be recognized that simple gestures may be combined to form more complex gestures. For example, bringing a finger into contact with a touch sensitive surface may be referred to as a “finger on” gesture, while removing a finger from a touch sensitive surface may be referred to as a separate “finger off” gesture. If the time between the “finger on” and “finger off” gestures is relatively short, the combined gesture may be referred to as “tapping”; if the time between the “finger on” and “finger off” gestures is relatively long, the combined gesture may be referred to as “long tapping”; if the distance between the two dimensional (x,y) positions of the “finger on” and “finger off” gestures is relatively large, the combined gesture may be referred to as “swiping”; if the distance between the two dimensional (x,y) positions of the “finger on” and “finger off” gestures is relatively small, the combined gesture may be referred to as “smearing”, “smudging” or “flicking”. Any number of two dimensional or three dimensional simple or complex gestures may be combined in any manner to form any number of other gestures, including, but not limited to, multiple finger contacts, palm or fist contact, or proximity to the device. A gesture can also be any form of hand movement recognized by a device having an accelerometer, gyroscope, or other motion sensor, and converted to electronic signals. Such electronic signals can activate a dynamic effect, such as shaking

virtual dice, where the sensor captures the user intent that generates a dynamic effect.

[00031] FIG. 1 is a block diagram of a haptically-enabled system 10 according to one embodiment of the present invention. System 10 includes a touch sensitive surface 11 or other type of user interface mounted within a housing 15, and may include mechanical keys/buttons 13. Internal to system 10 is a haptic feedback system that generates vibrations on system 10. In one embodiment, the vibrations are generated on touch surface 11.

[00032] The haptic feedback system includes a processor 12. Coupled to processor 12 is a memory 20 and an actuator drive circuit 16, which is coupled to a haptic actuator 18. Processor 12 may be any type of general purpose processor, or could be a processor specifically designed to provide haptic effects, such as an application-specific integrated circuit (“ASIC”). Processor 12 may be the same processor that operates the entire system 10, or may be a separate processor. Processor 12 can decide what haptic effects are to be played and the order in which the effects are played based on high level parameters. In general, the high level parameters that define a particular haptic effect include magnitude, frequency and duration. Low level parameters such as streaming motor commands could also be used to determine a particular haptic effect. A haptic effect may be considered dynamic if it includes some variation of these parameters when the haptic effect is generated or a variation of these parameters based on a user’s interaction.

[00033] Processor 12 outputs the control signals to drive circuit 16 which includes electronic components and circuitry used to supply actuator 18 with the required electrical current and voltage to cause the desired haptic effects. System 10 may include more than one actuator 18, and each actuator may include a separate

drive circuit 16, all coupled to a common processor 12. Memory device 20 can be any type of storage device or computer-readable medium, such as random access memory (RAM) or read-only memory (ROM). Memory 20 stores instructions executed by processor 12. Among the instructions, memory 20 includes an actuator drive module 22 which are instructions that, when executed by processor 12, generate drive signals for actuator 18 while also determining feedback from actuator 18 and adjusting the drive signals accordingly. The functionality of module 22 is discussed in more detail below. Memory 20 may also be located internal to processor 12, or any combination of internal and external memory.

[00034] Touch surface 11 recognizes touches, and may also recognize the position and magnitude or pressure of touches on the surface. The data corresponding to the touches is sent to processor 12, or another processor within system 10, and processor 12 interprets the touches and in response generates haptic effect signals. Touch surface 11 may sense touches using any sensing technology, including capacitive sensing, resistive sensing, surface acoustic wave sensing, pressure sensing, optical sensing, etc. Touch surface 11 may sense multi-touch contacts and may be capable of distinguishing multiple touches that occur at the same time. Touch surface 11 may be a touchscreen that generates and displays images for the user to interact with, such as keys, dials, etc., or may be a touchpad with minimal or no images.

[00035] System 10 may be a handheld device, such as a cellular telephone, PDA, computer tablet, gaming console, etc. or may be any other type of device that provides a user interface and includes a haptic effect system that includes one or more ERMs, LRAs, electrostatic or other types of actuators. The user interface may be a touch sensitive surface, or can be any other type of user interface such as a

mouse, touchpad, mini-joystick, scroll wheel, trackball, game pads or game controllers, etc. In embodiments with more than one actuator, each actuator may have a different output capability in order to create a wide range of haptic effects on the device. Each actuator may be any type of haptic actuator or a single or multidimensional array of actuators.

[00036] FIG. 2 is a cut-away side view of an LRA implementation of actuator 18 in accordance to one embodiment. LRA 18 includes a casing 25, a magnet/mass 27, a linear spring 26, and an electric coil 28. Magnet 27 is mounted to casing 25 by spring 26. Coil 28 is mounted directly on the bottom of casing 25 underneath magnet 27. LRA 18 is typical of any known LRA. In operation, when current flows through coil 28 a magnetic field forms around coil 28 which in interaction with the magnetic field of magnet 27 pushes or pulls on magnet 27. One current flow direction/polarity causes a push action and the other a pull action. Spring 26 controls the up and down movement of magnet 27 and has a deflected up position where it is compressed, a deflected down position where it is expanded, and a neutral or zero-crossing position where it is neither compressed or deflected and which is equal to its resting state when no current is being applied to coil 28 and there is no movement/oscillation of magnet 27.

[00037] For LRA 18, a mechanical quality factor or “Q factor” can be measured. In general, the mechanical Q factor is a dimensionless parameter that compares a time constant for decay of an oscillating physical system’s amplitude to its oscillation period. The mechanical Q factor is significantly affected by mounting variations. The mechanical Q factor represents the ratio of the energy circulated between the mass and spring over the energy lost at every oscillation cycle. A low Q factor means that a large portion of the energy stored in the mass and spring is lost at every cycle. In

general, a minimum Q factor occurs with system 10 is held firmly in a hand due to energy being absorbed by the tissues of the hand. The maximum Q factor generally occurs when system 10 is pressed against a hard and heavy surface that reflects all of the vibration energy back into LRA 18.

[00038] In direct proportionality to the mechanical Q factor, the forces that occur between magnet/mass 27 and spring 26 at resonance are typically 10-100 times larger than the force that coil 28 must produce to maintain the oscillation. Consequently, the resonant frequency of LRA 18 is mostly defined by the mass of magnet 27 and the compliance of spring 26. However, when an LRA is mounted to a floating device (i.e., system 10 held softly in a hand), the LRA resonant frequency shifts up significantly. Further, significant frequency shifts can occur due to external factors affecting the apparent mounting weight of LRA 18 in system 10, such as a cell phone flipped open/closed or the phone held tightly.

[00039] FIG. 3 is a cut-away perspective view of an ERM implementation of actuator 18 according to one embodiment of the present invention. ERM 18 includes a rotating mass 301 having an off-center weight 303 that rotates about an axis of rotation 305. In operation, any type of motor may be coupled to ERM 18 to cause rotation in one or both directions around the axis of rotation 305 in response to the amount and polarity of voltage applied to the motor. It will be recognized that an application of voltage in the same direction of rotation will have an acceleration effect and cause the ERM 18 to increase its rotational speed, and that an application of voltage in the opposite direction of rotation will have a braking effect and cause the ERM 18 to decrease or even reverse its rotational speed.

[00040] One embodiment of the present invention provides haptic feedback by determining and modifying the angular speed of ERM 18. Angular speed is a scalar

measure of rotation rate, and represents the magnitude of the vector quantity angular velocity. Angular speed or frequency ω , in radians per second, correlates to frequency ν in cycles per second, also called Hz, by a factor of 2π . The drive signal includes a drive period where at least one drive pulse is applied to ERM 18, and a monitoring period where the back electromagnetic field ("EMF") of the rotating mass 301 is received and used to determine the angular speed of ERM 18. In another embodiment, the drive period and the monitoring period are concurrent and the present invention dynamically determines the angular speed of ERM 18 during both the drive and monitoring periods.

[00041] FIGs. 4A-4C are views of a piezoelectric implementation of a haptic actuator 18 according to one embodiment of the present invention. FIG. 4A shows a disk piezoelectric actuator that includes an electrode 401, a piezo ceramics disk 403 and a metal disk 405. As shown in FIG 4B, when a voltage is applied to electrode 401, the piezoelectric actuator bends in response, going from a relaxed state 407 to a transformed state 409. When a voltage is applied, it is that bending of the actuator that creates the foundation of vibration. Alternatively, FIG. 4C shows a beam piezoelectric actuator that operates similarly to a disk piezoelectric actuator by going from a relaxed state 411 to a transformed state 413. FIG. 5 is a view of a haptic device using electrostatic friction (ESF) according to one embodiment of the present invention. Similar to the operational principles described by Makinen et al. in U.S. Pat. No. 7,982,588, the embodiment is based on the hypothesis that subcutaneous Pacinian corpuscles can be stimulated by means of a capacitive electrical coupling and an appropriately dimensioned control voltage, either without any mechanical stimulation of the Pacinian corpuscles or as an additional stimulation separate from such mechanical stimulation. An appropriately dimensioned high voltage is used as

the control voltage. In the present context, a high voltage means such a voltage that direct galvanic contact must be prevented for reasons of safety and/or user comfort. This results in a capacitive coupling between the Pacinian corpuscles and the apparatus causing the stimulation, wherein one side of the capacitive coupling is formed by at least one galvanically isolated electrode connected to the stimulating apparatus, while the other side, in close proximity to the electrode, is formed by the body member, preferably a finger, of the stimulation target, such as the user of the apparatus, and more specifically the subcutaneous Pacinian corpuscles.

[00042] It is one hypothesis that the invention is based on a controlled formation of an electric field between an active surface of the apparatus and the body member, such as a finger, approaching or touching it. The electric field tends to give rise to an opposite charge on the proximate finger. A local electric field and a capacitive coupling can be formed between the charges. The electric field directs a force on the charge of the finger tissue. By appropriately altering the electric field a force capable of moving the tissue may arise, whereby the sensory receptors sense such movement as vibration.

[00043] As shown in FIG. 5, one or more conducting electrodes 501 are provided with an insulator. When a body member such as finger 505 is proximate to the conducting electrode 501, the insulator prevents flow of direct current from the conducting electrode to the body member 505. A capacitive coupling field force 503 over the insulator is formed between the conducting electrode 501 and the body member 505. The apparatus also comprises a high-voltage source for applying an electrical input to the one or more conducting electrodes, wherein the electrical input comprises a low-frequency component in a frequency range between 10 Hz and 1000 Hz. The capacitive coupling and electrical input are dimensioned to produce an

electrosensory sensation which is produced independently of any mechanical vibration of the one or more conducting electrodes or insulators.

[00044] FIG. 6 is a view of a haptic device for inducing acoustic radiation pressure with an ultrasonic haptic transducer similar to that described by Iwamoto et al., "Non-contact Method for Producing Tactile Sensation Using Airborne Ultrasound", Eurohaptics 2008, LNCS 5024, pp. 504-513. An airborne ultrasound transducer array 601 is designed to provide tactile feedback in three-dimensional (3D) free space. The array radiates airborne ultrasound, and produces high-fidelity pressure fields onto the user's hands without the use of gloves or mechanical attachments. The method is based on a nonlinear phenomenon of ultrasound; acoustic radiation pressure. When an object interrupts the propagation of ultrasound, a pressure field is exerted on the surface of the object. This pressure is called acoustic radiation pressure. The acoustic radiation pressure P [Pa] is simply described as $P = \alpha E$, where E [$\text{J}=\text{m}^3$] is the energy density of the ultrasound and α is a constant ranging from 1 to 2 depending on the reflection properties of the surface of the object. The equation describes how the acoustic radiation pressure is proportional to the energy density of the ultrasound. The spatial distribution of the energy density of the ultrasound can be controlled by using the wave field synthesis techniques. With an ultrasound transducer array, various patterns of pressure field are produced in 3D free space. Unlike air-jets, the spatial and temporal resolutions are quite fine. The spatial resolution is comparable to the wavelength of the ultrasound. The frequency characteristics are sufficiently fine up to 1 kHz.

[00045] The airborne ultrasound can be applied directly onto the skin without the risk of the penetration. When the airborne ultrasound is applied on the surface of the skin, due to the large difference between the characteristic acoustic impedance

of the air and that of the skin, about 99.9% of the incident acoustic energy is reflected on the surface of the skin. Hence, this tactile feedback system does not require the users to wear any clumsy gloves or mechanical attachments.

[00046] FIG. 7 shows a three-dimensional (3D) diagram illustrating a haptic device 701 using a haptic substrate and a flexible surface in accordance with one embodiment of the present invention. Device 701 includes a flexible surface layer 703, a haptic substrate 705, and a deforming mechanism 711. It should be noted that device 701 can be a user interface device, such as an interface for a cellular phone, a personal digital assistant ("PDA"), an automotive data input system, and so forth. It should be further noted that the underlying concept of the exemplary embodiment of the present invention would not change if one or more blocks (circuits or layers) were added to or removed from device 701.

[00047] Flexible surface layer 703, in one instance, is made of soft and/or elastic materials such as silicone rubber, which is also known as polysiloxane. A function of the flexible surface layer 703 is to change its surface shape or texture upon contact with the physical pattern of haptic substrate 705. The physical pattern of haptic substrate 705 is variable as one or more of the local features 110-124 can be raised or lowered to present features to affect the surface of the flexible surface layer 703 upon contact. Once the physical pattern of haptic substrate 705 is determined, the texture of flexible surface layer 703 can change to confirm its surface texture to the physical pattern of haptic substrate 705. It should be note that the deformation of flexible surface layer 703 from one texture to another can be controlled by deforming mechanism 711. For example, when deforming mechanism 711 is not activated, flexible surface layer 703 maintains its smooth configuration floating or sitting over haptic substrate 705. The surface configuration of flexible

surface layer 703, however, deforms or changes from a smooth configuration to a coarse configuration when deforming mechanism 711 is activated and the haptic substrate 705 is in contact with the flexible surface layer 703 so as to generate a similar pattern on the top surface of the flexible surface layer 703.

[00048] Alternatively, flexible surface layer 703 is a flexible touch sensitive surface, which is capable of accepting user inputs. The flexible touch sensitive surface can be divided into multiple regions wherein each region of the flexible touch sensitive surface can accept an input when the region is being touched or depressed by a finger. In one embodiment, the flexible touch sensitive surface includes a sensor, which is capable of detecting a nearby finger and waking up or turning on the device. Flexible surface layer 703 may also include a flexible display, which is capable of deforming together with flexible surface layer 703. It should be noted that various flexible display technologies can be used to manufacture flexible displays, such as organic light-emitting diode (OLED), organic, or polymer TFT (Thin Film Transistor).

[00049] Haptic substrate 705 is a surface reconfigurable haptic device capable of changing its surface pattern in response to one or more pattern activating signals. Haptic substrate 705 can also be referred to as a haptic mechanism, a haptic layer, a tactile element, and the like. Haptic substrate 705, in one embodiment, includes multiple tactile or haptic regions 707, 709, wherein each region can be independently controlled and activated. Since each tactile region can be independently activated, a unique surface pattern of haptic substrate 705 can be composed in response to the pattern activating signals. In another embodiment, every tactile region is further divided into multiple haptic bits wherein each bit can be independently excited or activated or deactivated.

[00050] Haptic substrate 705, or a haptic mechanism, in one embodiment, is operable to provide haptic feedback in response to an activating command or signal. Haptic substrate 705 provides multiple tactile or haptic feedbacks wherein one tactile feedback is used for surface deformation, while another tactile feedback is used for input confirmation. Input confirmation is a haptic feedback to inform a user about a selected input. Haptic mechanism 705, for example, can be implemented by various techniques including vibration, vertical displacement, lateral displacement, push/pull technique, air/fluid pockets, local deformation of materials, resonant mechanical elements, piezoelectric materials, micro-electro-mechanical systems (“MEMS”) elements, thermal fluid pockets, MEMS pumps, variable porosity membranes, laminar flow modulation, or the like.

[00051] Haptic substrate 705, in one embodiment, is constructed by semi-flexible or semi-rigid materials. In one embodiment, haptic substrate should be more rigid than flexible surface 703 thereby the surface texture of flexible surface 703 can conform to the surface pattern of haptic substrate 705. Haptic substrate 705, for example, includes one or more actuators, which can be constructed from fibers (or nanotubes) of electroactive polymers (“EAP”), piezoelectric elements, fiber of shape memory alloys (“SMAs”) or the like. EAP, also known as biological muscles or artificial muscles, is capable of changing its shape in response to an application of voltage. The physical shape of an EAP may be deformed when it sustains large force. EAP may be constructed from Electrostrictive Polymers, Dielectric elastomers, Conducting Polymers, Ionic Polymer Metal Composites, Responsive Gels, Bucky gel actuators, or a combination of the above-mentioned EAP materials.

[00052] SMA (Shape Memory Alloy), also known as memory metal, is another type of material which can be used to construct haptic substrate 705. SMA may be

made of copper-zinc-aluminum, copper-aluminum-nickel, nickel-titanium alloys, or a combination of copper-zinc-aluminum, copper-aluminum-nickel, and/or nickel-titanium alloys. A characteristic of SMA is that when its original shape is deformed, it regains its original shape in accordance with the ambient temperature and/or surrounding environment. It should be noted that the present embodiment may combine the EAP, piezoelectric elements, and/or SMA to achieve a specific haptic sensation.

[00053] Deforming mechanism 711 provides a pulling and/or pushing force to translate elements in the haptic substrate 705 causing flexible surface 703 to deform. For example, when deforming mechanism 711 creates a vacuum between flexible surface 703 and haptic substrate 705, flexible surface 703 is pushed against haptic substrate 705 causing flexible surface 703 to show the texture of flexible surface 703 in accordance with the surface pattern of haptic substrate 705. In other words, once a surface pattern of haptic substrate 705 is generated, flexible surface is pulled or pushed against haptic substrate 705 to reveal the pattern of haptic substrate 705 through the deformed surface of flexible surface 703. In one embodiment, haptic substrate 705 and deforming mechanism 711 are constructed in the same or substantially the same layer.

[00054] Upon receipt of a first activating signal, haptic substrate 705 generates a first surface pattern. After formation of the surface pattern of haptic substrate 705, deforming mechanism 711 is subsequently activated to change surface texture of flexible surface 703 in response to the surface pattern of haptic substrate 705. Alternatively, if haptic substrate 705 receives a second activating signal, it generates a second pattern.

[00055] Haptic substrate 705 further includes multiple tactile regions wherein each region can be independently activated to form a surface pattern of the substrate. Haptic substrate 705 is also capable of generating a confirmation feedback to confirm an input selection entered by a user. Deforming mechanism 711 is configured to deform the surface texture of flexible surface 703 from a first surface characteristic to a second surface characteristic. It should be noted that haptic device further includes a sensor, which is capable of activating the device when the sensor detects a touch on flexible surface 703. Deforming mechanism 711 may be a vacuum generator, which is capable of causing flexible surface 703 to collapse against the first surface pattern to transform its surface configuration in accordance with the configuration of first pattern of haptic substrate 705.

[00056] Haptic substrate 705 illustrates the state when tactile regions 707 and 709 are activated. Tactile regions 707 and 709 are raised in a z-axis direction. Upon receipt of one or more activating signals, haptic substrate 705 identifies a surface pattern in accordance with the activating signals. Haptic substrate 705 provides identified pattern by activating various tactile regions such as regions 707 and 709 to generate the pattern. It should be noted that tactile regions 707 and 709 imitate two buttons or keys. In another embodiment, tactile region 707 or 709 includes multiple haptic bits wherein each bit can be controlled for activating or deactivating.

[00057] FIG. 8 is a view of a haptic device using ultrasonic surface friction (USF) similar to that described by Biet et al., "New Tactile Devices Using Piezoelectric Actuators", ACTUATOR 2006, 10th International Conference on New Actuators, 14-16 June 2006, Bremen, Germany. An ultrasonic vibration display 801 produces ultrasonic vibrations in the order of a few micrometers. The display 801 consists of a touch interface surface 803 that vibrates at the ultrasound range. The

vibrations 805 travel along the touch surface 803 at a speed v_t when a finger 809 is in contact and applies a force 807 F_t to the surface 803. The vibrations 805 create an apparent reduction of friction on the surface 803. One explanation is that by moving up and down, the touch surface 803 creates an air gap 813 between the surface 803 and the interacting finger 809, and is the air gap 813 that causes the reduction in friction. This can be thought as of a Lamb wave 815 along the surface 803 that at some instants in time is in contact with the finger 809 when the finger 809 is in contact with the crest or peak of the wave 805, and sometimes is not when the finger 809 is above the valley of the wave 805. When finger 809 is moved in a lateral direction 811 at a speed v_t , the apparent friction of the surface 803 is reduced due to the on and off contact of the surface 803 with the finger 809. When the surface 803 is not activated, the finger 809 is always in contact with the surface 803 and the static or kinetic coefficients of friction remain constant.

[00058] Because the vibrations 805 occur on surface 803 in the ultrasound range of typically 20 KHz or greater, the wavelength content is usually smaller than the finger size, thus allowing for a consistent experience. It will be noted that the normal displacement of surface 803 is in the order of less than 5 micrometers, and that a smaller displacement results in lower friction reduction.

[00059] FIGs. 9A-9C are screen views of a user initiated dynamic haptic effect according to one embodiment of the present invention. Dynamic effects involve changing a haptic effect provided by a haptic enabled device in real time according to an interaction parameter. An interaction parameter can be derived from any two-dimensional or three-dimensional gesture using information such as the position, direction and velocity of a gesture from a two-dimensional on-screen display such as on a mobile phone or tablet computer, or a three-dimensional gesture detection

system such as a video motion capture system or an electronic glove worn by the user, or by any other 2D or 3D gesture input means. FIG. 9A shows a screen view of a mobile device having a touch sensitive display which displays one photograph out of a group of photographs. FIG. 9B shows a screen view of a user gesture using a single index finger being swiped across the touch sensitive display from right to left in order to display the next photograph at a selected speed. Multiple inputs from the index finger are received from the single gesture. Each of the multiple inputs may occur at a different time and may indicate a different two dimensional position of the contact point of the index finger with the touch sensitive display.

[00060] FIG. 9C shows a screen view of the next photograph being displayed in conjunction with a dynamic haptic effect. Based upon the one or more inputs from the one or more user gestures in FIG. 9B, a dynamic haptic effect is provided during the user gesture and continuously modified as determined by the interaction parameter. The dynamic haptic effect may speed up or slow down, increase or decrease in intensity, or change its pattern or duration, or change in any other way, in real-time according to such elements as the speed, direction, pressure, magnitude, or duration of the user gesture itself, or the speed, direction or duration of the user gesture initiated animation, or based on a changing property of a virtual object such as the number of times an image has been viewed. The dynamic haptic effect may further continue and may further be modified by the interaction parameter even after the user gesture has stopped. For example, in one embodiment the dynamic haptic effect may be stop immediately at the end of the user gesture, or in another embodiment the dynamic haptic effect may optionally fade slowly after the end of the user gesture according to the interaction parameter. The effect of providing or modifying a dynamic haptic effect in real-time during and even after a

user gesture is that no two gestures such as page turns or finger swipes will feel the same to the user. That is, the dynamic haptic effect will always be unique to the user gesture, thereby creating a greater sense connectedness to the device and a more nuanced and compelling user interface experience for the user as compared to a simple static haptic effect provided by a trigger event.

[00061] In one embodiment, a user can flick from the screen in FIG. 9A to the screen in FIG. 9C, and back again. If the user attempts to flick at the end of the list, the screen will move a relatively small percentage of the total width, for example 10%-20% with a preferred movement of 16%, and then not move any more. The screen subsequently returns to the home position once it is released by the user.

[00062] The user interaction with a home screen may be implemented in different ways. In one embodiment, the user may drag to an adjacent screen using a relatively slow finger velocity. An actual change of screen will happen if the user's finger moved the screen more than 50%, with a preferred movement of 60%, of the total travel distance before lifting up the finger. In another embodiment, the user may flick to an adjacent screen using a relatively higher finger velocity. An actual change of screen will happen if the user flings the page beyond a threshold velocity computed from the finger position on the fling gesture. The interaction parameter may also be derived from device sensor data such as whole device acceleration, gyroscopic information or ambient information. Device sensor signals may be any type of sensor input enabled by a device, such as from an accelerometer or gyroscope, or any type of ambient sensor signal such as from a microphone, photometer, thermometer or altimeter, or any type of bio monitor such as skin or body temperature, blood pressure (BP), heart rate monitor (HRM), electroencephalograph (EEG), or galvanic skin response (GSR), or information or

signals received from a remotely coupled device, or any other type of signal or sensor including, but not limited to, the examples listed in TABLE 1 below.

TABLE 1 - LIST OF SENSORS

[00063] For the purposes of physical interaction design, a sensor is a transducer that converts a form of energy into an electrical signal, or any signal that represents virtual sensor information.

Acceleration

- Accelerometer

Biosignals

- Electrocardiogram (ECG)
- Electroencephalogram (EEG)
- Electromyography (EMG)
- Electrooculography (EOG)
- Electropalatography (EPG)
- Galvanic Skin Response (GSR)

Distance

- Capacitive
- Hall Effect
- Infrared
- Ultrasound

Flow

- Ultrasound

Force/pressure/strain/bend

- Air Pressure
- Fibre Optic Sensors
- Flexion
- Force-sensitive Resistor (FSR)
- Load Cell
- LuSense CPS² 155
- Miniature Pressure Transducer
- Piezoelectric Ceramic & Film
- Strain Gage

Humidity

- Hygrometer

Linear position

- Hall Effect
- Linear Position (Touch)
- Linear Potentiometer (Slider)
- Linear Variable Differential Transformer (LVDT)
- LuSense CPS² 155

Orientation/inclination

- Accelerometer
- Compass (Magnetoresistive)
- Inclinometer

Radio Frequency

- Radio Frequency Identification (RFID)

Rotary position

- Rotary Encoder
- Rotary Potentiometer

Rotary velocity

- Gyroscope

Switches

- On-Off Switch

Temperature

- Temperature

Vibration

- Piezoelectric Ceramic & Film

Visible light intensity

- Fibre Optic Sensors
- Light-Dependent Resistor (LDR)

[00064] Active or ambient device sensor data may be used to modify the haptic feedback based on any number of factors relating to a user's environment or activity. For example, an accelerometer device sensor signal may indicate that a user is engaging in physical activity such as walking or running, so the pattern and duration of the haptic feedback should be modified to be more noticeable to the user. In another example, a microphone sensor signal may indicate that a user is in a noisy environment, so the amplitude or intensity of the haptic feedback should be increased. Sensor data may also include virtual sensor data which is represented by information or signals that are created from processing data such as still images, video or sound. For example, a video game that has a virtual racing car may dynamically change a haptic effect based the car velocity, how close the car is to the camera viewing angle, the size of the car, and so on.

[00065] The interaction parameter may optionally incorporate a mathematical model related to a real-world physical effect such as gravity, acceleration, friction or inertia. For example, the motion and interaction that a user has with an object such as a virtual rolling ball may appear to follow the same laws of physics in the virtual environment as an equivalent rolling ball would follow in a non-virtual environment.

[00066] The interaction parameter may optionally incorporate an animation index to correlate the haptic output of a device to an animation or a visual or audio script. For example, an animation or script may play in response to a user or system initiated action such as opening or changing the size of a virtual window, turning a page or scrolling through a list of data entries.

[00067] Two or more gesture signals, device sensor signals or physical model inputs may be used alone or in any combination with each other to create an interaction parameter having a difference vector. A difference vector may be created from two or more scalar or vector inputs by comparing the scalar or vector inputs with each other, determining what change or difference exists between the inputs, and then generating a difference vector which incorporates a position location, direction and magnitude. Gesture signals may be used alone to create a gesture difference vector, or device sensor signals may be used alone to create a device signal difference vector.

[00068] FIGs. 10A-10B are screen views of example dynamic effects according to one embodiment of the present invention. As shown in FIG. 10A, dynamic haptics can be used to provide feedback on a drawing or writing interaction. The gesture used to paint, draw, or write can be haptified dynamically so that the motion of the user's finger is reflected by haptics that evolve over time. As shown by the example in FIG. 10B, dynamic haptic effects may play as a background to a corresponding visual or audio effect. Alternatively, a data display widget such as a list widget may move according to a user gesture. The background or widget can move in any direction – horizontally, vertically, or both horizontally and vertically. For example, dynamic haptic feedback may be generated during the list interaction according to the velocity of the user's gesture, or the position of the background or widget, or any number or combination of other characteristics or factors without limitation.

[00069] FIGs. 11A-11F are screen views of a physics based dynamic effect according to one embodiment of the present invention. As shown in FIGs. 11A-11C, a dynamic effect is provided based upon a rotation of a screen displaying an example web page. FIG. 11A shows the screen in the initial portrait orientation, FIG.

11B shows the screen rotating halfway between portrait and landscape orientation, and FIG. 11C shows the screen in the final landscape orientation. As shown in FIGs. 11D-11F, a dynamic effect is determined by a physical model that is computed by a processor. As shown in the physical model in FIG. 11D, a virtual ball 1101 has virtual physical properties such as mass and size. A device sensor signal such as an accelerometer signal is taken as an input to the physical model and is applied as a virtual force to virtual ball 1101. Thus the degree of rotation of the device is represented in the physical model by the position of the virtual ball 1101. As shown in FIG. 11E, the velocity of rotation is represented by the velocity of the ball 1103. Because of the shape of the boundaries of the physical space denoted by the white triangular corner boundary 1107 in FIG. 11F, a hard collision of the ball 1105 occurs with the boundary 1107 when the device tips fully horizontally into landscape orientation. Dynamic effects can provide a more compelling effect because the haptic effect can evolve over time to represent the motion of the ball. Without such dynamic effects, the haptic representation of the ball and the corresponding user perception of the rotating screen would be less intuitive and effective.

[00070] FIG. 12 is diagram showing an example free space gesture according to one embodiment of the present invention. Free space gestures involve capturing gesture information from a user with one or more onboard device sensors of a mobile device, such as an accelerometer, gyroscope, camera, etc. For example, a user holds mobile device 1201 and makes a circular motion 1203 to initiate a function such as turning on a television set or monitor 1205. A communication link 1207 between the mobile device 1201 and the television 1205 may be any wireless protocol such as infrared, Wifi, Bluetooth, etc. Alternatively, the mobile device 1201 may communicate with the television 1205 through the internet.

[00071] A dynamic effect can be associated with a free space gesture. For example, the magnitude of a dynamic effect may be a function of the speed of the free space gesture. A user need not be looking at the device's display and there may not be anything visually displayed or audibly played on the mobile device. It will be recognized that many other example functions may be initiated by free space gestures such as opening a door, initiating a mobile payment, controlling an appliance, game interactions, or controlling UI functions such change channel, skip next music track, etc.

[00072] FIGs. 13A-13B are graphs showing a grid size variation as a function of velocity according to one embodiment of the present invention. As described above, a user can move a screen, such as shown in FIGs. 9A-9C, by dragging or flinging it. In one embodiment, the combined haptic effect is implemented by position triggered haptic effects using a spatial grid obtained by dividing the visual display into smaller areas. A haptic effect is played when a line in grid 1301 or 1305 is crossed by the user's finger. The size of the grid is modified as a function of the velocity of the finger gesture. For example, when dragging a screen at a lower velocity VEL1, a first grid size 1303 is used, but when flicking a screen at a higher velocity VEL2, a larger grid size 1307 is used.

[00073] FIG. 14 is a graph showing an effect period value as a function of velocity according to one embodiment of the present invention. Four different levels of velocity in pixels per second, corresponding to four different grid sizes, are used for velocities below 80, below 300, below 600, and above 600, for grid sizes of 2, 7, 15, and 20. As shown in FIG. 14, the period decreases from 15 milliseconds to 2 milliseconds as the velocity increases from 600 to 1100 pix/sec.

[00074] A home screen overshoot function may be animated differently depending on whether the user is dragging or flinging it. FIG. 15 is a graph showing an animation duration as a function of a distance from center according to one embodiment of the present invention. The animation duration increases from 200 milliseconds to 870 milliseconds as the user drags from distance 1 to 288 pixels from the center of the screen.

[00075] FIG. 16 is a graph showing an animation duration as a function of a fling velocity according to one embodiment of the present invention. The animation duration increases from 200 milliseconds to 780 milliseconds as the user flings from velocity 50 pix/sec to 4500 pix/sec.

[00076] An end screen animation function may be implemented similarly to the home screen overshoot function of FIG. 16. FIG. 17 is a graph showing a haptic effect magnitude as a function of a velocity according to one embodiment of the present invention. An end screen animation index representing the haptic effect magnitude corresponding to the Immersion Corporation SDK/API increases from 0.1 to 1.0 as the user flings from velocity 100 pix/sec to 1100 pix/sec.

[00077] FIG. 18 is a graph showing an animation trajectory for a fall into place effect according to one embodiment of the present invention. Once the duration of an animation is found, it is mapped to the number of samples as shown in FIG. 18. The magnitude of the graph corresponding to the Immersion Corporation SDK/API is mapped to the distance to be traveled by the home screen to fall into place, with 1 being the location where the home screen is in the center. For example, if 150 is the distance to the center of the home screen, then 150 maps to 1 in the graph.

[00078] A haptic effect is played any time the position of the home screen crosses the center of the home screen. In one embodiment the haptic effect varies

as a function of velocity, but the location and time of execution may be a function of velocity and location.

[00079] FIG. 19 is a flow diagram for producing a dynamic haptic effect according to an embodiment of the present invention. In one embodiment, the functionality of the flow diagram of FIG. 19 is implemented by software stored in memory or other computer readable or tangible medium, and executed by a processor. In other embodiments, the functionality may be performed by hardware (e.g., through the use of an application specific integrated circuit ("ASIC"), a programmable gate array ("PGA"), a field programmable gate array ("FPGA"), etc.), or any combination of hardware and software.

[00080] At 1901, the system receives input of at least a first gesture signal at time T1 and a second gesture signal at time T2. At 1903, the system receives input of at least a first device sensor signal at time T3 and a second device sensor signal at time T4. Time T1, T2, T3 and T4 may occur simultaneously or non-simultaneously with each other and in any order. Multiple additional gesture inputs or device sensor inputs may be used to give greater precision to the dynamic haptic effect or to provide the dynamic haptic effect over a greater period of time. The gesture signals and the device sensor signals may be received in any order or time sequence, either sequentially with non-overlapping time periods or in parallel with overlapping or concurrent time periods. At 1905, the first gesture signal is compared to the second gesture signal to generate a gesture difference vector. At 1907, the first device sensor signal is compared to the second device sensor signal to generate a device signal difference vector. At 1909, an animation or physical model description may optionally be received. At 1911, an interaction parameter is generated using the gesture difference vector, the signal difference vector, and optionally the physical

model description. It will be recognized that any type of input synthesis method may be used to generate the interaction parameter from one or more gesture signals or device sensor signals including, but not limited to, the method of synthesis examples listed in TABLE 2 below. At 1913, a drive signal is applied to a haptic actuator according to the interaction parameter.

TABLE 2 – METHODS OF SYNTHESIS

- Additive synthesis - combining inputs, typically of varying amplitudes
- Subtractive synthesis - filtering of complex signals or multiple signal inputs
- Frequency modulation synthesis - modulating a carrier wave signal with one or more operators
- Sampling - using recorded inputs as input sources subject to modification
- Composite synthesis - using artificial and sampled inputs to establish a resultant “new” input
- Phase distortion - altering the speed of waveforms stored in wavetables during playback
- Waveshaping - intentional distortion of a signal to produce a modified result
- Resynthesis - modification of digitally sampled inputs before playback
- Granular synthesis - combining of several small input segments into a new input
- Linear predictive coding – similar technique as used for speech synthesis
- Direct digital synthesis - computer modification of generated waveforms
- Wave sequencing - linear combinations of several small segments to create a new input

- Vector synthesis - technique for fading between any number of different input sources
- Physical modeling - mathematical equations of the physical characteristics of virtual motion

[00081] Several embodiments are specifically illustrated and/or described herein. However, it will be appreciated that modifications and variations of the disclosed embodiments are covered by the above teachings and within the purview of the appended claims without departing from the spirit and intended scope of the invention.

WHAT IS CLAIMED:

1. A method of producing a haptic effect comprising:
receiving a first gesture signal;
receiving a second gesture signal;
generating an interaction parameter using the first gesture signal and the second gesture signal; and
applying a drive signal to a haptic output device according to the interaction parameter.
2. The method of claim 1 wherein the first or second gesture signal comprises a vector signal.
3. The method of claim 1 wherein the first or second gesture signal comprises an on-screen signal.
4. The method of claim 1 wherein generating an interaction parameter comprises generating an interaction parameter from a difference between the first gesture signal and the second gesture signal.
5. The method of claim 1 wherein generating an interaction parameter comprises generating an interaction parameter using the first gesture signal and the second gesture signal and a physical model.

6. The method of claim 1 wherein generating an interaction parameter comprises generating an interaction parameter using the first gesture signal and the second gesture signal and an animation.

7. The method of claim 1 further comprising:
 - receiving a first device sensor signal;
 - receiving a second device sensor signal; and
 - wherein generating an interaction parameter comprises generating an interaction parameter using the first gesture signal and the second gesture signal and the first device sensor signal and the second device sensor signal.

8. The method of claim 1 wherein the first device sensor signal or the second device sensor signal comprises an accelerometer signal.

9. The method of claim 1 wherein the first device sensor signal or the second device sensor signal comprises a gyroscope signal.

10. The method of claim 1 wherein the first device sensor signal or the second device sensor signal comprises an ambient signal.

11. The method of claim 1 wherein the first device sensor signal or the second device sensor signal comprises a virtual sensor signal.

12. A haptic effect enabled system comprising:
 - a haptic output device;

a drive module electronically coupled to the haptic output device for receiving a first gesture signal, receiving a second gesture signal, and generating an interaction parameter using the first gesture signal and the second gesture signal; and

a drive circuit electronically coupled to the drive module and the haptic output device for applying a drive signal to the haptic output device according to the interaction parameter.

13. The system of claim 12 wherein the first or second gesture signal comprises a vector signal.

14. The system of claim 12 wherein the first or second gesture signal comprises an on-screen signal.

15. The system of claim 12 wherein the drive module comprises a drive module for generating an interaction parameter from a difference between the first gesture signal and the second gesture signal.

16. The system of claim 12 wherein the drive module comprises a drive module for generating an interaction parameter using the first gesture signal and the second gesture signal and a physical model.

17. The system of claim 12 wherein the drive module comprises a drive module for generating an interaction parameter using the first gesture signal and the second gesture signal and an animation.

18. The system of claim 12 wherein the drive module comprises a drive module for receiving a first device sensor signal, receiving a second device sensor signal, and generating an interaction parameter using the first gesture signal and the second gesture signal and the first device sensor signal and the second device sensor signal.

19. The system of claim 12 wherein the first device sensor signal or the second device sensor signal comprises an accelerometer signal.

20. The system of claim 12 wherein the first device sensor signal or the second device sensor signal comprises a gyroscope signal.

21. The system of claim 12 wherein the first device sensor signal or the second device sensor signal comprises an ambient signal.

22. The system of claim 12 wherein the first device sensor signal or the second device sensor signal comprises a virtual sensor signal.

23. A computer readable medium having instructions stored thereon that, when executed by a processor, causes the processor to produce a haptic effect, the instructions comprising:

receiving a first gesture signal;

receiving a second gesture signal;

generating an interaction parameter using the first gesture signal and the second gesture signal; and

applying a drive signal to a haptic output device according to the interaction parameter.

24. The computer readable medium of claim 23, wherein the first or second gesture signal comprises a vector signal.

25. The computer readable medium of claim 23, wherein the first or second gesture signal comprises an on-screen signal.

26. The computer readable medium of claim 23, wherein generating an interaction parameter comprises generating an interaction parameter from a difference between the first gesture signal and the second gesture signal.

27. The computer readable medium of claim 23, wherein generating an interaction parameter comprises generating an interaction parameter using the first gesture signal and the second gesture signal and a physical model.

28. The computer readable medium of claim 23, wherein generating an interaction parameter comprises generating an interaction parameter using the first gesture signal and the second gesture signal and an animation.

29. The computer readable medium of claim 23, further comprising:
receiving a first device sensor signal;

receiving a second device sensor signal; and

wherein generating an interaction parameter comprises generating an interaction parameter using the first gesture signal and the second gesture signal and the first device sensor signal and the second device sensor signal.

30. The computer readable medium of claim 23, wherein the first device sensor signal or the second device sensor signal comprises a signal selected from the list consisting of accelerometer, gyroscope, ambient, or virtual.

ABSTRACT

A system that produces a dynamic haptic effect and generates a drive signal that includes two or more gesture signals. The haptic effect is modified dynamically based on the gesture signals. The haptic effect may optionally be modified dynamically by using the gesture signals and two or more real or virtual device sensor signals such as from an accelerometer or gyroscope, or by signals created from processing data such as still images, video or sound.

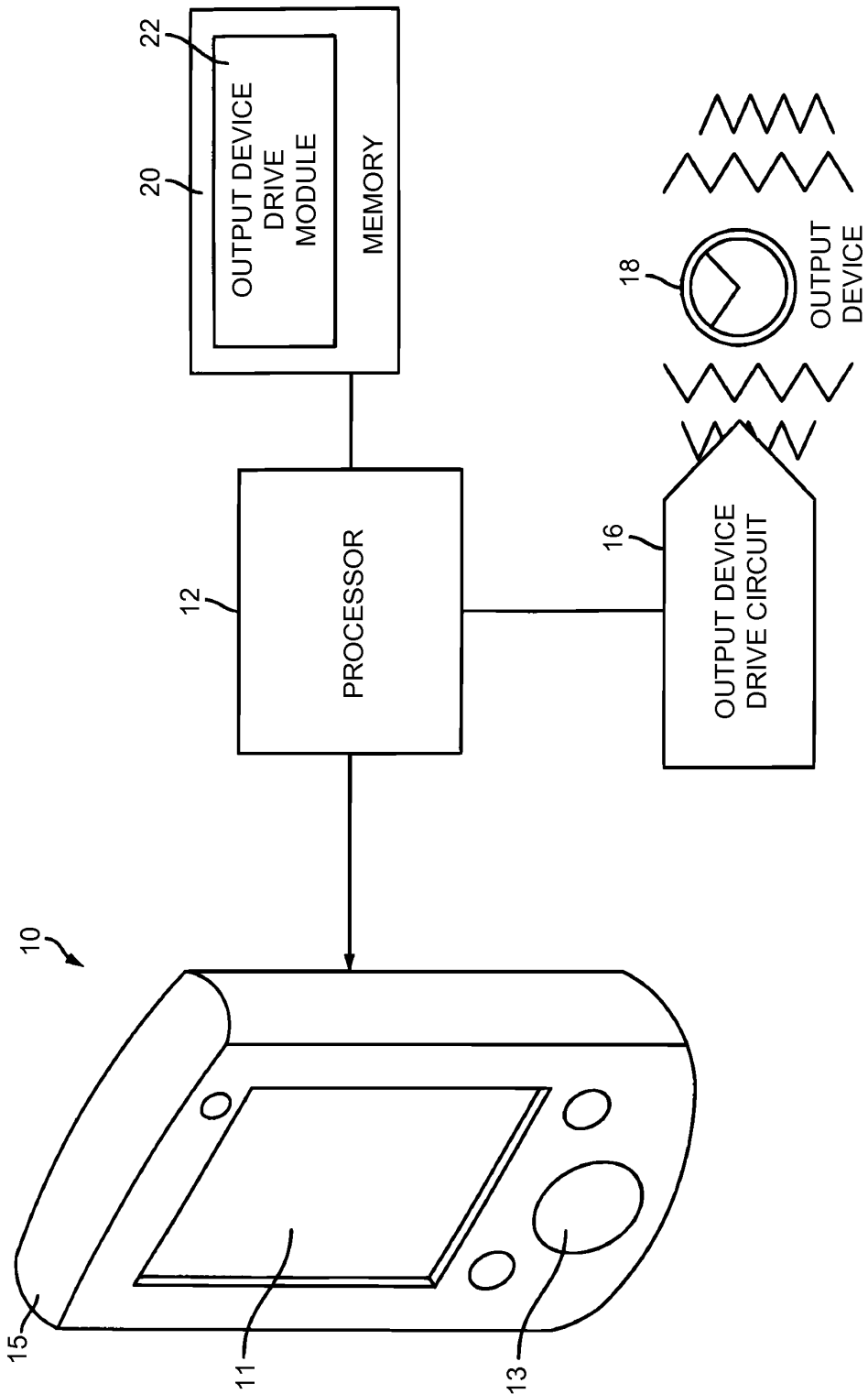


FIG. 1

18

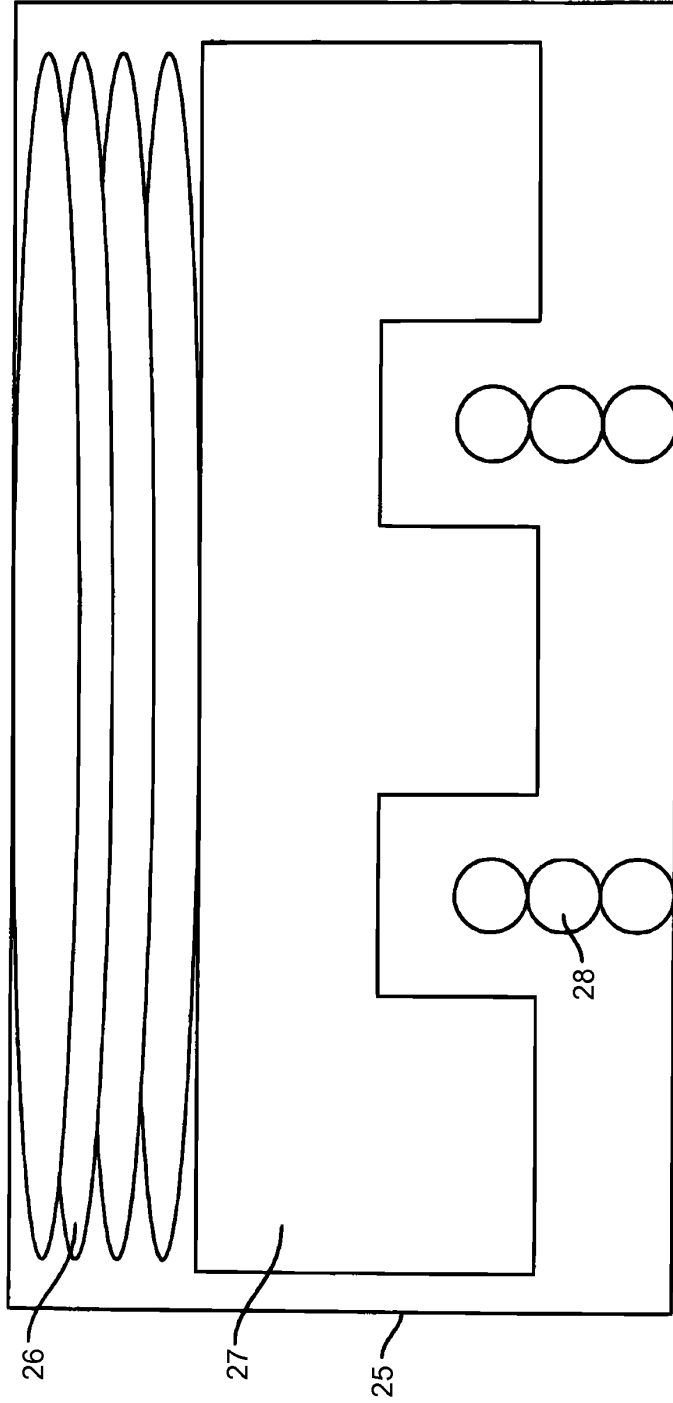
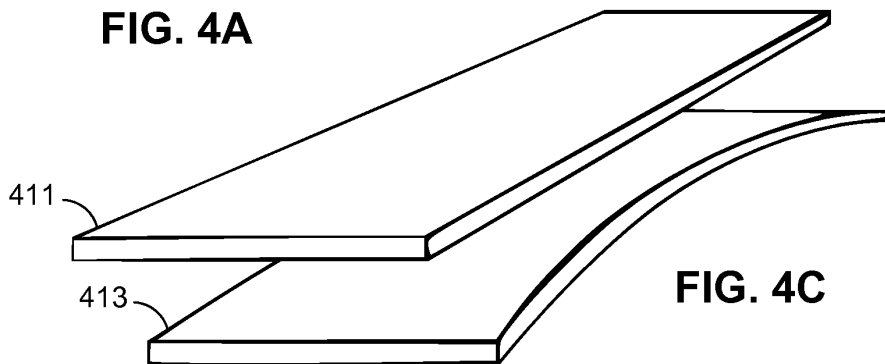
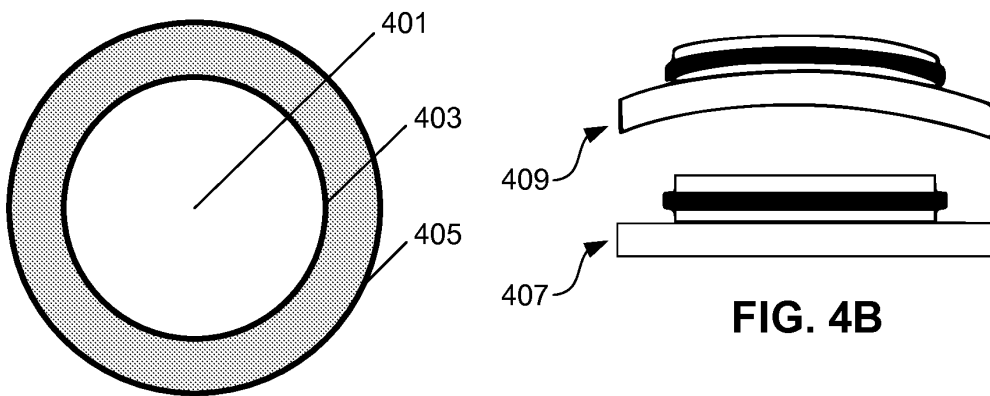
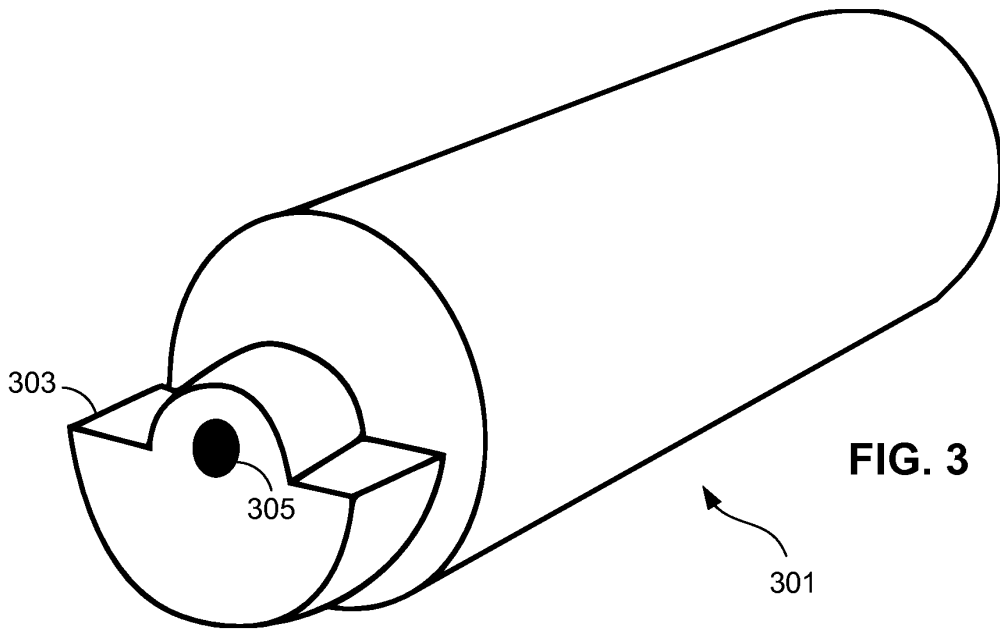


FIG. 2



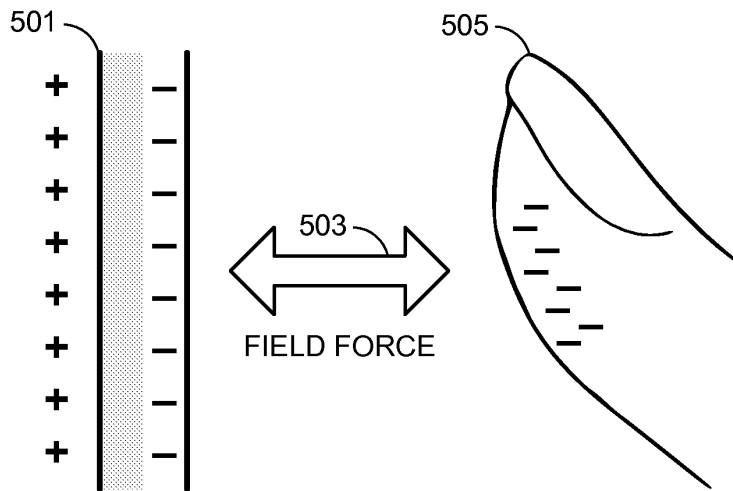


FIG. 5

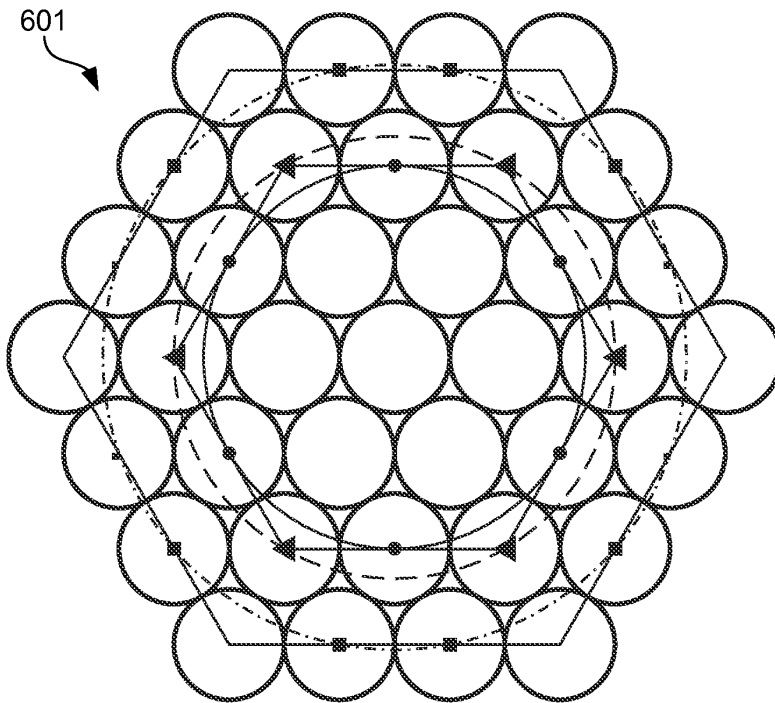


FIG. 6

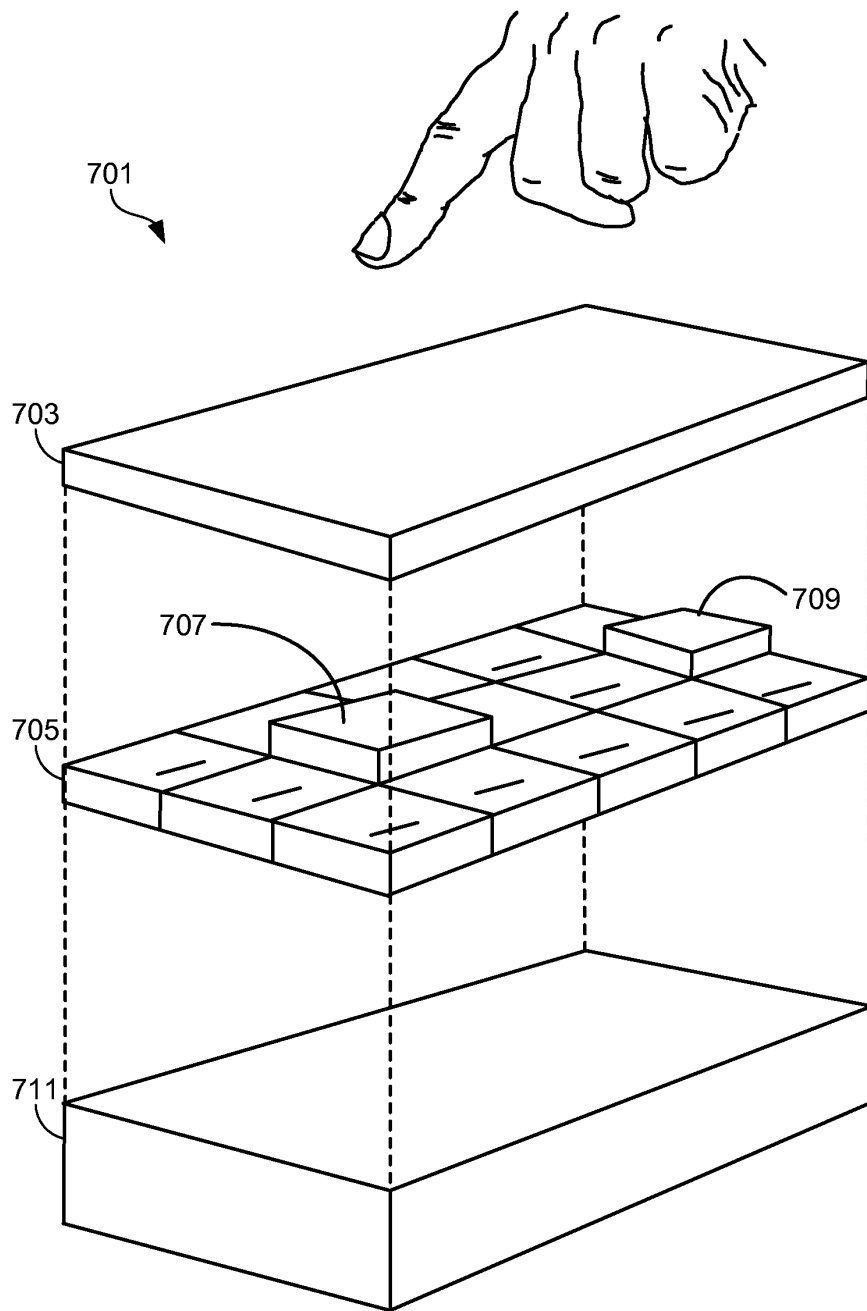


FIG. 7

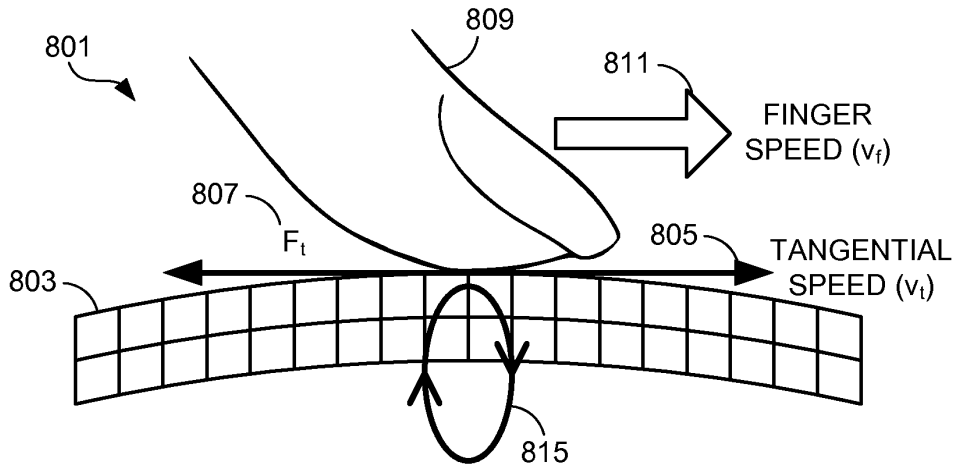


FIG. 8A

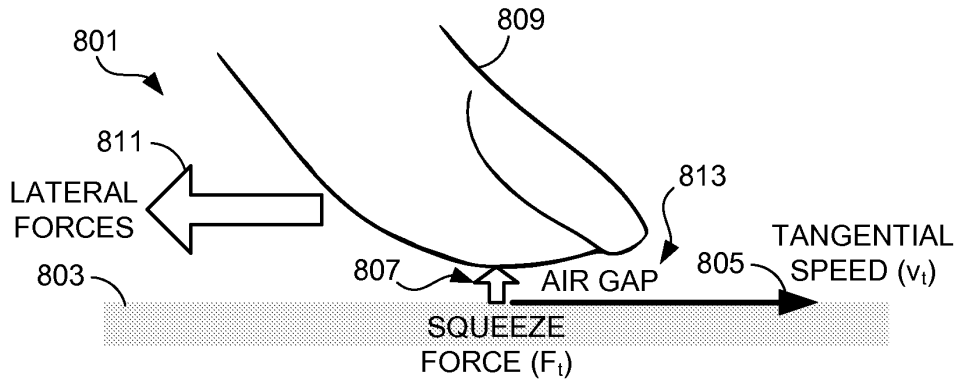


FIG. 8B



FIG. 9A

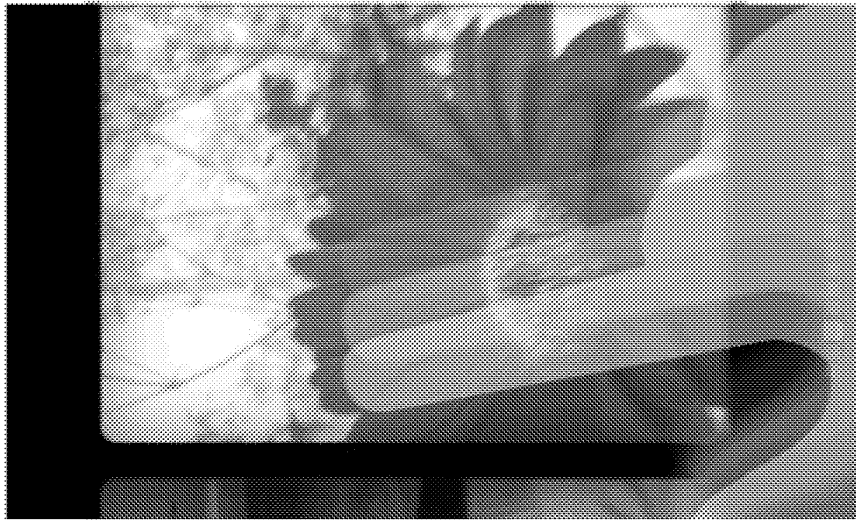


FIG. 9B

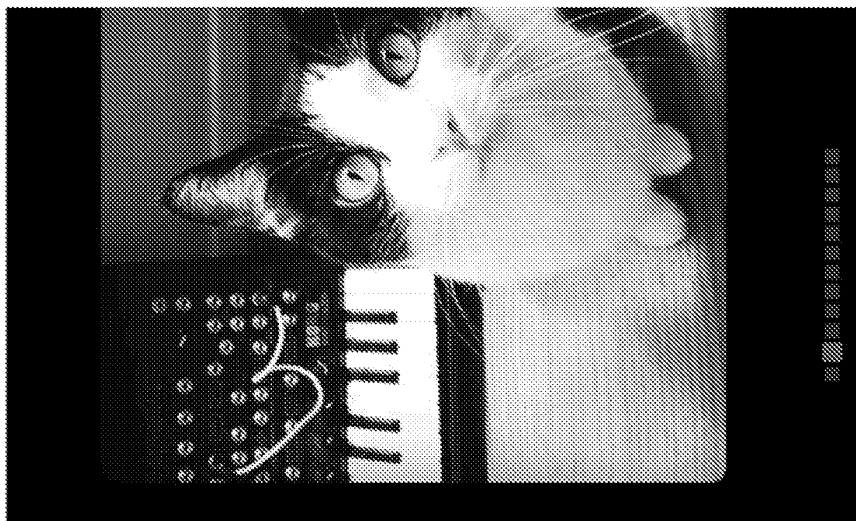


FIG. 9C

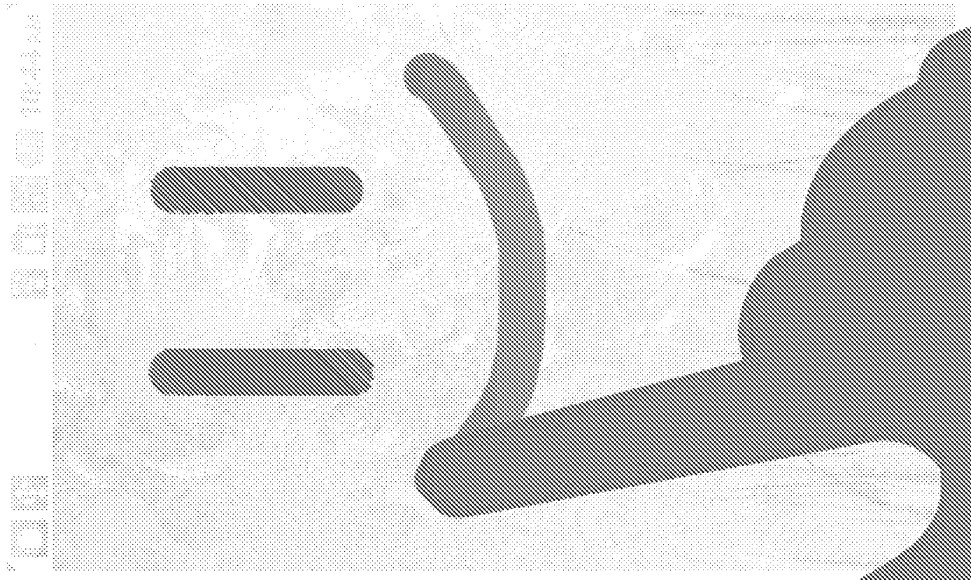


FIG. 10A

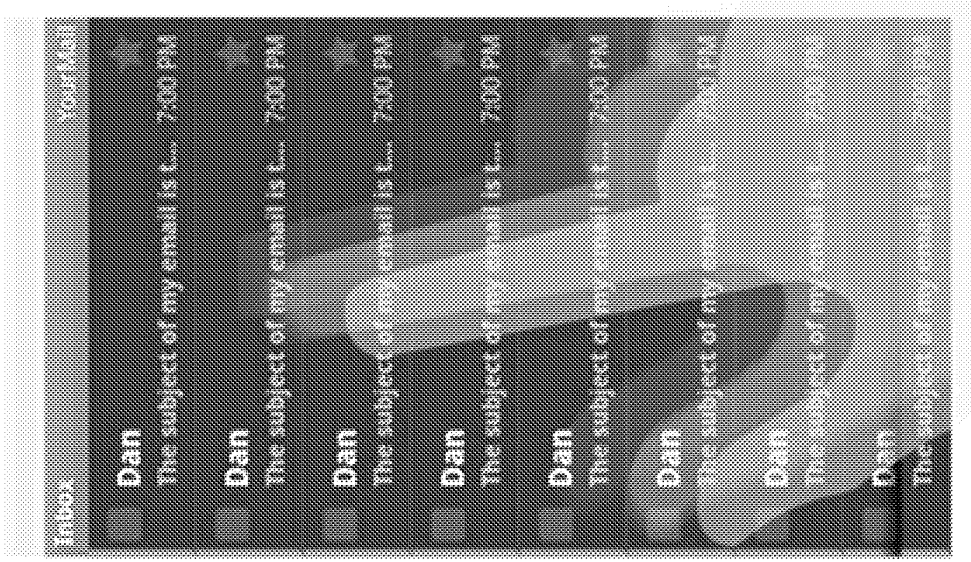


FIG. 10B

FAA Approves 500-Foot Ferris Wheel for Vegas Strip

A developer's plan to put a 500-foot observation wheel attraction on the Las Vegas Strip won't hamper operations at nearby McCarran International Airport, the Federal Aviation Administration said.

The agency's observation evaluation group told developer Howard Bulloch of Compass Investments that it expects the rotating wheel with 40 passenger gondolas won't affect airport facilities.

The wheel will be about as tall as two nearby casinos, and will be more than a half mile from an airport runway, the FAA said in its report.

Bulloch introduced the plans for the Circus Las Vegas Strip Wheel in March during a presentation at the site across Las Vegas Boulevard from the Mandalay Bay hotel.

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FIG. 11A

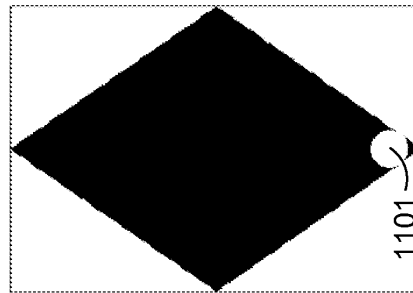


FIG. 11D

FIG. 11B

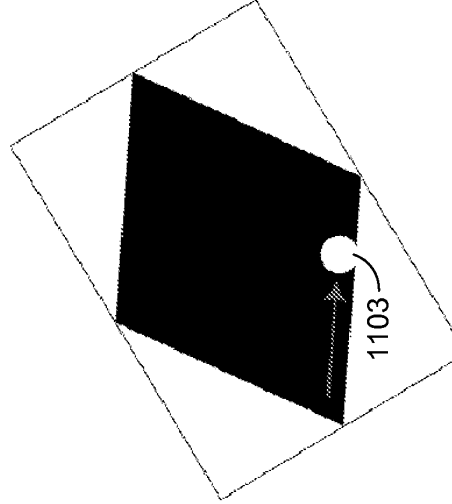


FIG. 11E

FIG. 11C

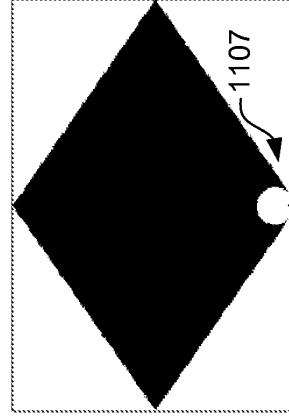


FIG. 11F

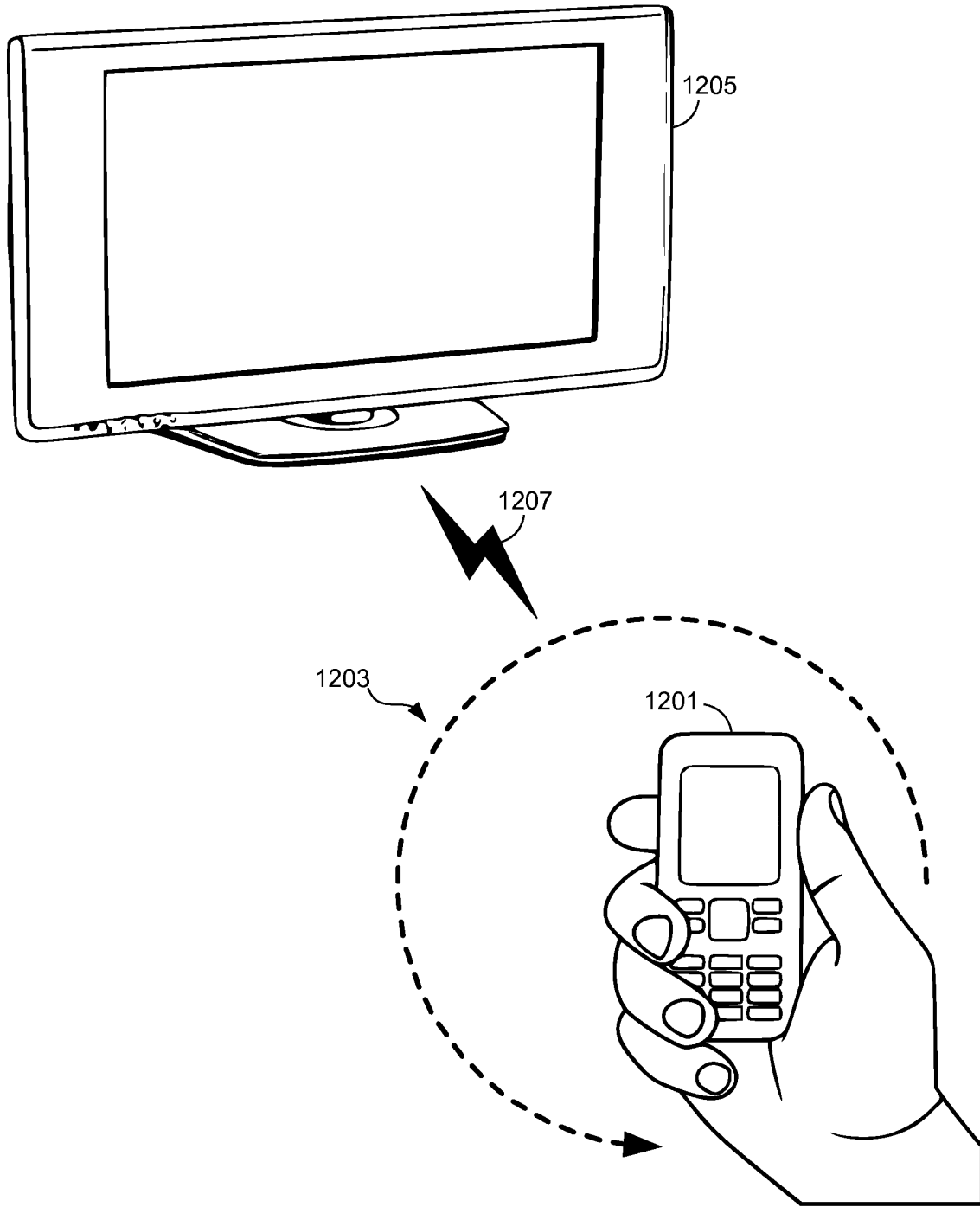


FIG. 12

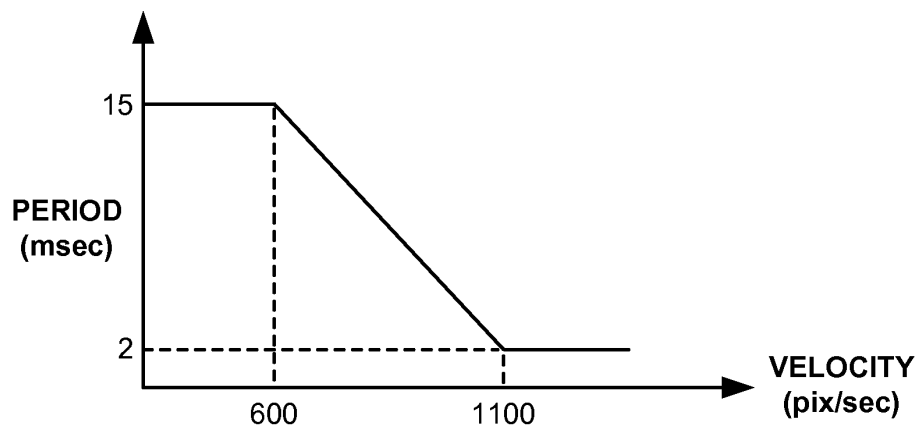
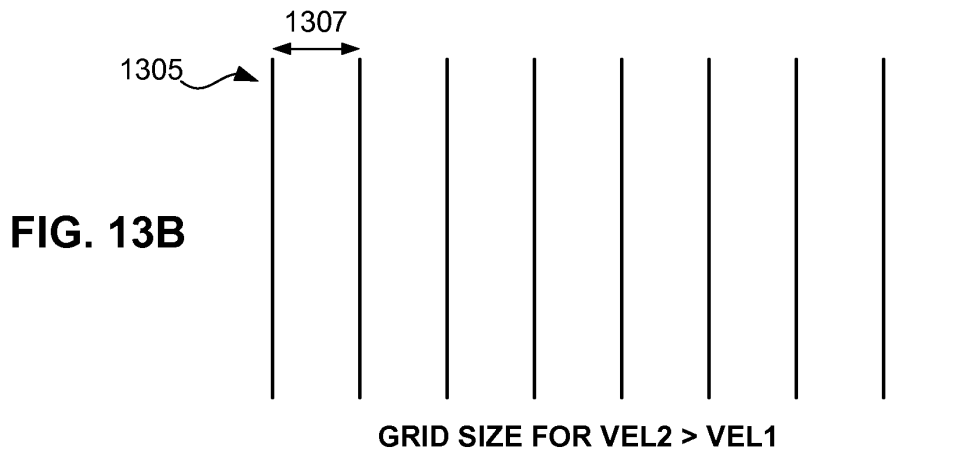
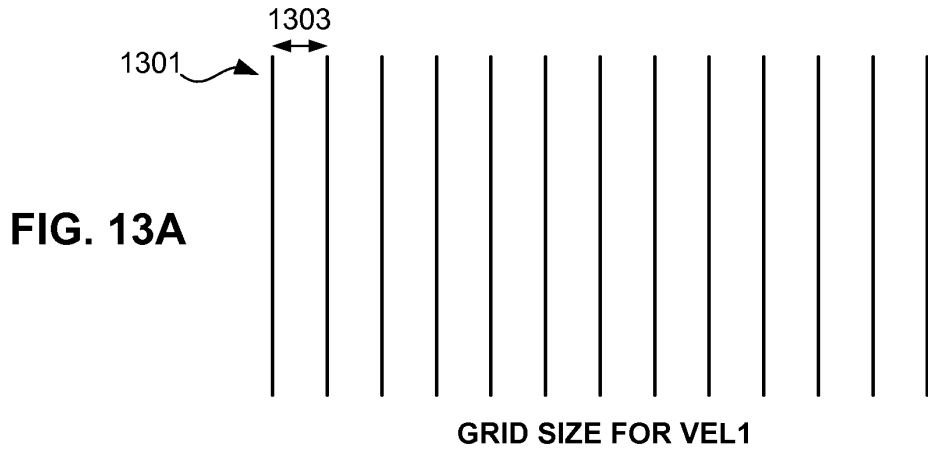


FIG. 14

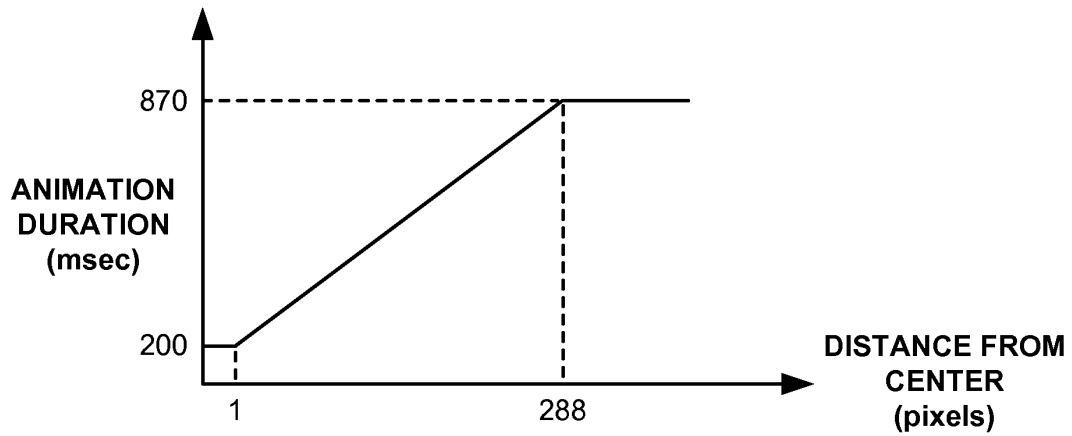


FIG. 15

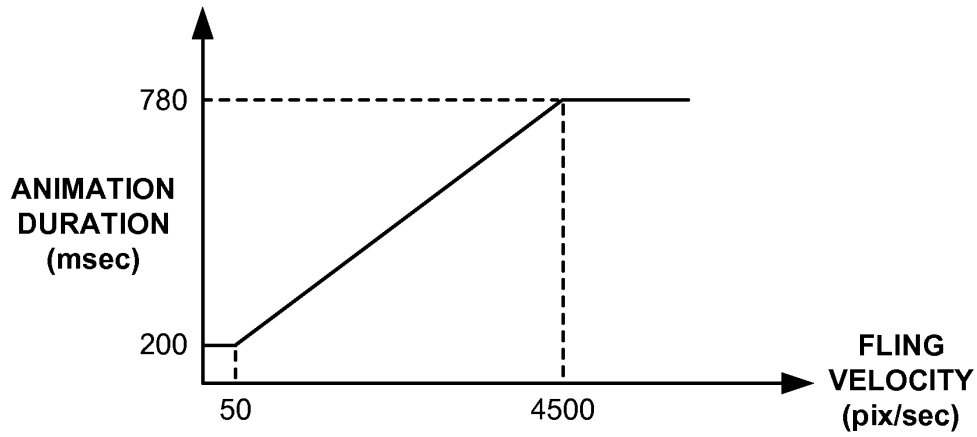


FIG. 16

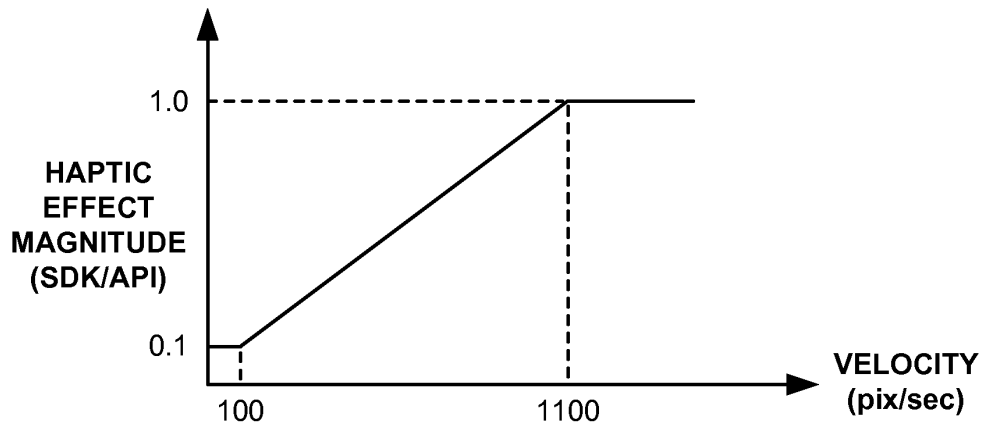


FIG. 17

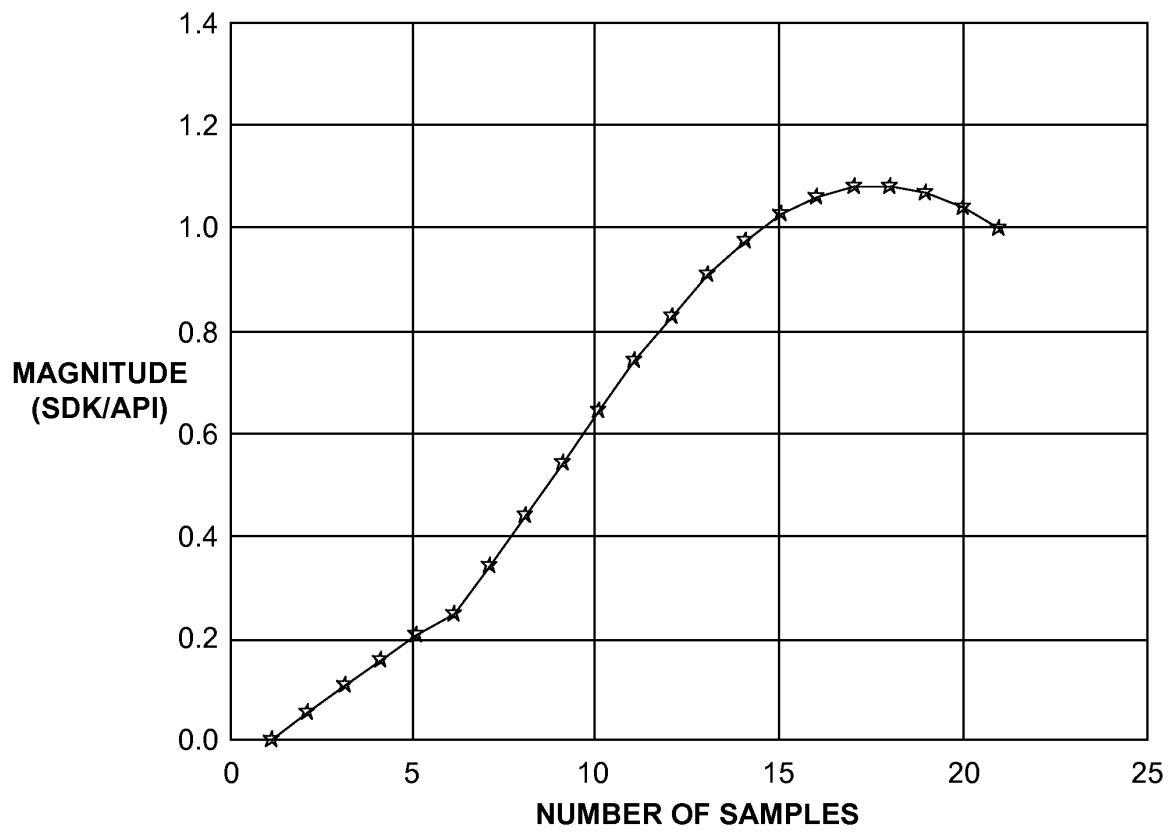


FIG. 18

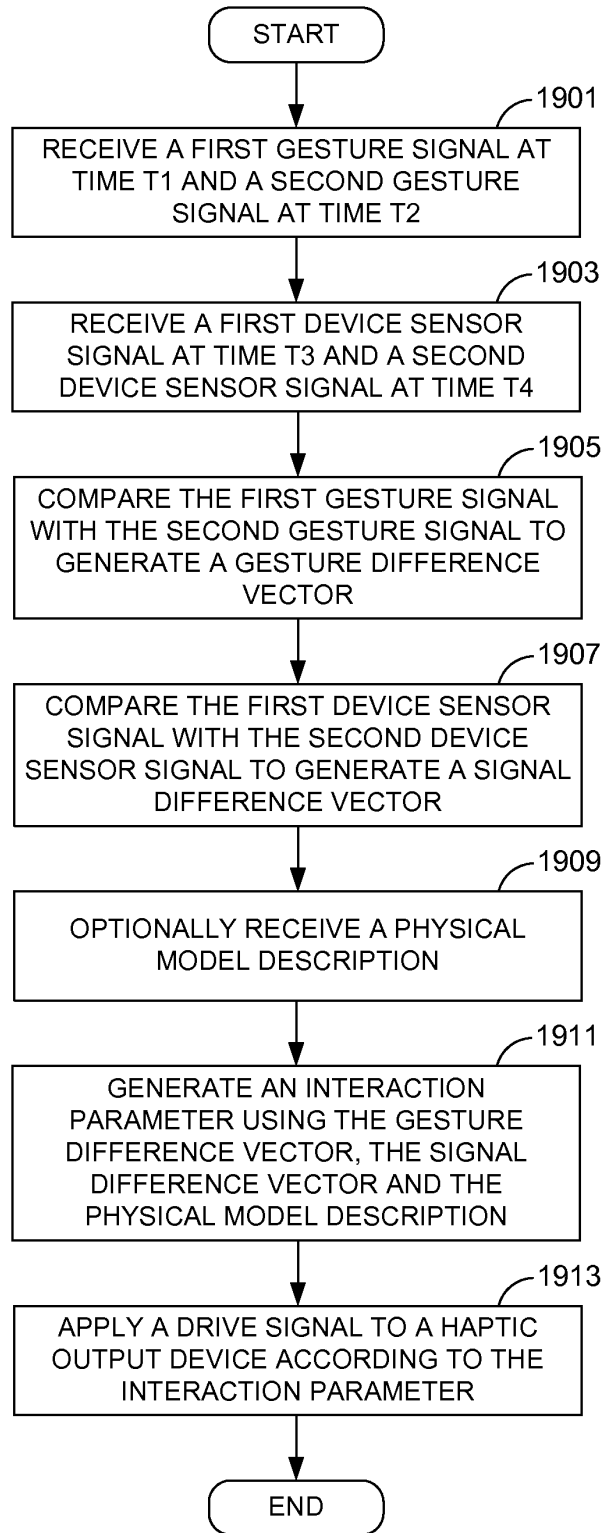


FIG. 19

Under the Paperwork Reduction Act of 1995, no persons are required to respond to a collection of information unless it contains a valid OMB control number.

Application Data Sheet 37 CFR 1.76	Attorney Docket Number	IMM389C1
	Application Number	
Title of Invention	METHOD AND APPARATUS FOR PRODUCING A DYNAMIC HAPTIC EFFECT	
The application data sheet is part of the provisional or nonprovisional application for which it is being submitted. The following form contains the bibliographic data arranged in a format specified by the United States Patent and Trademark Office as outlined in 37 CFR 1.76. This document may be completed electronically and submitted to the Office in electronic format using the Electronic Filing System (EFS) or the document may be printed and included in a paper filed application.		

Secrecy Order 37 CFR 5.2

Portions or all of the application associated with this Application Data Sheet may fall under a Secrecy Order pursuant to 37 CFR 5.2 (Paper filers only. Applications that fall under Secrecy Order may not be filed electronically.)

Applicant Information:

Applicant 1					
Applicant Authority		<input checked="" type="radio"/> Inventor		<input type="radio"/> Legal Representative under 35 U.S.C. 117	
				<input type="radio"/> Party of Interest under 35 U.S.C. 118	
Prefix	Given Name	Middle Name	Family Name	Suffix	
	David		Birnbaum		
Residence Information (Select One) <input checked="" type="radio"/> US Residency <input type="radio"/> Non US Residency <input type="radio"/> Active US Military Service					
City	San Jose	State/Province	CA	Country of Residence	US
Citizenship under 37 CFR 1.41(b)		US			
Mailing Address of Applicant:					
Address 1	311 Oak Street				
Address 2					
City	Oakland	State/Province	CA		
Postal Code	94607	Country	US		
Applicant 2					
Applicant Authority		<input checked="" type="radio"/> Inventor		<input type="radio"/> Legal Representative under 35 U.S.C. 117	
				<input type="radio"/> Party of Interest under 35 U.S.C. 118	
Prefix	Given Name	Middle Name	Family Name	Suffix	
	Juan	Manuel	Cruz-Hernandez		
Residence Information (Select One) <input type="radio"/> US Residency <input checked="" type="radio"/> Non US Residency <input type="radio"/> Active US Military Service					
City	Montreal	Country Of Residence	QC		
Citizenship under 37 CFR 1.41(b)		MX			
Mailing Address of Applicant:					
Address 1	840 Ste-Catherine West				
Address 2					
City	Montreal	State/Province	QC		
Postal Code	H3Z 1T1	Country	CA		
Applicant 3					
Applicant Authority		<input checked="" type="radio"/> Inventor		<input type="radio"/> Legal Representative under 35 U.S.C. 117	
				<input type="radio"/> Party of Interest under 35 U.S.C. 118	
Prefix	Given Name	Middle Name	Family Name	Suffix	
	Danny		Grant		
Residence Information (Select One) <input type="radio"/> US Residency <input checked="" type="radio"/> Non US Residency <input type="radio"/> Active US Military Service					
City	Montreal	Country Of Residence	QC		

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Application Data Sheet 37 CFR 1.76	Attorney Docket Number	IMM389C1
	Application Number	
Title of Invention	METHOD AND APPARATUS FOR PRODUCING A DYNAMIC HAPTIC EFFECT	

Citizenship under 37 CFR 1.41(b)	CA		
Mailing Address of Applicant:			
Address 1	1784 de Lunebourg		
Address 2			
City	Laval	State/Province	QC
Postal Code	H7M 2A1	Country	CA
Applicant 4			
Applicant Authority	<input checked="" type="radio"/> Inventor	<input type="radio"/> Legal Representative under 35 U.S.C. 117	<input type="radio"/> Party of Interest under 35 U.S.C. 118
Prefix	Given Name	Middle Name	Family Name
	Chris		Ulrich
Residence Information (Select One)	<input checked="" type="radio"/> US Residency <input type="radio"/> Non US Residency <input type="radio"/> Active US Military Service		
City	Ventura	State/Province	CA
		Country of Residence	US
Citizenship under 37 CFR 1.41(b)	CA		
Mailing Address of Applicant:			
Address 1	227 Palomares Ave		
Address 2			
City	Ventura	State/Province	CA
Postal Code	93003	Country	US
All Inventors Must Be Listed - Additional Inventor Information blocks may be generated within this form by selecting the Add button.			<input type="button" value="Add"/>

Correspondence Information:

Enter either Customer Number or complete the Correspondence Information section below. For further information see 37 CFR 1.33(a).	
<input type="checkbox"/> An Address is being provided for the correspondence information of this application.	
Customer Number	103772
Email Address	ImmersionIP@immersion.com <input type="button" value="Add Email"/> <input type="button" value="Remove Email"/>

Application Information:

Title of the Invention	METHOD AND APPARATUS FOR PRODUCING A DYNAMIC HAPTIC EFFECT		
Attorney Docket Number	IMM389C1	Small Entity Status Claimed	<input type="checkbox"/>
Application Type	Nonprovisional		
Subject Matter	Utility		
Suggested Class (if any)		Sub Class (if any)	
Suggested Technology Center (if any)			
Total Number of Drawing Sheets (if any)	14	Suggested Figure for Publication (if any)	

Under the Paperwork Reduction Act of 1995, no persons are required to respond to a collection of information unless it contains a valid OMB control number.

Application Data Sheet 37 CFR 1.76	Attorney Docket Number	IMM389C1
	Application Number	
Title of Invention	METHOD AND APPARATUS FOR PRODUCING A DYNAMIC HAPTIC EFFECT	

Publication Information:

<input checked="" type="checkbox"/>	Request Early Publication (Fee required at time of Request 37 CFR 1.219)
<input type="checkbox"/>	Request Not to Publish. I hereby request that the attached application not be published under 35 U.S.C. 122(b) and certify that the invention disclosed in the attached application has not and will not be the subject of an application filed in another country, or under a multilateral international agreement, that requires publication at eighteen months after filing.

Representative Information:

Representative information should be provided for all practitioners having a power of attorney in the application. Providing this information in the Application Data Sheet does not constitute a power of attorney in the application (see 37 CFR 1.32). Enter either Customer Number or complete the Representative Name section below. If both sections are completed the Customer Number will be used for the Representative Information during processing.

Please Select One:	<input type="radio"/> Customer Number	<input checked="" type="radio"/> US Patent Practitioner	<input type="radio"/> Limited Recognition (37 CFR 11.9)		
Prefix	Given Name	Middle Name	Family Name	Suffix	<input type="button" value="Remove"/>
	Thomas A.		Hassing		
Registration Number	36159				
Additional Representative Information blocks may be generated within this form by selecting the Add button.					

Domestic Benefit/National Stage Information:

This section allows for the applicant to either claim benefit under 35 U.S.C. 119(e), 120, 121, or 365(c) or indicate National Stage entry from a PCT application. Providing this information in the application data sheet constitutes the specific reference required by 35 U.S.C. 119(e) or 120, and 37 CFR 1.78(a)(2) or CFR 1.78(a)(4), and need not otherwise be made part of the specification.

Prior Application Status	Pending	<input type="button" value="Remove"/>	
Application Number	Continuity Type	Prior Application Number	Filing Date (YYYY-MM-DD)
	Continuation of	61599145	2012-02-15
Additional Domestic Benefit/National Stage Data may be generated within this form by selecting the Add button.			

Foreign Priority Information:

This section allows for the applicant to claim benefit of foreign priority and to identify any prior foreign application for which priority is not claimed. Providing this information in the application data sheet constitutes the claim for priority as required by 35 U.S.C. 119(b) and 37 CFR 1.55(a).

<input type="button" value="Remove"/>			
Application Number	Country ¹	Parent Filing Date (YYYY-MM-DD)	Priority Claimed
			<input checked="" type="radio"/> Yes <input type="radio"/> No
Additional Foreign Priority Data may be generated within this form by selecting the Add button.			

Under the Paperwork Reduction Act of 1995, no persons are required to respond to a collection of information unless it contains a valid OMB control number.

Application Data Sheet 37 CFR 1.76		Attorney Docket Number	IMM389C1
		Application Number	
Title of Invention	METHOD AND APPARATUS FOR PRODUCING A DYNAMIC HAPTIC EFFECT		

Assignee Information:

Providing this information in the application data sheet does not substitute for compliance with any requirement of part 3 of Title 37 of the CFR to have an assignment recorded in the Office.			
Assignee 1			
If the Assignee is an Organization check here. <input checked="" type="checkbox"/>			
Organization Name	Immersion Corporation		
Mailing Address Information:			
Address 1	30 Rio Robles		
Address 2			
City	San Jose	State/Province	CA
Country	US	Postal Code	95134
Phone Number	408-467-1900	Fax Number	408-467-1901
Email Address	ImmersionIP@immersion.com		
Additional Assignee Data may be generated within this form by selecting the Add button.			

Signature:

A signature of the applicant or representative is required in accordance with 37 CFR 1.33 and 10.18. Please see 37 CFR 1.4(d) for the form of the signature.					
Signature	/Thomas A. Hassing/			Date (YYYY-MM-DD)	2012-05-16
First Name	Thomas A.	Last Name	Hassing	Registration Number	36159

This collection of information is required by 37 CFR 1.76. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.14. This collection is estimated to take 23 minutes to complete, including gathering, preparing, and submitting the completed application data sheet form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. **DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.**

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3. A record in this system of records may be disclosed, as a routine use, to a Member of Congress submitting a request involving an individual, to whom the record pertains, when the individual has requested assistance from the Member with respect to the subject matter of the record.
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5. A record related to an International Application filed under the Patent Cooperation Treaty in this system of records may be disclosed, as a routine use, to the International Bureau of the World Intellectual Property Organization, pursuant to the Patent Cooperation Treaty.
6. A record in this system of records may be disclosed, as a routine use, to another federal agency for purposes of National Security review (35 U.S.C. 181) and for review pursuant to the Atomic Energy Act (42 U.S.C. 218(c)).
7. A record from this system of records may be disclosed, as a routine use, to the Administrator, General Services, or his/her designee, during an inspection of records conducted by GSA as part of that agency's responsibility to recommend improvements in records management practices and programs, under authority of 44 U.S.C. 2904 and 2906. Such disclosure shall be made in accordance with the GSA regulations governing inspection of records for this purpose, and any other relevant (i.e., GSA or Commerce) directive. Such disclosure shall not be used to make determinations about individuals.
8. A record from this system of records may be disclosed, as a routine use, to the public after either publication of the application pursuant to 35 U.S.C. 122(b) or issuance of a patent pursuant to 35 U.S.C. 151. Further, a record may be disclosed, subject to the limitations of 37 CFR 1.14, as a routine use, to the public if the record was filed in an application which became abandoned or in which the proceedings were terminated and which application is referenced by either a published application, an application open to public inspections or an issued patent.
9. A record from this system of records may be disclosed, as a routine use, to a Federal, State, or local law enforcement agency, if the USPTO becomes aware of a violation or potential violation of law or regulation.

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Application of:)	
)	
David Birnbaum et al.	)	Examiner:
)	
Application No.	)	Art Unit:
)	
Filed: May 16, 2012)	
	)	Confirmation No.
For: METHOD AND APPARATUS FOR)	
PRODUCING A DYNAMIC HAPTIC)	
EFFECT)	
)	

Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

AUTHORIZATION OF COMMUNICATIONS VIA THE INTERNET

Sir:

Under MPEP § 502.03, I hereby authorize the USPTO to communicate with me concerning any subject matter of this application by electronic mail to the email address "thassing@immersion.com". I understand that a copy of these communications will be made of record in the application file.

Respectfully submitted,
IMMERSION CORPORATION

Dated: 5/16, 2012

/Thomas A. Hassing/
Thomas A. Hassing
Reg. No. 36,159

30 Rio Robles
San Jose, CA 95134
(408) 467-1900

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**CERTIFICATION AND REQUEST FOR PRIORITIZED EXAMINATION
 UNDER 37 CFR 1.102(e) (Page 1 of 1)**

First Named Inventor:	David Birnbaum	Nonprovisional Application Number (if known):	
Title of Invention:	METHOD AND APPARATUS FOR PRODUCING A DYNAMIC HAPTIC EFFECT		

APPLICANT HEREBY CERTIFIES THE FOLLOWING AND REQUESTS PRIORITIZED EXAMINATION FOR THE ABOVE-IDENTIFIED APPLICATION.

1. The processing fee set forth in 37 CFR 1.17(i), the prioritized examination fee set forth in 37 CFR 1.17(c), and if not already paid, the publication fee set forth in 37 CFR 1.18(d) have been filed with the request. The basic filing fee, search fee, examination fee, and any required excess claims and application size fees are filed with the request or have been already been paid.
2. The application contains or is amended to contain no more than four independent claims and no more than thirty total claims, and no multiple dependent claims.
3. The applicable box is checked below:

I. Original Application (Track One) - Prioritized Examination under § 1.102(e)(1)

- i. (a) The application is an original nonprovisional utility application filed under 35 U.S.C. 111(a). This certification and request is being filed with the utility application via EFS-Web.
 ---OR---
 (b) The application is an original nonprovisional plant application filed under 35 U.S.C. 111(a). This certification and request is being filed with the plant application in paper.
- ii. An executed oath or declaration under 37 CFR 1.63 is filed with the application.

II. Request for Continued Examination - Prioritized Examination under § 1.102(e)(2)

- i. A request for continued examination has been filed with, or prior to, this form.
- ii. If the application is a utility application, this certification and request is being filed via EFS-Web.
- iii. The application is an original nonprovisional utility application filed under 35 U.S.C. 111(a), or is a national stage entry under 35 U.S.C. 371.
- iv. This certification and request is being filed prior to the mailing of a first Office action responsive to the request for continued examination.
- v. No prior request for continued examination has been granted prioritized examination status under 37 CFR 1.102(e)(2).

Signature	/Thomas A. Hassing/	Date	2012-05-16
Name (Print/Typed)	Thomas A. Hassing	Practitioner Registration Number	36,159
<p><i>Note: Signatures of all the inventors or assignees of record of the entire interest or their representative(s) are required in accordance with 37 CFR 1.33 and 11.18. Please see 37 CFR 1.4(d) for the form of the signature. If necessary, submit multiple forms for more than one signature, see below*.</i></p>			
<p><input type="checkbox"/> *Total of _____ forms are submitted.</p>			

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	Filing Date		2012-05-16
	First Named Inventor	BIRNBAUM	
	Art Unit		
	Examiner Name		
	Attorney Docket Number		IMM389C1

U.S.PATENTS						
Examiner Initial*	Cite No	Patent Number	Kind Code ¹	Issue Date	Name of Patentee or Applicant of cited Document	Pages, Columns, Lines where Relevant Passages or Relevant Figures Appear
	1	5666499		1997-09-09	Baudel et al.	
	2	5825308		1998-10-20	Rosenberg	
	3	6088019		2000-07-11	Rosenberg	
	4	6100874		2000-08-08	Schena et al.	
	5	6166723		2000-12-26	Schena et al.	
	6	6211861		2001-04-03	Rosenberg et al.	
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9	6337678		2002-01-08	Fish	
10	6429846		2002-08-06	Rosenberg et al.	
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27	7808488		2010-10-05	Martin et al.	
28	7821498		2010-10-26	Kramer et al.	
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30	7890863		2011-02-15	Grant et al.	

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	2	20020044132		2002-04-18	Fish	
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	41	20080216001		2008-09-04	Ording et al.	
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63	20100045619	2010-02-25	Birnbaum et al.
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75	20110025609		2011-02-03	Modarres et al.	
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85	20120105333		2012-05-03	Maschmeyer et al.	
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FOREIGN PATENT DOCUMENTS

Examiner Initial*	Cite No	Foreign Document Number ³	Country Code ²ⁱ	Kind Code ⁴	Publication Date	Name of Patentee or Applicant of cited Document	Pages, Columns, Lines where Relevant Passages or Relevant Figures Appear	T ⁵
	1	DE 200 19 074			2001-02-22	Siemens AG		<input type="checkbox"/>
	2	EP 0 899 650			1999-03-03	Xerox Corp.		<input type="checkbox"/>
	3	EP 1 401 185			2004-03-24	Samsung Electronics Co. Ltd.		<input type="checkbox"/>
	4	EP 1 691 263			2003-11-06	Apple		<input type="checkbox"/>
	5	EP 1 731 993			2006-12-13	Sony Corp.		<input type="checkbox"/>
	6	FR 2 910 160			2008-06-20	France Telecom		<input type="checkbox"/>
	7	GB 2 416 962			2006-02-08	Vodafone PLC		<input type="checkbox"/>
	8	WO 2004/044728 A2			2004-05-27	Sony Comp Entertainment Inc.		<input type="checkbox"/>

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9	WO 2004/075169 A2			2004-09-02	KONINKLIJKE PHILIPS ELECTRONICS, N.V.	<input type="checkbox"/>
10	WO 2004/081778 A1			2004-09-23	Handshake Interactive Technology	<input type="checkbox"/>
11	WO 2005/103863 A			2005-11-03	Fujitsu Limited	<input type="checkbox"/>
12	WO 2008/132540 A1			2008-11-06	Nokia Corp. et al.	<input type="checkbox"/>
13	WO 2009/037379			2009-03-26	MÄKINEN et al.	<input type="checkbox"/>
14	WO 2009/071750 A1			2009-06-11	Nokia Corporation	<input type="checkbox"/>
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17	WO 99/38064			1999-07-29	KONINKLIJKE PHILIPS ELECTRONICS N.V.	<input type="checkbox"/>

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NON-PATENT LITERATURE DOCUMENTS

Examiner Initials*	Cite No	Include name of the author (in CAPITAL LETTERS), title of the article (when appropriate), title of the item (book, magazine, journal, serial, symposium, catalog, etc), date, pages(s), volume-issue number(s), publisher, city and/or country where published.	T ⁵
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Attorney Docket Number	IMM389C1

1	BIET, M. et al., Discrimination of Virtual Square Gratings by Dynamic Touch on Friction Based Tactile Displays, Haptic Interfaces for Virtual Environment and Teleoperator Systems, 2008, Symposium, IEEE, Piscataway, NJ, XP 031339918, pp. 41-48, March 2008. ISBN: 978-1-4244-2005-6	<input type="checkbox"/>
2	BIET, M. et al., "New Tactile Devices Using Piezoelectric Actuators", L2EP, University of Lille, Polytech-Lille, ACTUATOR 2006, 10th International Conference on New Actuators, 14-16 June 2006, Bremen, Germany, pp.989-992	<input type="checkbox"/>
3	Bonderud, Doug, "Nokia Files Patent To Make Phones Digitally Stimulating", InventorSpot.com [online], [retrieved 2011-04-21]. Retrieved from the Internet <URL: http://inventorspot.com/articles/nokia_files_patent_make_phones_digitally_stimulating >	<input type="checkbox"/>
4	BUXTON, Bill, "Multi-Touch Systems that I have Known and Loved"; Microsoft Research; Original: Jan. 12, 2007; Version: July 17, 2007; <URL: http://www.billbuxton.com/multitouchOverview.html > pp. -16	<input type="checkbox"/>
5	Chang et al., ComTouch: Design of a Vibrotactile Communication Device, DIS2002, London Copyright 2002 ACM 1-58113-2-9-0/00/0008, 10 pages	<input type="checkbox"/>
6	DEWITT, A., Designing Sonification of User data in Affective Interaction, Master of Science Thesis Stockholm, Sweden, XP 002551466, at URL: http://w3.nada.kth.se/utbildning/grukth/exjobb/rapportistor/2007/rapporter07/de_witt_anna_07142.pdf , as available via the Internet and printed on 10-20-09.	<input type="checkbox"/>
7	Greene, Kate, "A Touch Screen with Texture", Technology Review [online], [retrieved 2011-04-21]. Retrieved from the Internet <URL: http://www.technologyreview.com/printer_friendly_article.aspx?id=26506 >	<input type="checkbox"/>
8	Hsin-Un YAO et al., "An Experiment on Length Perception with a Virtual Rolling Stone"; Proc. Eurohaptics 2006; pp. 325-330.	<input type="checkbox"/>
9	http://en.wikipedia.org/w/index.php?title=Gesture_recognition&printable=yes ; 07-23-2010	<input type="checkbox"/>
10	Iwamoto, T. et al., "Airborne Ultrasound Tactile Display", The University of Tokyo, SIGGRAPH 2008, Los Angeles, California, August 11-15, 2008, ISBN 978-1-60558-466-9/08/0008	<input type="checkbox"/>
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Signature	/Thomas A. Hassing/	Date (YYYY-MM-DD)	2012-05-16
Name/Print	Thomas A. Hassing	Registration Number	36,159

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U.S.PATENTS						
Examiner Initial*	Cite No	Patent Number	Kind Code ¹	Issue Date	Name of Patentee or Applicant of cited Document	Pages, Columns, Lines where Relevant Passages or Relevant Figures Appear
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	1	20070236450		2007-10-11	Colgate et al.	
	2	20090284485		2009-11-19	Colgate et al.	
	3	20100108408		2010-05-06	Colgate et al.	
	4	20110260988		2011-10-27	Colgate et al.	

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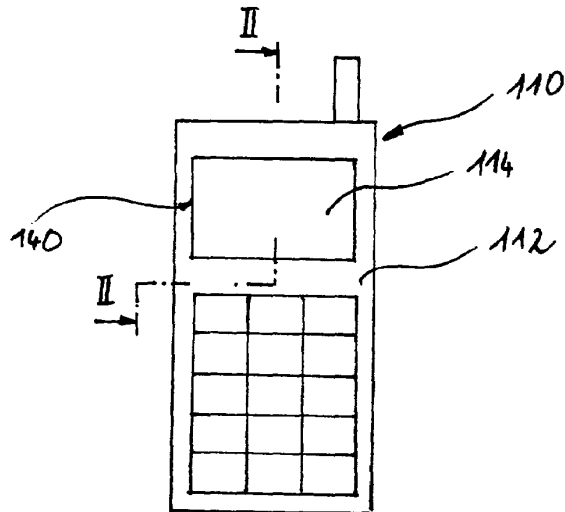
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73 Inhaber:
Siemens AG, 80333 München, DE

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54 Mobile elektronische Vorrichtung mit Anzeige- und Bedienungsorgan

57 Mobile elektronische Vorrichtung (110), insbesondere Mobilfunk-Endgerät, schnurloses Telefon, Organizer oder dergleichen, umfassend:
– ein Gehäuse (112) und
– ein Anzeige- und Bedienungsorgan (140; 240, 340; 440) zum Anzeigen von Informationen und zum Bedienen der mobilen elektronischen Vorrichtung (110), wobei das Anzeige- und Bedienungsorgan (140; 240; 340; 440) ein flächiges im wesentlichen formstabiles Anzeigefeld (114) umfasst, wobei weiter die Oberfläche (142; 242; 342; 442) des Anzeigefeldes (114) relativ zu dem Gehäuse (112) der mobilen elektronischen Vorrichtung (110) um wenigstens eine Kippachse (144, 146; 250, 252; 344, 346, 350, 352; 444) aus einer Ausgangsstellung heraus in wenigstens eine Verkippsstellung verkippsbar ist und wobei durch Verkippen der Oberfläche (142; 242; 342; 442) in die wenigstens eine Verkippsstellung eine der wenigstens einen Verkippsstellung zugeordnete Bedienfunktion der mobilen elektronischen Vorrichtung (110) aktivierbar ist.



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Beschreibung

Mobile elektronische Vorrichtung mit Anzeige- und Bedienungs-
5 organ

Die vorliegende Erfindung betrifft eine mobile elektronische
Vorrichtung, insbesondere ein Mobilfunk-Endgerät, ein schnur-
loses Telefon, einen Organizer oder dergleichen.

10

Mobile elektronische Vorrichtungen werden zunehmend mit immer
mehr Funktionen und Leistungsmerkmalen ausgestattet. Um einem
Benutzer einer mobilen elektronischen Vorrichtung eine beque-
me Nutzung der angebotenen Funktionen und Leistungsmerkmale
15 zu ermöglichen, ist in der Regel eine menügesteuerte Benut-
zerführung in der mobilen elektronischen Vorrichtung imple-
mentiert. Zur Steuerung durch ein solches Bedienungs-menü wer-
den auf einem Anzeigefeld der mobilen elektronischen Vorrich-
tung bestimmte zur Auswahl stehende Menüpunkte mit sogenann-
20 ten Softkey-Labels angezeigt und mit separaten zugeordneten
Bedienungstasten, sogenannten Softkeys, ausgewählt.

Eine entsprechende Lösung nach dem Stand der Technik ist zur
Veranschaulichung in Fig. 7 dargestellt, welche einen Aus-
schnitt einer fotografischen Darstellung eines herkömmlichen,
25 allgemein mit 10 bezeichneten Mobilfunk-Endgeräts zeigt. Die-
ses umfaßt ein Gehäuse 12, an welchem ein Anzeigefeld (Dis-
play) 14 befestigt ist. In dem Anzeigefeld 14 sind verschie-
dene Bedienungsfunktionen dargestellt, nämlich die mit 16 be-
30 zeichnete Bedienungsfunktion „Network“, die mit 18 bezeichne-
te Bedienungsfunktion „Internetbrowser“ und die mit 20 be-
zeichnete Bedienungsfunktion „Organizer“. Zur Auswahl einer
einzelnen Bedienungsfunktionen muß ein in der Software des
Mobilfunk-Endgeräts 10 implementierter Auswahlrahmen 22 in
35 einer die Bedienungsfunktionen 16,18,20 umfassenden Liste in
Richtung nach oben oder nach unten bewegt werden, entspre-
chend den in dem Anzeigefeld 14 durch die als Softkey-Label

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dargestellten Pfeilen 24,26. Umrahmt der Auswahlrahmen 22 die gewünschte Bedienungsfunktion, so kann diese ausgewählt werden.

- 5 Die Bewegung des Auswahlrahmens 22 in Richtung der Softkey-Label-Pfeile 24,26 erfolgt durch eine Wipp-Taste 28, welche um eine Kippachse 30 aus einer Ausgangsstellung heraus ver-
 10 kippbar ist. Wird beispielsweise das auf der rechten Seite der Kippachse 30 liegenden Ende der Wipp-Taste 28 niedergedrückt, so bewegt sich der Auswahlrahmen 22 entsprechend dem Pfeil 26 innerhalb der die Bedienungsfunktionen 16 - 18 um-
 15 fassenden Liste nach unten. Wird hingegen das bezüglich der Kippachse linke Ende der Wipp-Taste 28 niedergedrückt, so bewegt sich der Auswahlrahmen 22 innerhalb der Liste nach oben.
 20 Zur Auswahl einer der Bedienungsfunktionen 16,18,20 kann eine weitere Wipp-Taste 32 niedergedrückt werden, deren zugeordnete Funktion durch den Softkey-Label 34 mit „Auswahl“ bezeichnet ist. Zur Anzeige und Auswahl einzelner Bedienungsfunktionen aus der menügesteuerten Benutzerführung des Mobilfunk-
 25 Endgeräts 10 sind bei dem Stand der Technik nach Fig. 7 demzufolge sowohl die Wipp-Tasten 28 und 32 als auch diesen zugeordnete Softkey-Labels 24, 26 und 32 erforderlich.

- 25 Aufgrund der wachsenden Zahl der bei mobilen elektronischen Vorrichtungen jüngerer Generation zur Verfügung gestellten Bedienungsfunktionen wirft die vorstehend geschilderte Lösung gemäß dem Stand der Technik mit Softkey-Labels und diesen zugeordneten Bedienungstasten die folgenden Probleme auf: das
 30 Erfordernis, für die Anzeige und die Bedienung der menügesteuerten Benutzerführung für die einzelnen Bedienungsfunktionen sowohl auf dem Anzeigefeld in Form eines Softkey-Labels als auch auf einem Bedienungsfeld in Form von Bedienungstasten doppelt Raum zur Verfügung zu stellen, läuft der
 35 Entwicklung zur Miniaturisierung der mobilen elektronischen Vorrichtung entgegen. Darüberhinaus können aus Platzgründen nur eine begrenzte Anzahl von Softkey-Label- und Tasten-Kombinationen an einer mobilen elektronischen Vorrichtung zur

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Verfügung gestellt werden. Bietet jedoch eine bestimmte Ebene der menügesteuerten Benutzerführung eine Vielzahl von Optionen zur Auswahl an, so ist es erforderlich die Auswahl mit den wenigen zur Verfügung stehenden Softkey-Label- und Tasten-Kombinationen durchzuführen, was in einer unkomfortablen Bedienung der mobilen elektronischen Vorrichtung resultieren kann.

Ferner sind aus dem Stand der Technik mobile elektronische Vorrichtungen, insbesondere Organizer oder portable Datenbanken bekannt, welche über ein durch Druckbetätigung aktivierbares Display, einen sogenannten Touchscreen verfügen. Auf einem derartigen Touchscreen sind einzelne Bedienungsfunktionen einer menügesteuerten Benutzerführung angezeigt, welche durch Druckbetätigung mittels eines Fingers oder eines gesondert dafür vorgesehenen Stifts aktiviert werden können. Derartige Touchscreens sind jedoch in der Herstellung sehr kostenintensiv und besitzen aufgrund der durch die Druckbetätigung verursachten mechanischen Belastung verhältnismäßig kurze Lebensdauer. Darüberhinaus ergibt sich bei kleindimensionierten Touchscreens, insbesondere im Falle von mehreren gleichzeitig angezeigten und zur Auswahl stehenden Bedienungsfunktionen das Problem einer unerwünschten Fehlausewahl einer Bedienungsfunktion, da bei einer unpräzisen Touchscreenbetätigung der einer anderen nicht zur Auswahl vorgesehenen Bedienungsfunktion zugeordneten Touchscreenbereich ansprechen kann.

Es ist demgegenüber Aufgabe der vorliegenden Erfindung, eine mobile elektronische Vorrichtung bereitzustellen, bei welcher die Auswahl einzelner Bedienungsfunktionen einer menügesteuerten Benutzerführung mit einfachen und kostengünstigen Mitteln komfortabel und benutzerfreundlich ausführbar ist.

Diese Aufgabe wird erfindungsgemäß durch eine mobile elektronische Vorrichtung, insbesondere ein Mobilfunk-Endgerät, ein schnurloses Telefon, einen Organizer oder dergleichen gelöst,

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welche Vorrichtung ein Gehäuse und ein Anzeige- und Bedie-
nungsorgan zum Anzeigen von Informationen und zum Bedienen
der mobilen elektronischen Vorrichtung umfaßt, wobei das An-
zeige- und Bedienungsorgan ein flächiges, im wesentlichen
5 formstabile Anzeigefeld umfaßt, wobei weiter die Oberfläche
des Anzeigefeldes relativ zu dem Gehäuse der elektronischen
Vorrichtung um wenigstens eine Kippachse aus einer Ausgangs-
stellung heraus in wenigstens eine Verkippstellung verkippbar
ist und wobei durch Verkappen der Oberfläche in die wenig-
10 stens eine Verkippstellung eine der wenigstens einen Verkipp-
stellung zugeordnete Bedienungsfunktion der mobilen elektro-
nischen Vorrichtung aktivierbar ist.

Erfindungsgemäß dient der Anzeige und der Bedienung der menü-
15 gesteuerten Benutzerführung der mobilen elektronischen Vor-
richtung ein einziges Anzeige- und Bedienungsorgan, welches
die Anzeige der einzelnen Bedienungsfunktionen und deren Ak-
tivierung kombiniert. Die einzelnen Bedienungsfunktionen wer-
den, wie aus dem Stand der Technik bekannt, auf dem Anzeige-
20 feld, beispielsweise in dessen Eckpunkten, angezeigt. Zur
Auswahl einer der Bedienungsfunktionen wird dann das Anzeige-
und Bedienungsorgan aus seiner Ausgangsstellung heraus in ei-
ne der auszuwählenden Bedienungsfunktion zugeordnete Verkipp-
stellung gebracht und dadurch die Bedienungsfunktion akti-
25 viert. Es ist somit nicht mehr erforderlich, zusätzlich zu
der Fläche für die Softkey-Labels, welche zur Darstellung der
einzelnen zur Auswahl stehenden Bedienungsfunktionen erfor-
derlich sind, auch noch die Fläche von gesondert ausgebilde-
ten, den Softkey-Labels zugeordneten Bedienungstasten zur
30 Verfügung zu stellen. Dieser Raum kann somit anderweitig ge-
nutzt werden bzw. durch Miniaturisierung der mobilen elektro-
nischen Vorrichtung eingespart werden.

Ferner zeigt die erfindungsgemäße elektronische Vorrichtung
35 mit ihrem kombinierten Anzeige- und Bedienungsorgan nicht die
eingangs erläuterten Nachteile von Touchscreen-Lösungen, da
die Oberfläche des Anzeigefeldes in definierte Verkippstel-

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lungen gebracht werden kann und dadurch definiert und mit deutlich herabgesetzter Fehlerrate die einzelnen Bedienungsfunktionen ausgewählt werden können. Es ist allein erforderlich, das Erreichen der jeweiligen Verkippstellung zu erfassen, beispielsweise durch einen oder mehrere elektrische Kontakte, welcher bzw. welche bei Erreichen der Verkippstellung geschlossen wird bzw. werden und in der Ausgangsstellung geöffnet ist bzw. sind. Es sei ergänzt, daß gleichermaßen zur Lagerfassung der Oberfläche, statt Kontakten, Drucksensoren, Näherungsschalter oder dergleichen verwendet werden können.

Aufgrund der formstabilen Ausgestaltung des Anzeigefeldes ist das Anzeige- und Bedienungsorgan ferner unempfindlich gegenüber den bei der Bedienung auftretenden mechanischen Belastungen, so daß auch eine hinreichend lange Lebensdauer gewährleistet ist.

Hinsichtlich der konstruktiven Gestaltung der Oberfläche des Anzeigefeldes kann vorgesehen sein, daß diese im wesentlichen planar ausgebildet ist. Dadurch läßt sich die Anzeige der erfindungsgemäßen Vorrichtung einfach ablesen. Darüberhinaus führt die planare Ausbildung der Oberfläche des Anzeigefeldes zu einem ansprechenden äußeren Erscheinungsbild der mobilen elektronischen Vorrichtung.

In einer Gestaltungsvariante der Erfindung kann vorgesehen sein, daß die Oberfläche um zwei Kippachsen verkippbar ist, welche sich vorzugsweise im Bereich des Anzeigefeldes kreuzen. Dadurch ist es möglich, vier Verkippstellungen bereitzustellen und damit insgesamt vier Bedienungsfunktionen zur Auswahl zur Verfügung zu stellen. Die Oberfläche des Anzeigefeldes kann bei einer derartigen Ausgestaltung um jede der Kippachsen ausgehend von einer Ausgangsstellung - in Richtung der jeweiligen Kippachse betrachtet - im Uhrzeigersinn oder im Gegen-Uhrzeigersinn in eine jeweilige Verkippstellung verkippt werden. Durch die Anordnung des Kreuzungspunkts der Kippachsen im Bereich des Anzeigefelds wird die Ergonomie des

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Anzeige- und Bedienungsorgans und damit der Bedienung der mobilen elektronischen Vorrichtung weiter verbessert. So ist es nämlich möglich, daß ein Benutzer der mobilen elektronischen Vorrichtung seinen Daumen etwa im Bereich des Kreuzungspunktes der Kippachsen auf der Oberfläche positioniert und durch leichte Abrollbewegungen des Daumens auf der Oberfläche diese in bestimmte Verkippstellungen bringt, um somit eine der jeweils hergestellten Verkippstellung zugeordnete Bedienungsfunktion auszuwählen. In diesem Zusammenhang kann weiter vorgesehen sein, daß die Kippachsen im wesentlichen orthogonal zueinander verlaufen. Greift man wieder das Beispiel der Bedienung des Anzeige- und Bedienungsorgans mit einem Daumen auf, so muß die Bedienungsperson ihren Daumen auf der Oberfläche lediglich in vier jeweils um 90° zueinander winkelfer-setzte Richtungen bewegen, wodurch eine einfache Bedienung der mobilen elektronischen Vorrichtung mit geringer Fehlerrate möglich wird.

Alternativ zu einer um zwei Kippachsen verkippbaren Oberfläche kann erfindungsgemäß weiter vorgesehen sein, daß die Oberfläche um vier Kippachsen verkippbar ist, welche sich vorzugsweise in einem gemeinsamen Punkt, vorzugsweise im Bereich des Anzeigefeldes kreuzen. Durch eine derartige Ausgestaltung der erfindungsgemäßen mobilen elektronischen Vorrichtung lassen sich insgesamt acht Verkippstellungen realisieren - zwei je Kippachse, so daß ein Benutzer aus acht verschiedenen Bedienungsfunktionen der menügesteuerten Benutzerführung auswählen kann. Kreuzen sich alle vier Kippachsen in einem gemeinsamen Punkt und liegt dieser gemeinsame Kreuzungspunkt im Bereich des Anzeigefeldes, so gilt das vorstehend mit Bezug auf die um zwei Kippachsen verkippbare Oberfläche gesagte: Ein Benutzer kann das Anzeige- und Bedienungsorgan einfach und bequem durch Positionierung seines Daumens im Bereich des Kreuzungspunkts auf der Oberfläche bedienen, indem er mit seinem Daumen Abrollbewegungen um die jeweilige Kippachse zu der angestrebten Verkippstellung ausführt. Ein konstruktiv vorteilhafter und bedienungsfreundli-

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cher Aufbau ergibt sich beispielsweise dann, wenn wenigstens zwei, vorzugsweise alle vier Kippachsen paarweise orthogonal zueinander verlaufen.

- 5 Um die Ergonomie des Anzeige- und Bedienungsorgans weiter zu erhöhen, kann erfindungsgemäß vorgesehen sein, daß sich die Kippachsen im wesentlichen im Flächenschwerpunkt der Oberfläche kreuzen. Greift man wiederum den vorstehend geschilderten Fall auf, daß ein Benutzer das Anzeige- und Bedienungsorgan
10 mit seinem Daumen bedient, so legt dieser für eine einfache Bedienung seinen Daumen in den Bereich des Flächenschwerpunktes der Oberfläche und führt dann entsprechend der von ihm gewünschten auszuwählenden Bedienungsfunktionen Abrollbewegungen mit dem Daumen durch. Bei Anordnung des Kreuzungspunkts der Kippachsen im Bereich des Flächenschwerpunktes der
15 Oberfläche kommt es zu einer gleichmäßigen Druckbelastung der Oberfläche und der Aktivteile des Anzeige- und Bedienungsorgans, wodurch die Lebensdauer verlängert wird.
- 20 In einer Weiterbildung der Erfindung kann vorgesehen sein, daß die Oberfläche im wesentlichen rechteckige oder quadratische Form aufweist und daß die wenigstens eine Kippachse durch die Eckpunkte oder/und durch die Seitenmittelpunkte der Oberfläche verläuft. Gleichermäßen ist es jedoch auch mög-
25 lich, der Oberfläche eine runde, beispielsweise kreisrunde oder elliptische, Form zu verleihen und die wenigstens eine Kippachse beispielsweise parallel zu einer Längsachse der mobilen elektronischen Vorrichtung oder/und parallel zu einer Querachse der mobilen elektronischen Vorrichtung anzuordnen.
- 30 Um die Bedienung des Anzeige- und Bedienungsorgans zu erleichtern und um die Wahrscheinlichkeit einer Fehlauswahl von Bedienungsfunktionen möglichst gering zu halten, kann erfindungsgemäß weiter vorgesehen sein, daß die Oberfläche des Anzeigefeldes unter Vorspannung in ihrer Ausgangsstellung ge-
35 halten wird. Verkippt man die Oberfläche aus ihrer Ausgangsstellung heraus in die wenigstens eine Verkippstellung, so

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erfolgt dies gegen die Vorspannkraft. Es ist anzumerken, daß die Vorspannkraft verhältnismäßig klein sein kann, so daß beim Verkippen der Oberfläche des Anzeigefeldes aus der Ausgangsstellung heraus ein spürbarer, jedoch geringer Widerstand auftritt, beispielsweise entsprechend dem Widerstand, welcher beim Niederdrücken einer herkömmliche Drucktaste auftritt. Eine derartige Vorspannung der Oberfläche des Anzeigefeldes in ihre Ausgangsstellung führt dazu, daß sich die Oberfläche des Anzeigefeldes nach Verlagerung in die Verkippstellung unter Lösung der Druckbeaufschlagung, beispielsweise durch den Daumen des Benutzers, selbsttätig in ihre Ausgangsstellung zurück bewegt, woraufhin die nächste Bedienungsfunktion ausgewählt werden kann. Es sei jedoch darauf hingewiesen, daß es nicht erforderlich ist, die Oberfläche des Anzeigefeldes nach Aktivierung einer Bedienungsfunktion durch Herbeiführen einer Verkippstellung in die Ausgangsstellung zurückzuführen, um die nächste Bedienungsfunktion zu aktivieren, sondern daß der Benutzer auch ohne Einnehmen der „Zwischenstation“ Ausgangsstellung ausgehend von einer Verkippstellung die Oberfläche des Anzeigefeldes in eine andere Verkippstellung bewegen kann, um die nächste Bedienungsfunktion auszuwählen.

Für eine konstruktive Realisierung eines erfindungsgemäßen Anzeige- und Bedienungsorgans gibt es verschiedene Möglichkeiten. So ist es in einer Ausführungsform der Erfindung möglich, das Anzeigefeld an dem Gehäuse verkippbar zu lagern. Bei Verkippen der Oberfläche des Anzeigefelds ausgehend von der Ausgangsstellung in eine Verkippstellung wird somit das gesamte Anzeigefeld mit der Oberfläche mitverkippt. Alternativ ist es jedoch auch möglich, daß das Anzeigefeld eine die Oberfläche definierende Abdeckung umfaßt, und daß lediglich die Abdeckung verkippbar an dem Gehäuse verkippbar gelagert ist. Bei einer derartigen Gestaltungsvariante kann die eigentliche Anzeigevorrichtung, beispielsweise ein LCD-Display oder dergleichen, fest in dem Gehäuse der mobilen elektronischen Vorrichtung installiert werden. Zur Bedienung, d.h. zur

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Aktivierung einzelner Bedienungsfunktionen muß dann lediglich die verkippbare Abdeckung des Anzeigefeldes in eine entsprechende Verkippstellung gebracht werden. Dies bedeutet, daß lediglich die Abdeckung relativ zu dem Gehäuse verlagert
5 wird.

Um den bei der Bedienung des Anzeige- und Bedienungsorgans auftretenden mechanischen Belastungen gerecht zu werden, kann vorgesehen sein, daß die Abdeckung aus einem transparenten
10 Material, insbesondere aus einem transparenten Kunststoff oder aus Glas hergestellt ist. Bei einer derartigen Materialwahl ist die vorangehend geforderte Formstabilität des Anzeigefeldes, insbesondere der Oberfläche des Anzeigefeldes, gewährleistet.

15 Um zu verhindern, daß in einen Spalt, welcher sich beim Verkippen der Oberfläche des Anzeigefeldes relativ zu dem Gehäuse bildet, Schmutz, Staub, Feuchtigkeit oder dergleichen eintritt, kann in einer Weiterbildung der Erfindung vorgesehen
20 sein, daß das Anzeigefeld und/oder gegebenenfalls die Abdeckung mit dem Gehäuse über eine Dichtung verbunden ist. Die Dichtung kann beispielsweise eine Gummilippe oder eine Silikonichtung sein, welche zwar eine Bewegung der Oberfläche des Anzeigefeldes gemäß vorstehender Beschreibung zuläßt,
25 welche jedoch den bei dieser Bewegung (Verkipfung) entstehenden Spalt unter elastischer Deformation stets geschlossen hält. Die bei der elastischen Deformation der Dichtung zu überwindenden Kräfte können die vorstehend angesprochene Vorspannung der Oberfläche in ihre Ausgangsstellung bewirken
30 oder unterstützen.

Die Erfindung betrifft ferner ein Anzeige- und Bedienungsorgan für eine mobile elektronische Vorrichtung, insbesondere ein Mobilfunk-Endgerät, ein schnurloses Telefon, einen Organizer oder dergleichen, zum Anzeigen von Informationen und
35 zum Bedienen der mobilen elektronischen Vorrichtung, wobei

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das Anzeige- und Bedienungsorgan mit den Merkmalen gemäß der vorstehenden Beschreibung ausgeführt sein kann.

Im folgenden werden Ausführungsbeispiele der vorliegenden Erfindung anhand der beiliegenden Figuren erläutert. Es stellen
5 dar:

- Figur 1 eine schematische Darstellung eines erfindungsgemäßen Mobilfunk-Endgeräts;
10
- Figur 2 eine Teilschnittansicht des in Fig. 1 gezeigten Mobilfunk-Endgeräts, geschnitten entlang der Schnittlinie II-II aus Fig. 1;
- 15 Figur 3 ein erstes erfindungsgemäßes Ausführungsbeispiel eines Anzeige- und Bedienungsorgan des in Fig. 1 gezeigten Mobilfunk-Endgeräts in schematischer Darstellung;
- 20 Figur 4 ein zweites erfindungsgemäßes Ausführungsbeispiel eines Anzeige- und Bedienungsorgans in schematischer Darstellung;
- Figur 5 ein drittes erfindungsgemäßes Ausführungsbeispiel eines Anzeige- und Bedienungsorgans in schematischer Darstellung;
25
- Figur 6 ein viertes erfindungsgemäßes Ausführungsbeispiel eines Anzeige- und Bedienungsorgans in schematischer Darstellung und
30
- Figur 7 einen Ausschnitt einer fotografischen Darstellung eines Mobilfunk-Endgeräts nach dem Stand der Technik.
35

In Figur 1 ist ein schematisch dargestelltes erfindungsgemäßes Mobilfunk-Endgerät allgemein mit 110 bezeichnet. Dieses

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umfasst ein Gehäuse 112, an welchem ein im wesentlichen rechteckig ausgebildetes Anzeige- und Bedienungsorgan 140 vorgesehen ist. Das Anzeige- und Bedienungsorgan 140 umfasst ein Anzeigefeld 114, welches mit einem nicht näher dargestellten LCD-Schirm versehen ist, zur Anzeige von Informationen und Bedienungsfunktionen des Mobilfunk-Endgeräts 110.

Wie aus der Teilschnittansicht gemäß Fig. 2 ersichtlich, ist das Anzeige und Bedienungsorgan 140 mit einer Abdeckplatte 136 versehen, deren Oberfläche 142 der Außenumgebung des Mobilfunk-Endgeräts 110 dargeboten ist. Die Abdeckplatte 136 ist über eine umlaufende Silikondichtung 138 dichtend mit dem Gehäuse 112 verbunden und um eine Kippachse 144 verkippt an diesem gelagert. Durch Druckbeaufschlagung mit einer Druckkraft F von der Oberfläche 142 her läßt sich die Abdeckplatte 136 aus einer in Fig. 2 mit durchgezogenen Linien gezeigten Ausgangsstellung in eine in Fig. 2 strichliert gezeigte Verkippstellung bringen.

Im folgenden werden verschiedene Ausführungsbeispiele verkipptbarer Anzeige- und Bedienungsorgane mit Bezug auf Fig. 3 - 6 erläutert.

Das in Figur 3 schematisch gezeigte Anzeige- und Bedienungsorgan 140 ist um zwei im wesentlichen orthogonale Kippachsen 144 und 146 verkipptbar an dem Gehäuse 112 des Mobilfunk-Endgeräts 110 (siehe Fig. 1 und 2) gelagert. Die Kippachsen 144 und 146 kreuzen sich in dem Kreuzungspunkt K_1 , welcher im wesentlichen mit dem Flächenschwerpunkt der Oberfläche 142 zusammenfällt. Im Bereich der Seitenmitten des Anzeigefeldes werden verschiedene Bedienungsfunktionen angezeigt, dargestellt als „Option 1“, „Option 2“, „Option 3“ und „Option 4“. Verkippt man die Oberfläche 142 um die Kippachse 144, beispielsweise durch Druckbeaufschlagung im Bereich der Darstellung der Bedienungsfunktion „Option 1“, so wird die entsprechenden Bedienungsfunktion aktiviert. Verkippt man hingegen die Oberfläche 142 um die Kippachse 144 in entgegengesetzter

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Richtung, so wird eine Bedienungsfunktion „Option 3“ aktiviert. Ein Verkippen der Oberfläche 142 um die Kippachse 146 bewirkt eine Aktivierung der Bedienungsfunktion „Option 2“ bzw. „Option 4“ je nach Kipprichtung.

5

Figur 3 zeigt, daß mit dem erfindungsgemäßen Anzeige- und Bedienungsorgan 140 einerseits die jeweiligen Bedienungsfunktionen (Optionen) angezeigt werden können und andererseits diese durch Verkippen der Oberfläche 142 aktiviert werden können. Das Anzeigen der Bedienungsfunktionen und die Aktivierung derselben wird also in ein und demselben Organ 140 kombiniert, wodurch im Gegensatz zu dem Stand der Technik nach Figur 7 die Wipp-Tasten 28 und 32 weggelassen werden können und Bauraum eingespart werden kann.

15

Figur 4 zeigt schematisch ein zweites Ausführungsbeispiel eines erfindungsgemäßen Anzeige- und Bedienungsorgans 240, welches an dem Mobilfunk-Endgerät 110 nach Fig. 1 vorgesehen sein kann. Der Unterschied zu dem Anzeige- und Bedienungsorgan 140 gemäß dem ersten Ausführungsbeispiel der Erfindung nach Figur 3 liegt lediglich darin, daß Kippachsen 250 und 252 nicht mehr durch die Seitenmitten des rechteckigen Anzeige- und Bedienungsorgans 240, sondern durch dessen Eckpunkte, d.h. diagonal, verlaufen. Die Kippachsen 244 und 246 kreuzen sich in dem Kreuzungspunkt K_2 , welcher im wesentlichen mit dem Flächenschwerpunkt der Oberfläche 242 zusammenfällt. Ein Verkippen der Oberfläche 242 des Anzeige- und Bedienungsorgans 240 um die Kippachse 250 bewirkt eine Aktivierung der Bedienungsfunktionen „Option 2“ oder „Option 3“. Entsprechend bewirkt ein Verkippen der Oberfläche 242 des Anzeige- und Bedienungsorgans 240 um die Kippachse 252 eine Aktivierung der Bedienungsfunktionen „Option 1“ oder „Option 4“.

In Figur 5 ist ein drittes Ausführungsbeispiel eines erfindungsgemäßen Anzeige- und Bedienungsorgans 340 gezeigt, welches an dem Mobilfunk-Endgerät 110 nach Fig. 1 vorgesehen sein kann. Diesem Anzeige- und Bedienungsorgan 340 sind ins-

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gesamt acht Bedienungsfunktionen „01“ bis „08“ zugeordnet. Um jede der in dem Anzeige- und Bedienungsorgan 340 angezeigten Bedienungsfunktionen „01“ bis „08“ zu aktivieren, ist es erforderlich, durch Verkippen der Oberfläche 342 jeweils eine

5 von acht entsprechenden Verkippstellungen anzusteuern. Dies wird dadurch erreicht, daß das Anzeige- und Bedienungsorgan 340 sowohl um die Horizontalachse 344, als auch um die Vertikalachse 346, als auch um die Diagonalachse 350, als auch um die zweite Diagonalachse 352 verkippbar an dem nicht darge-

10 stellten Gehäuse gelagert ist. Die vier Kippachsen 344, 346, 350 und 352 kreuzen sich allesamt in dem selben Kreuzungspunkt K_3 , welcher mit dem Flächenschwerpunkt der Oberfläche 342 im wesentlichen zusammenfällt.

15 Entsprechend dem ersten und zweiten Ausführungsbeispiel nach Figuren 3 und 4 werden bei dem dritten Ausführungsbeispiel gemäß Figur 5 die Bedienungsfunktionen „07“ und „02“ durch Verkippen der Oberfläche 342 um die Achse „344“, die Bedienungsfunktionen „05“ und „04“ durch Verkippen der Oberfläche

20 342 um die Kippachse 346, die Bedienungsfunktionen „06“ und „03“ durch Verkippen der Oberfläche 342 um die Kippachse 352 und schließlich die Bedienungsfunktionen „08“ und „01“ durch Verkippen um die Kippachse 350 aktiviert.

25 Schließlich zeigt Fig. 6 ein viertes erfindungsgemäßes Ausführungsbeispiel. In Fig. 6 ist schematisch ein Anzeigefeld 440 dargestellt, auf welchem verschiedene Bedienungsfunktionen „Listeneintrag 1“, „Listeneintrag 2“ und „Listeneintrag 3“ in einer listenartigen Struktur abgebildet sind. Bei-

30 spielsweise repräsentiert jede Bedienungsfunktion einen Eintrag in einem Telefonbuch, durch welches listenartige Telefonbuch geblättert werden kann. Dies erfolgt durch Verkippen der Oberfläche 432 um die Kippachse 444. Verkippt man beispielsweise die Oberfläche 432 des Anzeige- und Bedienungsorgans 440 um die Kippachse 444 derart, daß das Anzeige- und

35 Bedienungsorgan 440 an einem in Figur 6 unteren Rand niedergedrückt wird, so springt die in dem Anzeigefeld angezeigte

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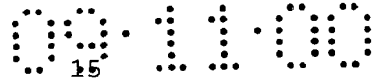
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Liste entsprechend den in Figur 6 strichliert gezeigten Pfeilen weiter, so daß am unteren Rand des Anzeige- und Bedienungsorgans 440 als nächstes der strichliert dargestellte Listeneintrag erscheint und der Listeneintrag 1 von der Anzeige verschwindet. Es läßt sich durch jeweiliges Verkippen der Oberfläche 432 um die Kippachse 444 durch die Liste blättern (scrollen).

Wie vorstehend mit Bezug auf Figuren 1 bis 6 erläutert, werden die jeweiligen Bedienungsfunktionen des Mobilfunk-Endgeräts durch Verkippen der Oberfläche des Anzeige- und Bedienungsorgans aktiviert. Den Anzeige- und Bedienungsorganen gemäß Figuren 1 bis 3 sind jeweils mehrere Kippachsen zugeordnet, welche sich jeweils in den Flächenschwerpunkten K_1 , K_2 und K_3 schneiden. Zur Bedienung der jeweiligen Anzeige- und Bedienungsorgane kann ein Benutzer einen Finger, beispielsweise seinen Daumen im Bereich der Flächenschwerpunkte K_1 , K_2 oder K_3 positionieren und durch Abrollbewegungen in Richtung zu den jeweiligen auszuwählenden Optionen die Oberfläche des Anzeige- und Bedienungsorgans verkippen. Dadurch ist eine komfortable und benutzerfreundliche Bedienung möglich.

Die vorstehend beschriebenen Ausführungsbeispiele zielen allesamt auf die erfindungsgemäße Gestaltung eines Mobilfunk-Endgeräts ab. Es sei jedoch abschließend darauf hingewiesen, daß die Erfindung gleichermaßen bei jeglicher elektronischer Vorrichtung Anwendung finden kann, also beispielsweise auch bei schnurlosen Telefonen, Organizern oder dergleichen.

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Bezugszeichenliste

Stand der Technik (Fig. 7):

5	10	Mobilfunk-Endgerät
	12	Gehäuse
	14	Anzeigefeld
	16	Bedienungsfunktion „Network“
	18	Bedienungsfunktion „Internetbrowser“
10	20	Bedienungsfunktion „Organizer“
	22	Auswahlrahmen
	24,26	Pfeil - Anzeigebereich
	28	Wipp-Taste
	30	Kippachse
15	32	Wipp-Taste
	34	Auswahl-Anzeigebereich

Erfindung (Fig. 1-6)

	110	Mobilfunk-Endgerät
20	112	Gehäuse
	114	Anzeigefeld
	136	Abdeckplatte
	138	Dichtung
	140	Anzeige- und Bedienungsorgan (1. Ausführungsbeispiel)
25		
	142	Oberfläche
	144	Kippachse
	146	Kippachse
	K ₁	Kreuzungspunkt
30		
	240	Anzeige- und Bedienungsorgan (2. Ausführungsbeispiel)
	242	Oberfläche
	250	Kippachse
35	252	Kippachse
	K ₂	Kreuzungspunkt

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- 340 Anzeige- und Bedienungsorgan (3. Ausführungsbeispiel)
- 342 Oberfläche
- 344 Kippachse
- 5 346 Kippachse
- 350 Kippachse
- 352 Kippachse
- K₃ Kreuzungspunkt

- 10 440 Anzeige- und Bedienungsorgan (4. Ausführungsbeispiel)
- 442 Oberfläche
- 444 Kippachse

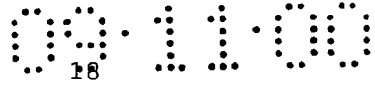
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Schutzansprüche

1. Mobile elektronische Vorrichtung (110), insbesondere Mobilfunk-Endgerät, schnurloses Telefon, Organizer oder dergleichen, umfassend:
 - ein Gehäuse (112) und
 - ein Anzeige- und Bedienungsorgan (140;240;340;440) zum Anzeigen von Informationen und zum Bedienen der mobilen elektronischen Vorrichtung (110),wobei das Anzeige- und Bedienungsorgan (140;240;340;440) ein flächiges im wesentlichen formstabiles Anzeigefeld (114) umfasst, wobei weiter die Oberfläche (142;242;342;442) des Anzeigefeldes (114) relativ zu dem Gehäuse (112) der mobilen elektronischen Vorrichtung (110) um wenigstens eine Kippachse (144, 146; 250, 252; 344,346,350,352;444) aus einer Ausgangsstellung heraus in wenigstens eine Verkippstellung verkippbar ist und wobei durch Verkappen der Oberfläche (142;242;342;442) in die wenigstens eine Verkippstellung zugeordnete Bedienungsfunktion der mobilen elektronischen Vorrichtung (110) aktivierbar ist.
2. Vorrichtung nach Anspruch 1, dadurch gekennzeichnet, dass die Oberfläche (142;242;342;442) im wesentlichen planar ausgebildet ist.
3. Vorrichtung nach Anspruch 1 oder 2, dadurch gekennzeichnet, dass die Oberfläche (142;242) um zwei Kippachsen (144,146;250,252) verkippbar ist, welche sich vorzugsweise im Bereich des Anzeigefeldes (114) kreuzen.
4. Vorrichtung nach Anspruch 3, dadurch gekennzeichnet,

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dass die Kippachsen (144;146) im wesentlichen orthogonal zueinander verlaufen.

5. Vorrichtung nach Anspruch 1 oder 2,
5 dadurch gekennzeichnet,
dass die Oberfläche (342) um vier Kippachsen
(344,346,350,352) verkippbar ist, welche sich vorzugswei-
se in einem gemeinsamen Punkt (K_3) im Bereich des Anzei-
gefeldes (114) kreuzen.
10
6. Vorrichtung nach Anspruch 5,
dadurch gekennzeichnet,
dass wenigstens zwei, vorzugsweise alle vier, Kippachsen
(344,346) paarweise orthogonal zueinander verlaufen.
15
7. Vorrichtung nach einem der Ansprüche 3 - 6,
dadurch gekennzeichnet,
dass sich die Kippachsen (144,146;250,252;344,346,350,
352) im wesentlichen im Flächenschwerpunkt der Oberfläche
20 (142;242;342) kreuzen.
8. Vorrichtung nach einem der vorangehenden Ansprüche,
dadurch gekennzeichnet,
dass die Oberfläche (142;242;342;442) im wesentlichen
25 rechteckige oder quadratische Kontur aufweist und dass
die wenigstens eine Kippachse (144,146;250,252;344,
346,350,352;444) durch die Eckpunkte oder/und durch die
Seitenmittelpunkte der Oberfläche (142;242;342;442) ver-
laufen.
30
9. Vorrichtung nach einem der vorangehenden Ansprüche,
dadurch gekennzeichnet,
dass die Oberfläche (142;242;342;442) unter Vorspannung
35 in ihrer Ausgangsstellung gehalten ist.

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10. Vorrichtung nach einem der vorangehenden Ansprüche,
dadurch gekennzeichnet,
dass das Anzeigefeld (114) an dem Gehäuse (112) verkipp-
bar gelagert ist.
- 5
11. Vorrichtung nach einem der vorangehenden Ansprüche,
dadurch gekennzeichnet,
dass das Anzeigefeld (114) eine die Oberfläche (142) de-
finierende Abdeckung (136) umfasst, und dass lediglich
10 die Abdeckung (136) verkippbar an dem Gehäuse (112) gela-
gert ist.
12. Vorrichtung nach Anspruch 11,
dadurch gekennzeichnet,
15 dass die Abdeckung (136) aus einem transparenten Materi-
al, insbesondere aus einem transparenten Kunststoff oder
aus Glas, hergestellt ist.
- 20 13. Vorrichtung nach einem der vorangehenden Ansprüche,
dadurch gekennzeichnet,
dass das Anzeigefeld (114) oder/und gegebenenfalls die
Abdeckung (136) mit dem Gehäuse (112) über eine Dichtung
(138) dichtend verbunden ist.
- 25
14. Vorrichtung nach einem der vorangehenden Ansprüche,
dadurch gekennzeichnet,
dass das Anzeigefeld (114) einen LCD-Schirm umfasst.
- 30
15. Anzeige- und Bedienungsorgan (140;240;340;440) für eine
mobile elektronische Vorrichtung (110), insbesondere ein
Mobilfunk-Endgerät, ein schnurloses Telefon, einen Orga-
nizer oder dergleichen, zum Anzeigen von Informationen
35 und zum Bedienen der mobilen elektronischen Vorrichtung
(110), wobei das Anzeige- und Bedienungsorgan

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(140;240;340;440) mit den Merkmalen nach einem der voran-
gehenden Ansprüche ausgeführt ist.

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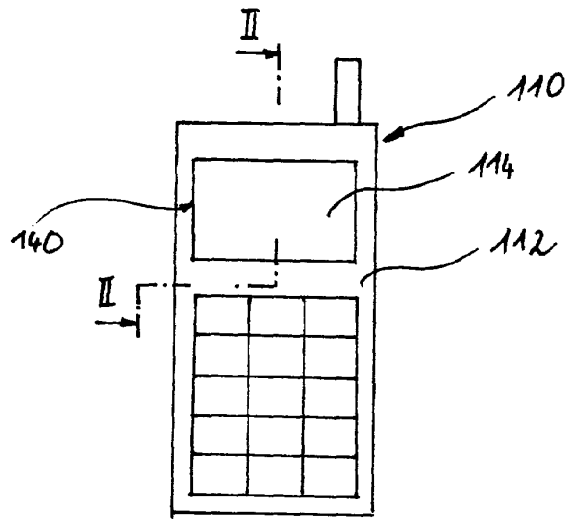


FIG. 1

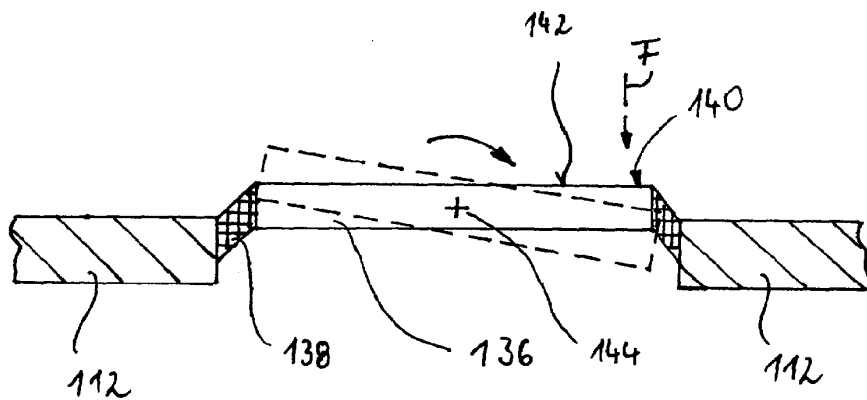


FIG. 2

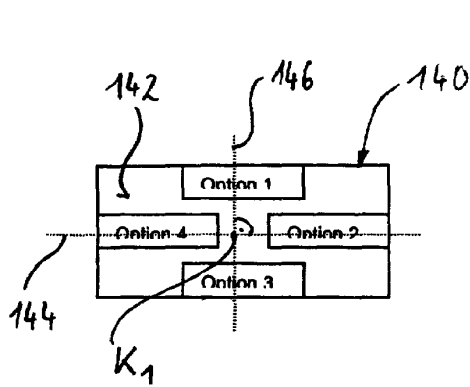


FIG. 3

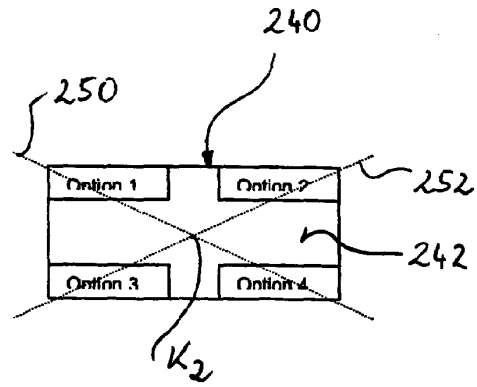


FIG. 4

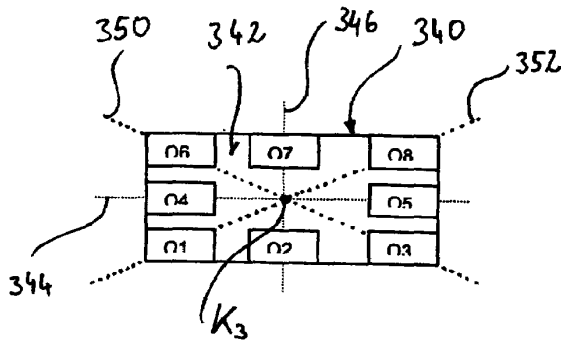


FIG. 5

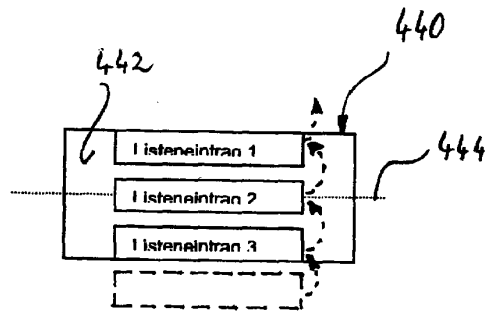


FIG. 6

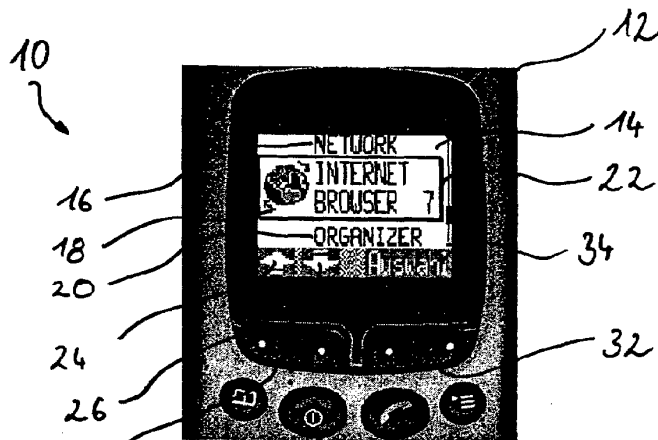


FIG. 7



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(71) Applicant: Xerox Corporation
Rochester, New York 14644 (US)

(72) Inventors:
• Fishkin, Kenneth P.
Redwood City, California 94063 (US)
• Harrison, Beverley L.
Palo Alto, California 94306 (US)

- Mochon, Carlos
Boston, Massachusetts 02215 (US)
- Want, Roy
Los Altos, California 94024 (US)
- Chang, Bay-Wei
Foster City, California 94404 (US)
- Igarashi, Takeo
Chigasaki-shi, Kanagawa-ken, 253-0025 (JP)
- Mackinlay, Jock D.
Palo Alto, California 94303 (US)
- Zellweger, Polle T.
Palo Alto, California 94303 (US)
- Adler, Annette M.
Palo Alto, California 94301 (US)
- Howard, Matthew E.
San Francisco, California 94114 (US)

(74) Representative: Walker, Antony James Alexander
W.P. Thomson & Co.,
Coopers Building,
Church Street
Liverpool L1 3AB (GB)

(54) A computer user interface using a manipulatory grammar

(57) A method for inputting information to a device connected to a deformable piece includes the steps of manipulating the deformable piece to provide a first morpheme input to the device. The first morpheme input normally triggers a first default action by the device, such as controlling a display, modifying a data structure, or communicating with another electronic device. When a user asynchronously manipulates the deformable piece to provide a second morpheme input to the device, the second morpheme input converts the normally triggered first default action to a second action generally not equivalent to the first default action. This mode of interaction allows formation of morphemic sentences to control a graspable device.

The method is implemented by a device (10) supporting a manipulatable user interface, the device com-

prising:

a feedback module (33) for presenting information related to a data structure,
a processor (24) for controlling the feedback module (33) and the data structure, and
a deformable piece (20) including multiple subregions. The deformable piece is attached in a vicinity to the feedback module (33), with the deformable piece contacting at least one sensor (22) that monitors positional changes within multiple subregions of the deformable piece (20). The at least one sensor (22) is connected to the processor (24).

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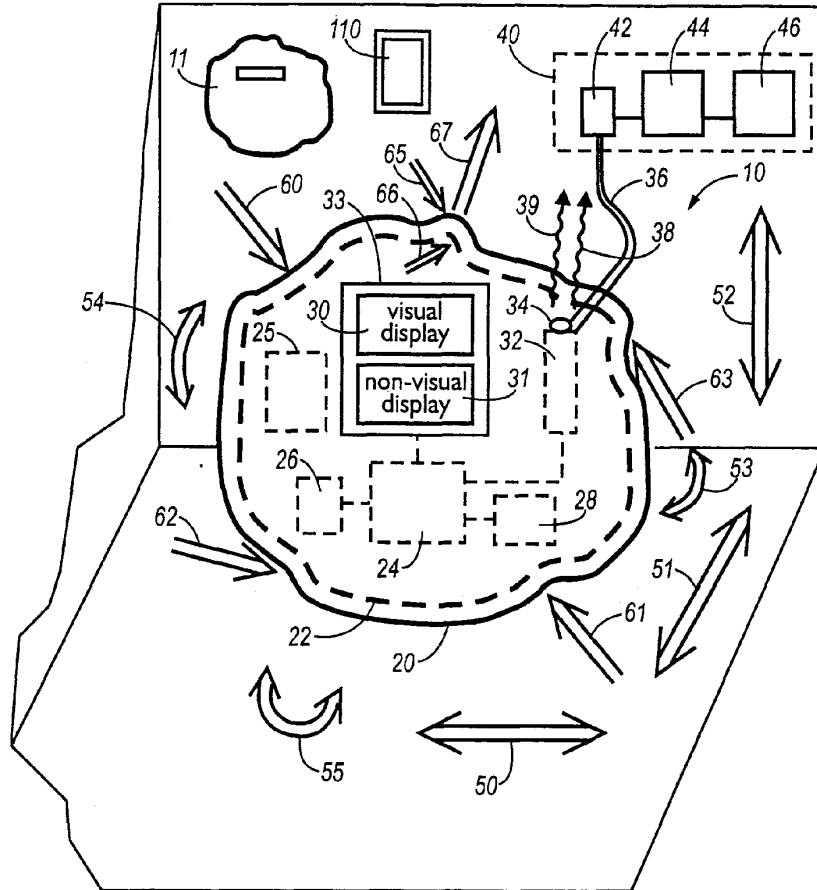


Fig. 1

Description

[0001] Reliably, quickly, and intuitively transmitting complex commands to small portable computers can be difficult. Small computer devices do not generally have sufficient computer processing power to respond reliably to voice or handwritten (pen based) commands, keyboards are often absent or too small for accurate finger input, and conventional buttons are too large or support too limited a command instruction set. User interface techniques that rely on bulky external modules (full size infrared linked keyboards, tethered data gloves, or camera based gestural recognition equipment, for example) are expensive, often not readily available outside selected sites, and probably too awkward for widespread use in conjunction with consumer level portable computing devices.

[0002] User interface designers for portable computers have attempted to compensate for some of these problems by constructing devices that rely on various spatial, positional, or environmental cues that manually or automatically allow for activation of various modes in the device. For example, some laptop computers use the action of opening/closing the lid to initiate automatic bootup/powerdown of the computer without requiring any additional signal input (e.g. such as depressing a "start" button or typing "l_o_g_o_n" on a keyboard) from a user. Alternatively, the use of small portable computers that automatically switch control modes depending on position, orientation, or room location have been investigated. Buttonless manual control of a portable computer through deliberate user actions such as tilting the portable computer have also been described.

[0003] However, all these solutions for interfacing with small portable computers have generally been limited in scope and functionality. What is needed is a user interface system suitable for even very small portable computers (having volumetric dimensions on the order of a one cubic centimeter) that is powerful, can be intuitively operated by an ordinary user with little training, and is still readily capable of modification or extension by the user. The present invention meets these requirements by providing a manipulatory user interface that responds to a user twisting, folding, bending, squeezing, shaking, tilting, spinning, lifting, or otherwise physically manipulating the computer.

[0004] In the manipulatory user interface system of the present invention, the most basic level of manipulation is known as a "senseme". A senseme is defined as a single indivisible type of physical manipulation. A partial list of categories of sensemes include material transformations such as squeezing, twisting, stretching; local spatial transformations such as translation, rotation, orbiting; and environmental transformations based on temperature, light level, or vibration. For example, a small portable computer may support a deformable piece having multiple embedded sensors that detect folding, twisting, or bending of the deformable piece by

a user. This computer can also contain a number of accelerometers that sense relative spatial information; gyroscopic, radio or infrared positional sensors for determining absolute position; and various thermal or photo-sensors that respectively detect temperature and light level changes. Intentional or unintentional modifications detected by one or more of these sensor systems can provide the basis for a powerful user interface scheme.

[0005] As will be appreciated, each senseme category contains many individually distinguishable members. For example, consider the category of senseme known as a "pinch"; a structural transformation generally completed by a user squeezing the deformable piece between a forefinger and thumb. A pinch can be modified by varying its speed (quick or slow pinch), magnitude/intensity (light or hard pinch), portion of deformable piece pinched (top, bottom, or center of deformable piece pinched), or even portion of body used to pinch (right handed pinch or left handed pinch), with each modification being distinguishable as a senseme capable of being mapped onto a computer control command.

[0006] Although the wide variety of easily distinguishable sensemes would alone provide a powerful user interface to a computer, the present invention further extends the flexibility of the senseme based user interface by supporting computer control based on a "morpheme" input. The morpheme is a temporally synchronous (or overlapping asynchronous) tuple of one or more sensemes. Note that a morpheme can (and often will) contain more than one senseme. The sensemes combined into a morpheme can come either from the same category (the user pinches with a right hand while tapping with a left hand finger), or different categories (the user pinches the deformable piece with a right hand while modifying the spatial position of the portable computer by tilting it forward).

[0007] Any morpheme can in turn be extended by participation in a "sentence". A sentence is defined as a sequence of one or more temporally disjoint morphemes. The sentence level allows definition of a physical manipulatory grammar by appropriate choice of morpheme sequence, and corollary rules governing, for example, use of active (verb like) morphemes, naming (noun) morphemes, or connectors. Other possible grammar constructs used in sentences may include those based on "home" systems. Home systems are general-purpose gestural languages, whose grammar and syntax are not borrowed in any way from a host language. Examples of these languages are gestural languages developed by deaf children of hearing parents who have not been exposed to American Sign Language (ASL), and the "plains talk" of North American Indians, which was used as a trade language.

[0008] Accordingly, a first aspect of the present invention provides a method for inputting information to a computer connected to a deformable piece that can be manipulated, and optionally to various position sensors (both relative and absolute), pressure sensors, thermal

sensors, or even light sensors. The method comprises the steps of manipulating the deformable piece to provide a first morpheme input to the computer, with the first morpheme input normally triggering a first default action by the computer. The deformable piece may also be manipulated to provide a second morpheme input to the computer, with the second morpheme input converting the normally triggered first default action to a second action. The first and second morphemes (and any subsequent morphemes) together form a sentence that can be interpreted as a command to implement a computer controlled action, whether it be to unlock an electronically controlled door, display a graphical image on a computer display, or begin logging on to a computer network. Advantageously, such a user interface system is well suited for interaction with small computer devices, and may even be cross-cultural to a limited extent, with ability to squeeze or pinch being universal human attributes.

[0009] According to a second aspect of the present invention there is provided a device supporting a manipulatable user interface, the device comprising:

a feedback module for presenting information related to a data structure,
 a processor for controlling the feedback module and the data structure, and
 a deformable piece including multiple subregions, the deformable piece attached in a vicinity to the feedback module, with the deformable piece contacting at least one sensor that monitors positional changes within multiple subregions of the deformable piece, the at least one sensor being connected to the processor.

[0010] According to a third aspect of the present invention there is provided a device supporting a manipulatable user interface, the device comprising:

a processor and memory, and
 a deformable piece including multiple subregions, the deformable piece attached in a vicinity to the processor and memory, with the deformable piece contacting a sensor mesh that monitors positional changes within multiple subregions of the deformable piece, the sensor mesh being connected to the processor.

[0011] According to a fourth aspect of the present invention there is provided a device supporting a manipulatable user interface, the device comprising:

a feedback module for presenting information related to a data structure,
 a processor for controlling the feedback module and the data structure, and
 a detector for determining handedness of a user, the detector being connected to the processor for

modifying the displayed data structure based on handedness of a user.

[0012] According to a fifth aspect of the present invention there is provided a method for inputting information to a device connected to a deformable piece, the method comprising the steps of:

spatially rotating device to provide a first morpheme input to the device, the first morpheme input normally triggering a first default action by the device, and
 asynchronously manipulating the deformable piece to provide a second morpheme input to the device, with the second morpheme input converting the normally triggered first default action to a second action.

[0013] According to a sixth aspect of the present invention there is provided a plurality of tileable devices for transferring data, comprising:

a first device having a processor and a first wireless communication module for transferring data,
 a second device having a processor and a second wireless communication module for transferring data,
 a third device having a processor and a third wireless communication module for transferring data, wherein the first device is connected in substantially simultaneous wireless communication with the second device and the third device to pass data based on spatial positions of the respective first device, second device and third device.

[0014] The present invention is particularly useful for portable computers that can be held in the palm of a hand. If the portable computer is partially or completely surrounded with a deformable material having embedded or contact pressure/deformation sensors, a user is able to gesture with or manipulate the whole computer in order to achieve some desired result. Material deformation can be implemented at various scales. For instance, a computer and connected deformation sensors mounted inside a flexible tube could respond to right angle bending of the tube, or even complex knotting or looping of the tube. In practice however, only minute surface deformations are required, being just sufficient to provide tactile feedback to pressing, pinching, or bending type manipulations. In either case, however, the measurement of location and pressure applied to a surface is sufficient to characterize the mode of interaction (distinguishing a pinch from a prod).

[0015] One particularly preferred embodiment of a handheld portable computer that responds to a physical manipulatory grammar in accordance with the present invention includes a computer, a feedback module to provide visual, auditory, or tactile feedback to a user (e.

g., processor connected LCD display, audio speaker, or tactile display to present Braille or other conventional touch interface), and co-mounted graspable, deformable piece partially or completely surrounding the feedback module. In addition, various thermal or pressure sensors are mounted to detect handedness of a user, with the grasping hand generally being the non-dominant hand for the user. Depending on the handedness of the user (which can be considered as a morpheme), the displayed data structure is modified. For example, text displayed on an LCD display screen may be automatically shifted rightward on the screen to allow pen based annotation on the left side of the screen, thereby aiding left handed users.

[0016] Physically manipulatable user interfaces additionally provide an opportunity for multiple devices to interact in a user friendly manner. For example, a tileable display system having multiple displays with touch sensitive deformable pieces surrounding the display can be used to organize documents based on relative position of contact of each display. For example, if two displays initially showing separate data structures (e.g. two different pages from two different electronic books) are brought together in side by side touching contact, the displayed visual information can alter (e.g. by displaying adjacent pages of a single electronic book). As will be appreciated, one can also use multiple computers connected to physically manipulatable control elements to construct complex commands for organizing data structures.

[0017] The method of the present invention may further comprise the step of spatially manipulating the deformable piece as at least one of the first and second morpheme inputs to the device.

[0018] At least one of the first and second morpheme inputs to the device may require spatially translating the device, panning the device, pushing the device relative to a user, pulling the device relative to a user, moving the device within a room and/or moving the device between widely separated sites.

[0019] At least one of the first and second morpheme inputs to the device may be based on detected light variations, detected thermal variations, detected electromagnetic variations, detected vibration variations and/or detected acoustic variations. Information can be input to the device of the present invention by:

- a) shaking the deformable piece to provide a morpheme input to the device and triggering a first default action by the device in response to shaking the deformable piece;
- b) flicking the deformable piece to provide a morpheme input to the device, and triggering a first default action by the device in response to flicking the deformable piece;
- c) facing the deformable piece to provide a morpheme input to the device, and triggering a first default action by the device in response to facing the

deformable piece;

d) lifting the deformable piece to provide a morpheme input to the device and triggering a first default action by the device in response to lifting the deformable piece;

e) orienting the deformable piece relative to an external environmental object to provide a morpheme input to the device, and triggering a first default action by the device in response to orienting the deformable piece relative to an external environmental object; and/or

f) whacking the deformable piece to provide a morpheme input to the device, and triggering a first default action by the device in response to whacking the deformable piece.

[0020] Embodiments of the present invention will now be described, by way of example, with reference to the accompanying drawings, in which:

Figure 1 is a schematic diagram of an approximately spherical hand holdable portable computer having a deformable surface, a status display, and a pressure sensor array for detecting surface deformations;

Figure 2 is a graphical diagram illustrating various physical manipulation morphemes, with axes respectively illustrating complexity of senseme tuples required to form a morpheme, and plasticity of a device required to support the physical manipulation;

Figures 3-16 schematically illustrate various preferred classes of physical manipulation morphemes;

Figure 17 is a graphical diagram illustrating various spatial morphemes, with a first axis illustrating complexity of senseme tuples required to form a morpheme, and a second axis illustrating the degree of positional information needed to support the physical manipulation (moving along a continuum from relative local measurement along a single specified dimension to absolute global measurement with six degrees of freedom determined);

Figures 18-26 schematically illustrate various preferred spatial manipulation morphemes;

Figure 27 is a graphical illustration showing increasing degrees of sensor system complexity that can be used to detect various categories of environmental stimuli, including light effects, thermal effects, the electromagnetic environment, and the vibratory/acoustic environment;

Figure 28 is a graphical diagram illustrating various physical manipulation morphemes for multiple interacting devices, with axes respectively illustrating the complexity of senseme tuples required to form a morpheme, and increasing level of physical contact;

Figures 29-34 schematically illustrate various preferred manipulation morphemes for multiple inter-

acting devices;

Figures 35 and 36 are schematic diagrams illustrating "squeeze" and "tilt" morphemes applicable to a portable computer;

Figure 37 is a schematic diagram illustrating tilt and squeeze morphemes used to control view of large two dimensional data sets with a relatively small display of a portable computer;

Figure 38 is a schematic illustration representing a portable computer having a display ready to receive annotations from a right handed user;

Figure 39 is a schematic illustration representing a portable computer having a display ready to receive annotations from a left handed user;

Figure 40 is an electronic schematic illustrating components of the pressure and tilt sensitive modules of a portable computer such as illustrated in Figures 35-39.

Figures 41 and 42 are schematic illustrations of a scanner/printer/copier using a paper shaped display interface to support morphemic input;

Figures 43-45 are schematic illustrations of tileable displays capable of supporting morphemic input;

Figure 46 illustrates optical sensors and patterns suitable for use in conjunction with tileable displays such as illustrated in Figures 43-45 ;

Figure 47 illustrates radio transponders suitable for use in conjunction with tileable displays such as illustrated in Figures 43-45; and

Figure 48 illustrates addressing of multiple tileable displays.

[0021] Figure 1 illustrates an embodiment of the present invention suitable for supporting a morphemic user interface grammar. Support of the grammar can require detection of a user's physical manipulation of a device, detection of relative or absolute spatial location of the device, detection of various environmental factors acting on the device, and even detection and interaction with multiple devices or external computer networks. As illustrated, a device 10 has a deformable surface 20 with an underlying deformation sensor mesh 22 for detecting surface deformation across or within multiple subregions of the deformable surface 20. The deformation sensor mesh 22 is connected to an internally contained processor 24 having associated memory system 26. For detecting various positional or environmental variables, a sensing system 28 is also provided. The illustrated device further includes a feedback module 33, which may include an externally visible status display 30 or a non-visual feedback module 31 (typically delivering auditory or tactile feedback). In the illustrated device, a communications system 32 for reception or transmission of information to other electronic or computing devices is also provided. All these components can be powered by a power supply 25, which is usually an internally mounted rechargeable battery of conventional construction.

[0022] Although the device 10 is illustrated as having

an approximately spheroidal and unitary mass, various other shapes are contemplated to be within the scope of the present invention. For example, the overall shape may be similar to various rectangular prisms, or can be ellipsoidal, toroidal, planar, or even be malleable enough to support a wide range of user defined irregular shapes. In addition, multiple cooperating shape elements are contemplated using conventional designs that permit interlocking of multiple shape elements (e.g. using a ball and socket, a lock and key, or slidable or rotatable interlocked components).

[0023] Whatever the shape of device 10, for operation of the present invention the device 10 is completely or partially enveloped by the deformable surface 20. The present invention supports use of a great variety of designs and materials for the deformable surface 20, depending on the required plasticity, durability, longevity, and of course, cost constraints. For example, contemplated designs for deformable surface 20 include, but are not limited to:

a closed or open celled polymeric foam material having a wall thickness of millimeters to centimeters, with thinner walled embodiments being supported (e.g. by adhesive attachment) by an internal hard shell (constructed from polymeric or metallic materials), and those thicker walled embodiments directly supporting (by, e.g. brackets or supports) internal components such as processor 24. Suitable foams may include those composed in whole or in part of widely available synthetic rubbers such as polychloroprene (neoprene), polystyrenes, rubber or nitrile rubber latex foams, polysiloxanes, block polymers including styrene-butadiene or styrene isoprene, or any other conventional material having good elasticity and deformability;

a thin single layer polymeric surface loosely wrapped around a internal hard shell (the hard shell being constructed from polymeric or metallic materials). For example, a nylon or cotton weave, single layer polyethylene, synthetic rubber (with little or no foam cells present), or natural polymeric materials such as leather wrapped around a polystyrene casing can be used;

a composite layered surface having a durable polymeric outer layer supported by an inner foam layer; or even

a polymeric bilayer having an intermediate fluid or gel layer of a viscous or thixotropic material that can be used to support extreme deformations. The intermediate layer can be relatively thick (one the order of centimeters), or in certain embodiments can have a thickness measured on micron to millimeter scales. Such extremely thin layers would allow complex twisting, folding, curling, or crumpling actions, and have been described in conjunction with U.S. Patent 5,389,945, assigned to Xerox Corp., the disclosure of which is herein specifically incor-

porated by reference.

[0024] The deformation sensor mesh 22 can be embedded within, or positioned to contact, the deformable surface 20. The deformation sensor mesh 22 can include an array of individual compressional or tensional strain sensors, or alternatively, embedded or attached positional sensors. For certain applications, continuous sensors (e.g. bilayer sheets of capacitance sensors) may be employed. One particularly useful continuous sensor type uses multiple capacitance or resistance strips, with deformation pressure resulting in a positionally localizable analog signal proportional to the applied deformation pressure. Various sensor types can be used, including simple capacitance sensors, resistive strain sensors, analog or digital pressure switches, inductive sensors, or even fluid flow sensors. Depending on the sensor type employed, sensor data can be directly fed to the processor 24 in digital form, or be transformed to digital format by a general purpose analog/digital converter that typically provides a 4 or 8 bit range (although as few as one or as many as 32 bits may be required by various applications). An analog to digital converter may be internal to the processor 24 or provided as an external module. As will be appreciated, the sensor mesh 22 is intended to include combinations of sensors and sensor types, which can be used over the whole or part of the deformable surface 20.

[0025] A positional or environmental sensor system 28 can also be supported by device 10. Various sensor modes can be supported, including absolute or relative positional information as determined by gyroscopic sensors, accelerometers, or acoustic or infrared ranging techniques. Environmental sensors, including conventional light, image, thermal, electromagnetic, vibratory, or acoustic sensors can also be present. Depending on the desired application, even costly environmental or positional sensors such as those incorporating differential GPS positioning, image analysis or recognition, acoustic or voice identification, or differential thermal sensors can be used as morphemic input. Such morphemic input, taken in conjunction with morphemic input as detected by sensor mesh 22, can enhance precision and flexibility of a user's control of device 10.

[0026] As illustrated, both sensor system 28 and sensor mesh 22 are connected to the processor 24 and associated memory 26. The processor 24 and memory 26 are typically mounted within the deformable surface 20, by either direct attachment to the deformable surface 20 or by attachment to a hard casing positioned within the deformable surface 20. Conventional CISC or RISC processors can be used in the illustrated embodiment, with low power processors such as the Signetics 87c752 or 87c751, Motorola 68HC11 or 68582, or ARM 710 being preferred. If convenient, coprocessors such as analog to digital converters or digital signal processors can be used alone or in conjunction with a main processor. Conventional flash, static, or dynamic RAM can be used in

the present invention, although for certain applications higher cost embedded DRAM may also be used. In some storage intensive applications, memory 26 can include additional harddisk storage, either located within the device 10 or available through an external connection. As will be appreciated, for many applications use of optional external communications can at least partially supplant use of internal processors and memory (except for that necessary to support required sensor or communication buffering and signalling).

[0027] The present invention optionally supports communications with an external computer system 40 using its internal communications system 32 and associated transceiver 34. The external computer system 40 also includes a transceiver 42, a personal computer or workstation 44, and is connected to a local or wide area network computer system 46. The transceivers 34 and 42 can support various communication protocols and designs, including use of a serial tethered line 36 (using, for example the RS-232C interface protocols), use of infrared signals 38 adhering to widely utilized IRDA communication standards, or use of radiofrequency signal 37 (which can be, for example, a cellular telephone, 900MHz radio, or digital PCS telephonic communications). Alternative communication standards, or even alternative communication carriers such as those based on optical or acoustic techniques, can of course be employed.

[0028] As will be appreciated, in addition to direct communication with external computer system 40, the device 10 can be directly or indirectly maintained in continuous or intermittent communication with a number of suitably equipped electronic devices, including a tablet computer 110, or even a physically manipulatable portable computer 11 similar in design and function to device 10. Communication can be direct to a target device, or through an intermediary retransmitter such as computer system 40. Other possible communication targets include automation control systems, security authorization units, personal digital assistants, notebook computers, or any other suitably equipped electronic system.

[0029] Results of communications with external devices, presentation of device stored information, or device status updates can all be provided to a user through processor 24 controlled update of feedback module 33. Feedback to a user can be primarily visual, such as can occur in conjunction with visual display 30. Generally, the display 30 can be a conventional passive or active matrix liquid crystal display, although use of more sophisticated (and expensive) displays based on various electrooptical or micromechanical techniques can of course be used. In addition, for certain devices a non-imaging display such as may be formed by a small number of status lights (e.g. red or green LEDs), or localized or distributed chromatic changes (in conjunction with a deformable surface 22 constructed with suitable electrochromic materials) may be all that is necessary for visual feedback to the user.

[0030] In some embodiments of the invention, visual output through display 30 may be augmented (or even replaced) with a non-visual display 31. The non-visual display 31 can include tactile displays based on internal actuators, auditory feedback, or even displays based on conformational changes in device appearance. For example, one possible feedback display is based on internal auditory speakers (emitting a range of sounds from simple "beeps" to well formed speech, depending on available processor speed and functionality) for providing user feedback. As will be appreciated, non-visual display 31 and its associated actuators or electronics can support alternative feedback modes, including, for example, force feedback to a user through internal actuators, tactile based feedback (e.g. with multiple surface projections for presentation of Braille or other conventional tactile user interface), modifications to the surface texture of the device, or any other conventional mechanism for supplying information to a user.

[0031] To better appreciate operation of the present invention, some selected modes of physical manipulation of device 10 are schematically presented in Figure 1. As seen in Figure 1, device 10 can be translationally moved in three spatial dimensions, as illustrated with reference to orthogonal force arrows 50, 51, and 52. In addition to translational motion, the device 10 can be rotationally moved in any or all three spatial dimensions, as represented by arrows 53, 54, and 55. By use of sensor system 28 (alone or in combination with communication system 32), the relative or absolute position and orientation in three dimensions can be determined.

[0032] In addition to determining spatial position and orientation through use of sensors 28, the device 10 can optionally use sensor mesh 22 to measure and localize transient or continuing force application, with force vectors and related timing information being determined and interpreted. A few possible force actions (deformation modes) are schematically illustrated in Figure 1, with arrows 60 and 61 illustrating depression of surface 20 (with the combination representing a squeeze), arrows 62 and 63 illustrating sliding or rubbing deformation (with the combination representing a twist), and the combination of sliding arrows 65 and 66, and outward pull 67, together representing a pinch and outward pull. The strength of the applied force can be measured (e.g. a hard or soft squeeze is differentiated), its spatial expanse found (e.g. to differentiate between poking with a fingertip or a thumb pad), and timing determined (e.g. to differentiate between a quick or a slow depression of the surface). The deformation so caused may be either permanent or transitory.

[0033] As will be appreciated by those skilled in the art, each of the foregoing force actions represented by arrows can be considered a senseme. Some temporally distinguishable sensemes (or combinations of sensemes such as the foregoing discussed pinch/pull combination) further represent morphemes used as a basis for a morphemic grammar in accordance with the

present invention. All of the following described morphemes can be modified by numerous variations in applied pressure, force utilized, appendages used, body parts, or extraneous intermediary objects used to apply force. In addition, timing of various objects (whether quick, slow, or alternately quick and slow) can modify interpretation of a morpheme. For example, if "squeeze" is taken as a typical morpheme, one can appreciate various squeeze operations such as quick squeeze, slow squeeze, hard squeeze, soft squeeze, narrow squeeze, wide squeeze, squeeze between hands, squeeze between one hand and a user's chest or head, squeeze between one hand and a table or wall, a squeeze made between two pens or two books, or even a squeeze between a user's tongue and the roof of the mouth. For purposes of the present invention, all such squeeze morphemes would be considered members of the "squeeze" class, with individual variations acting as possible modifiers or selected cases, just as a "house cat" might be considered a particular member of the class of "felines", which more generally embraces lions, tigers, and bobcats.

[0034] To aid in understanding the diversity of contemplated physical manipulation morphemes, Figure 2 illustrates selected morphemes arranged by increasing plasticity of the device required to enable morpheme utilization, and by increasing complexity of available senseme tuples required to form or interpret a morpheme applied to a particular class of device. Beginning with the least plastic device and the simplest senseme set used to compose a morpheme, a definition of a possible physical manipulation and typical function invoked by that manipulation of a device similar (but of course possibly more complex) to that described in conjunction with Figure 1 is presented:

DEPRESS

[0035] Definition: Indenting one or more subregions of the device through the application of pressure.

[0036] Example: As seen in Figure 3, consider a device 122 having a display 123. The device 122 supports a graphical illustration software application which allows users to position geometric shapes or user defined graphical objects. The device can have four pads 124 placed around it, one on each side. By deforming a particular side, the user indicates a desire to "nudge" the currently selected geometric shape 125 away from that side to a new position 126.

SQUEEZE

[0037] Definition: To deform one or more subregions of a device through the application of vectors of force, some components of which are directed towards each other, which compress the morphological structure of the device. This is a special case of depression.

[0038] Example: As illustrated in Figure 4, consider a

device 132 which can display one or more documents in either iconic (closed) or textual display (open) modes. By selecting an open document 135, and then squeezing a deformable edge 134 of the device 132, the user indicates a desire to make the document "smaller", in this case to iconize it as icon 136.

FOLD

[0039] Definition: To deform a second subregion by bending the first subregion such that it partially or completely overlaps the second subregion. Further deformations can be applied to that new morphological structure on other subregions.

[0040] Example: As illustrated in Figure 5, consider a device 142 which can display documents. Suppose this device 142 has been augmented such that a deformable horizontal "flap" 144 on a top edge of the device 142 can be folded to partially obscure a display 143. When the user makes this folding gesture, the user indicates a desire to password-protect ("hide") the currently displayed document.

CURL

[0041] Definition: Deforming one or more subregions of the device by spirally configuring subregions relative to each other in a cylindrical or circular morphological structure.

[0042] Example: As illustrated in Figure 6, consider a device 150 which can display documents in various languages (English, French, etc.). When the user takes such a device 150, curls in a direction indicated by arrow 157 into a tube, and then uncurls it, this "abra-cadabra" gesture tells the device 150 to display the current document in a different language.

STRETCH

[0043] Definition: Deforming one or more subregions of a device through the application of vectors of forces, some components of which are directed away from each other, the vectors being applied at opposite ends of the device. Example: As illustrated in Figure 7, consider a device 160 with a graphical software application which allows users to manipulate geometric shapes. By stretching the device 160, the user indicates a desire to "resize" or "rescale" the currently displayed shape 165 to a larger size 166, the amount of resizing being a function of the amount of deformation. Note that SQUEEZING can indicate resizing the currently displayed to a smaller size.

PINCH

[0044] Definition: Manipulating one or more subregions by applying vectors of forces, aligned directly towards each other, on opposite sides of the affected su-

bregion(s). This is typically, but not exclusively, accomplished using two-finger tactile force. PINCH is a special case of SQUEEZE.

[0045] Example: As illustrated in Figure 8, consider a device 170 which can copy documents. By performing a "pinching" action 175, the user indicates that they wish the next set of copies to be issued in stapled form.

DOGEAR

[0046] Definition: Deforming a second subregion by folding a first subregion at a logical corner or edge of the second subregion, indicating a marker or location point (e.g. a bookmark) to be later referenced. DOGEAR is a special case of FOLD.

[0047] Example: As illustrated in Figure 9, consider a device 180 which displays a subset of the pages from a multi-page document. By "dogearing" the upper right corner 185 of device 180, the user indicates that they wish a bookmark associated with the currently displayed page or pages.

TWIST

[0048] Definition: Deforming one or more subregions of the device through the application of two opposing rotational forces offset from each other by a non-zero difference about some central axis.

[0049] Example: As illustrated in Figure 10, consider a device 190 which, over time, becomes degraded in some aspect of its performance (its disk becomes fragmented, its memory needs garbage-collection, etc.). By performing a "TWIST" gesture 195, the user indicates that they wish the device to "wring itself out", performing, for example, garbage collection.

RELIEF-MAP

[0050] Definition: Deforming one or more subregions of the device by raising and or lowering them by either spatial transformation or the addition/removal of material.

[0051] Example: As illustrated in Figure 11, consider a device 200 which can display documents in either one- or two- page format. When the user "scores" the device by making a vertical indentation about the center axis of the device while it displays a single page 206, the device 200 interprets the morpheme to request display of documents in a two-page format as pages 207 and 208.

RIP

[0052] Definition: Deforming one or more subregions of the device by introducing a spatial discontinuity, by applying vectors of force to partially or totally disconnect these subregions from the device.

[0053] Example: As illustrated in Figure 12, consider a device 210 which can copy some or all of its informa-

tion. When the user performs the "ripping" gesture 215, removing one or more subregions, the device 210 copies its currently selected data set onto those subregions 216 and 217.

PERFORATE

[0054] Definition: Deforming one or more subregions of the device by means of introducing a change in the spatial connectivity of the subregions such that a hole is introduced (either temporarily or permanently) in the device.

[0055] Example: As illustrated in Figure 13, consider a device 220 which is used to route messages between various parts of a device network, and which displays this functionality to the user by means of lines 222 representing message pathways. When the user perforates the device 220 with a finger or object 224 to introduce a hole in one of these pathways 222, the system stops routing messages along that pathway.

SIMILARITY

[0056] Definition: Deformation of one or more subregions of a device previously configured to represent some other predefined object. Typically the device acts in a manner consistent with the behavior of the real-world object when it is manipulated in this manner.

[0057] Example: As illustrated in Figure 14, consider a device 230 which contains text-to-speech and audio input capability, and which presents itself to the user in an anatomically accurate shape of a human head. When the user opens lips 232 on the human head, internal sensors detect opening of the lips and activate text-to-speech capability.

3D MAP

[0058] Definition: The morphing of a device that can be molded around an external object to permit a sensor mesh to determine simultaneously size and shape of the external object. The range of possible external objects is large but is limited by the size of the device's solid inner-housing and the volume of the moldable material in the outer housing. In this system the device has the ability to accurately sense the amount of material from its inner surface to the outer edge of the moldable material (example: via ultrasonic sounding, similar to sonar in water) thus determining an accurate electronic model for the shape of the molded enclosure.

[0059] Example: As illustrated in Figure 15, by pressing a device attached moldable material 244 around the surface of an external object (e.g. a cog 242) a device 240 can automatically generate a CAD model of that object and store it in its memory.

MIMICRY

[0060] Definition: Deforming one or more subregions of the device such that the resultant morphological structure resembles a known real-world object and through this association of subregions, the device acts in a manner consistent with the object it resembles.

[0061] Example: As illustrated in Figure 16, consider a device 250 containing a computer which contains text-to-speech and audio input capability, and which presents itself to the user as a misshapen blob having the consistency and plasticity of moldable putty or clay. When the user performs the "MIMICRY" action by molding part of the device 250 to resemble an ear, the audio input capability is activated.

[0062] In addition to morphemes based on physical manipulation, various morphemes based on varying degrees of relative or absolute spatial positioning are contemplated to be useful in practice of the present invention. To aid in understanding the diversity of contemplated spatial morphemes, Figure 17 illustrates selected spatial morphemes arranged by increasing knowledge of spatial position required to enable morpheme utilization, and by increasing complexity of available senseme tuples required to form or interpret a morpheme applied to a particular class of device. Beginning with a device having only rudimentary relative positioning functionality for supporting simple spatial sensemes, and ending with a device absolutely positionable to within centimeters anywhere on Earth, a definition of a possible spatial manipulation and typical function invoked by that manipulation of a device similar (but of course possibly more complex) to that described in conjunction with Figure 1 is presented:

TRANSLATE (relative to device)

[0063] Definition: The linear movement of a device's center of mass from one position in space to another.

[0064] Example: Used to substitute for mouse controlled graphical "sliders" in conventional graphical user interfaces. When it is only physically possible to display a small amount of list, large listings can still be searched by "scrolling" a display window in response to the TRANSLATE morpheme.

SHAKE

[0065] Definition: Spatially translating all subregions of a device by repeated movement in opposing directions, such that the net translation is negligible.

[0066] Example: As illustrated in Figure 18, consider a device 260 which is used as a calculating device. When the user performs the "SHAKE" gesture, the device 260 clears its accumulator.

REVOLVE

[0067] Definition: Rotating all subregions of a device by rotating the subregions about a point internal to the device, about any arbitrary plane.

[0068] Example: As illustrated in Figure 19, consider a device 270 which displays an imaged slice of volumetric data, such as medical data from a series of CAT scans. By rotating the device about a center point 272 internal to the device 270 to a new position 274, the plane specifying the imaged slice is changed accordingly.

TILT

[0069] Definition: Rotating one or more subregions of a device by rotating the subregions such that one or more components of the rotary force are in the direction of gravity and the amount of rotation is between about -180 degrees and +180 degrees.

[0070] Example: Consider a device which displays frames from an animation sequence on the side facing the user. As the device is tilted away, the speed of the animation increases - as its tilted towards the user, the speed of the animation decreases, analogous to operation of a gas pedal.

FLICK

[0071] Definition: A forwards TILT immediately followed by an opposing backwards TILT.

[0072] Example: As illustrated in Figure 20, consider a device 280 which can transmit some subset of its data to another device. When the user performs the "FLICK" gesture by quickly tilting in the direction of arrow 282, followed by a reverse tilt along arrow 282, the device 280 performs this transmission, towards the device (not shown) pointed to by the ray of the gesture.

SPIN

[0073] Definition: Rotating one or more subregions of the device by rotating the subregions about a point internal to the device, such that the plane of rotation is one of the device's surface planes. SPIN can be considered a special case of REVOLVE.

[0074] Example: As illustrated in Figure 21, consider a device 290 which can display a frame of video 295 from a video sequence. The user performs the "SPIN" gesture in a counter-clockwise direction, the device displays earlier frames in the sequence; when the gesture is performed in a clockwise direction (arrow 292), the device 290 displays a later frame 296 in the sequence (represented by film strip 294).

ORIENT

[0075] Definition: Rotating one or more subregions of

the device by rotating the subregions about the center of the device, such that the plane of rotation is one of the device's surface planes, and the amount of the rotation is a multiple of 90 degrees (i.e. to rotate the device between cardinal compass points). Orient can be considered a special case of SPIN, which in turn is a special case of REVOLVE.

[0076] Example: As illustrated in Figure 22, consider a device 300 which can display a document in either 1 page, 2-page, or 4-page format ("1-up", "2-up", or "4-up"). When the user performs the orient gesture in a clockwise direction (arrow 302), the device 300 increases the number of document pages it is displaying from one page 305 to two pages 306 and 307. Further orient gestures would increase the number of displayed pages. When performed in a counter-clockwise direction, the device 300 decreases the number of pages it is displaying.

20 FACE

[0077] Definition: Manipulating one or more subregions of the device such that a first set of subregions is no longer bottom-most and a second distinct set of subregions now assumes the first subregions former position.

[0078] Example: As illustrated in Figure 23, consider a device 310 which displays documents, and which allows users to edit such documents. Consider further the case in which the device presents itself to the user in the form of a cube, in which 6 different documents are displayed on the 6 different faces. When the user performs the "FACE" gesture by making a particular face top-most, the document which is now on the top-most face becomes editable by the user, while the document which is no longer top-most is no longer editable.

LIFT

[0079] Definition: The movement of a device's center of mass in a direction opposite to the current gravitation force acting on the device.

[0080] Example: Commanding the device to display the computer's file system at a position one level higher in the hierarchy.

PAN

[0081] Definition: The application of a TRANSLATION to a device such that it is moved parallel to the front of the user's body, at a substantially constant height.

[0082] Example: Viewing a spread-sheet on a device with a display so small only one cell can be shown. By PANing the device, the contents of the current row can be shown in sequence depending on the rate or amount of PAN. However, if the device were rotated away from its current orientation during the PAN, a new row would be chosen. The selection of the row could be dependent

on the deviation from the original orientation.

PUSH-PULL

[0083] Definition: Manipulating one or more subregions of the device by spatially translating them such that they are moved along a line of projection from the center of the device to the vertical axis of the user's body.

[0084] Example: Consider a device with audio output capability. As the device is "pushed" further away from the body, its audio output level increases. When it's "pulled" towards the body, its level decreases.

WHACK

[0085] Definition: The application of an accelerative or de-accelerative force to one or more subregions of a device such that said subregions contact or are contacted by an external object, causing an equal and opposite countering force.

[0086] Example: As illustrated in Figure 24, consider a device 320 which can perform long and unpredictable database searches. When the user performs the WHACK gesture (e.g. upon a table 322), the current search is aborted.

ORIENT (relative to environment)

[0087] Definition: Manipulating two subregions of the device such that the line drawn between the centers of those two subregions alters its orientation with respect to the surrounding environment.

[0088] Example: Displaying a CAD drawing of a machine-part in 3D on the display of a mobile device. As the orientation of the device changes, so too does the viewing angle and position of the rendered image.

ORBIT

[0089] Definition: Rotating one or more subregions by rotating the subregions and/or the center of mass of the device about some point exterior to the physical boundaries of the device, about any arbitrary axis.

[0090] Example: As illustrated in Figure 25, consider a device 330 which can search a network database, such as the World Wide Web, for information. When the user performs the "orbit" gesture, such a search is initiated. The radius 332 of the rotation 334 specifies the breadth of the search - wider circles specify a wider search. The speed of the gesture specifies the time limit imposed on the search - the quicker the gesture, the more cursory the search.

ORBIT RELATIVE TO USER

[0091] Definition: Rotating one or more subregions by rotating the subregions and/or the center of mass of the

device about some point exterior to the physical boundaries of the device, where said point is proximal to a body feature of the user. This is a special case of ORBIT.

[0092] Example: As illustrated in Figure 26, consider a device 340 which can perform audio output. By performing the ORBIT gesture (in direction indicated by arrow 344) about the user's ear 345, the audio output is activated.

MOVEMENT IN ROOM

[0093] Definition: The local detection of a device's 3D position relative to reference points found within an enclosing room. Differences in the measured position are used to trigger actions.

[0094] Example: A virtual filing system that allows you to save and restore files based on the devices current position in the room. To save a file you might think carefully about the contents of the file and then walk to the position in the room that might be most easily associated with it. When retrieving the file you would use the same thought processes and go back to the position you had associated with the file. On doing so the files associated with that position would be displayed and you would then be able to select the file you were looking for. The system is useful because the human mind is very good at remembering information that is spatially organized rather than in some abstract information data structure.

MOVEMENT BETWEEN WIDELY SEPARATED SITES

[0095] Definition: Manipulating one or subregions of the device such that the detected absolute spatial position of those subregions is changed.

[0096] Example: Consider a device which can display information from a database of client information. When the device is moved to a different client site, the device automatically updates its display to display information for the nearest client site.

[0097] In addition to morphemes based on physical manipulation or spatial positioning, various morphemes based on sensed environmental conditions are contemplated to be useful in practice of the present invention. To aid in understanding the diversity of contemplated environmental morphemes, Figure 27 illustrates selected environmental morphemes loosely arranged in order of increasing sensor complexity needed in some commonly sensed environmental categories. For each of the proffered categories, some selected sensing systems supportable by a device such as that described in conjunction with Figure 1 are presented:

LIGHT

[0098] Definition: Manipulating one or more subregions of the device such that the amount of light falling upon those subregions changes.

[0099] Example: Consider a device used in a lecture

hall to take notes. When the room lights are turned on, the light sensors detect this and turn down the backlight to conserve energy. When the room lights are turned off (e.g. during a slide show) the light sensors detect this and turn up the backlight to increase viewability.

[0100] Light sensors can range from thresholded binary light detectors, to light pattern detectors, to full imaging systems. Advanced techniques can include image analysis and recognition to identify objects or persons.

HEAT

[0101] Definition: Manipulating one or more subregions of the device such that the amount of heat applied to those subregions changes.

[0102] Example: Consider a portable computer which has a stylus for entering text. By looking at the heat profile along the back surface of the computer, the computer can detect whether it is being held with the left hand, the right hand, both hands, or neither hand, and update its interface accordingly.

[0103] Thermal (heat) sensors can range from simple temperature sensors to sophisticated differential thermal mappers and thermal imagers.

ELECTROMAGNETIC

[0104] Definition: Manipulating one or more subregions of the device such that the electromagnetic spectrum applied to those subregions changes.

[0105] Example: By analyzing the radio spectrum, the device can derive estimates as to its absolute spatial position, and use that to alter its functionality.

[0106] Electromagnetic detection can include magnetic compasses, radio detection, or GPS signal detection. More advanced techniques can include electromagnetic spectrum analysis and interpretation, such as roughly determining location based on available radio signals.

VIBRATE

[0107] Definition: Manipulating one or more subregions of the device by vibration.

[0108] Example: Consider a device which displays textual information. When the user takes the device on the bus, the ambient vibration level sensed by the device changes, and the device increases the size of the displayed text to help the user compensate.

[0109] This class of environmental morphemes can include detection of intermittent contacts, low frequency rumbings, or acoustic level detection. More advanced techniques requiring greater processor power include maximum frequency identification, spectral analysis of acoustic frequencies (enabling the device to distinguish background environmental noises from speech, for example), or even speech based identification of persons

in the vicinity of a device.

[0110] In addition to morphemes based on physical manipulation, spatial position, or sensed environmental factors, various morphemes based on cooperation between multiple interacting devices are contemplated to be useful in practice of the present invention. To aid in understanding the diversity of contemplated spatial morphemes, Figure 28 illustrates multidevice morphemes arranged by an increasing level of possible physical contact, and by increasing complexity of available senseme tuples required to form or interpret a morpheme applied to a particular class of device. Beginning with a device having only rudimentary edge deformation functionality for supporting simple spatial sensemes, and ending with complex deformable or embeddable devices that can be wrapped about each other, a definition of a possible multidevice manipulation and typical function invoked by that multidevice manipulation of devices similar (but of course possibly more complex) to that described in conjunction with Figure 1 is presented:

TOUCH

[0111] Definition: To move one or more subregions of a device such that they enter physical contact with a subregion of a second device, in any alignment and to any extent. Or, to take two devices so aligned and remove that alignment.

[0112] Example: Consider two portable computers 350 and 351, the first of which contains a database, and the second of which contains an IRDA port. When the user touches the first computer 350 to the second computer 351, the database is transmitted via the second computer's port.

MATCH

[0113] Definition: To move one or more subregions of a device such that they enter physical contact with one or more subregions of a second device, with the subregion(s) of the first device and the subregion(s) of the second device being aligned along one or more edges. Or, to take two devices so aligned and remove that alignment.

[0114] Example: As illustrated in Figure 30, consider, multiple devices 360, 361, and 362, which contain different versions of the same basic database. When the user MATCHes the first device 360 to the second device 361, followed by matching the third device 362 to the matched first and second devices, their databases are reconciled (synchronized).

STACK

[0115] Definition: To move one or more subregions of a device such that they enter physical contact with a subregion of a second device, such that the first device is now located above, but physically adjacent to, the sec-

ond device. Or, to take two devices so aligned and remove (i.e. unstack) that alignment.

[0116] Example: As illustrated in Figure 31, consider a set of devices 370, 371, and 372, each of which is displaying a frame of video from a longer video sequence. When the devices are stacked, the ordering of the stacking specifies an order for the video editing, and a single composite video is now produced.

TILE

[0117] Definition: To move one or more subregions of a device such that they physically contact with a subregion of a second device, such that the first device and second device now form a single seamless spatial unit or to take two devices so aligned and remove that alignment. TILE is a special case of MATCH.

[0118] Example: As illustrated in Figure 32, consider a set of devices 380, 381, 382, 383, each of which can independently display a portion of a large photograph. When the devices are tiled, each device displays the portion of the photograph appropriate to its current relative position in the tiled grid.

RELATIVELY ALIGN

[0119] Definition: To move one or more subregions of a device such that they engage in a particular spatial relation to one or more other devices, where said devices are not touching.

[0120] Example: As illustrated in Figure 33, consider a set of devices 390, 391, 392, and 393 which are displaying a multi-page document. Whichever device is presently placed at the far left (device 390) displays the table of contents, whichever one is presently placed at the far right (device 393) displays the index, and the others display pages according to their respective locations. As different devices can have different display capabilities, moving them about can alter the document display. For example, if only one of the devices has a color display, when it is moved from second position to third position then (a) the device which was in third position, displaying page #2, now displays page # 1, and (b) the color display, which was displaying page #1, now displays page #2 in color.

WRAPPING/EMBEDDING

[0121] Definition: Manipulating one or more subregions of a device such that these subregions spatially occlude or are spatially occluded by some portion of the second device.

[0122] Example: As illustrated in Figure 34, consider a first device 400 which contains the infrastructure to support the filtering of email. Consider a second set of devices 401 and 402 which implement particular email filters. When the user physically embeds device 401 (or 402) into the first device 400, by which the first device

400 now wraps the second device 401 (or 402), the particular email filter supported by the second device is activated.

[0123] As those skilled in the art will appreciate, combinations of any of the foregoing described morphemes based on physical manipulation, spatial position, environmental conditions, or multiple interacting devices can be extended by participation in a morphemic "sentence". A sentence is defined as a sequence of one or more temporally disjoint morphemes. Typically, between about 1/10th of a second and 2-3 seconds suffices to distinguish morphemes within a sentence. Of course, in some circumstances and indefinite time period may elapse. The sentence level allows definition of a physical manipulatory grammar by appropriate choice of a morpheme sequence, and corollary rules governing, for example, use of active (verb like) morphemes, naming (noun) morphemes, or connectors. Just as the position and relation of words in a sentence define the sentence's meaning (e.g. "horse chestnut" is not the same as "chestnut horse"), similarly the position and relation of morphemes in a manipulatory sentence define the sentence's meaning. For example, in a communication mode a FLICK followed by a WHACK could mean "transfer data and erase the local copy", while a WHACK followed by a FLICK means "power on the device and transfer data". In other settings, a FLICK or a WHACK could mean something entirely different. To better understand construction of morphemic sentences, the following examples are discussed:

DATA TRANSFER SENTENCE

[0124] Consider a device which can transmit some or all of its information to another device. Furthermore, this transmission can be done either unencrypted, or encrypted (to increase security). Furthermore, this transmission of a text+graphics document can either include the graphics, or omit them (to save time). Suppose that the user wishes to perform the command "Transmit the information in document A, encrypted, omitting graphics, to machine B". Then a gestural sequence (morphemic sentence) to support this could be:

- DEPRESS - the user presses on a displayed representation of A, indicating that A is to be selected for an upcoming operation
- FLICK - the user flicks the device in the direction of device B, indicating that the operation is a transmission to B
- FOLD - the user folds the top quarter of the device over the lower three-quarters, indicating that the transmission is to be encrypted.
- TWIST - the user twists the device about its central axis, indicating that the data is to be "wrung out", i. e. the graphics are to be omitted
- SQUEEZE - the user squeezes the device, indicating that they are confirming that the operation is to

proceed.

[0125] Note that none of these gestures, in isolation, performs an act - the "ensemble" of temporally separated morphemes must be interpreted in order to form the complete action.

DRAWING MODIFICATION SENTENCE

[0126] Consider a device which displays geometric shapes for user manipulation. Furthermore, one of the manipulations supported is to resize (or rescale) a shape. Furthermore, suppose that this resizing can be done either aliased (jaggy) or anti-aliased (edges are smoothed). Suppose that the user wishes to perform the command "Resize shape A by 120%, about the X axis only, using anti-aliasing". Then a morphemic sentence to support this could be:

DEPRESS- the user presses on a displayed representation of A, indicating that A is to be selected for an upcoming operation

STRETCH - the user stretches some portion of the device, indicating that the operation is to be a resize. When the user starts stretching, a portion of the status display displays "100". The user continues to stretch until the status display reads "120"

RELIEF-MAP - the user "scores" the display by making a horizontal line of depression, indicating that the operation is to take place only about the horizontal (X) axis.

DEPRESS - a circular thumb stroke is made in a different area of the device, indicating that anti-aliasing (smoothing the edges) is to be performed.

DATABASE PRESENTATION SENTENCE

[0127] Consider a device which contains various personal information databases, such as a list of phone numbers, a list of addresses, and a calendar. Suppose that the user wishes the most appropriate of those databases displayed. Then a gestural sequence to support this could be:

SPATIAL LOCATION - the user carries the device such that it is spatially proximate to either the telephone, the address book, or the refrigerator (where the family calendar is displayed), whichever is appropriate.

DEPRESS - the user touches the device to activate the operation. The device now displays the personal information appropriate to that location.

DATABASE RETRIEVAL SENTENCE

[0128] To extend the foregoing example of a database presentation sentence, consider two computers which contain calendar databases. If the user wishes to syn-

chronize the calendars, a suitable gestural sequence to support this could be:

SQUEEZE - the user squeezes the device to activates its gestural recognition capabilities

ORBIT - the user orbits the device about the surface of the other device 3 times, indicating a desire to only match data for the next 3 weeks.

MATCH - the user matches the edge of the device to the edge of the calendar, indicating a desire to "match" contents between the two devices.

PRINTER/COPIER CONTROL SENTENCE

[0129] Consider a device which can produce paper copies of documents. Suppose that the user wishes to tell such a device to produce a stapled, two sided copy of document A, enlarged to the next greater size. Then a gestural sequence to support this could be:

DEPRESS - the user presses on a displayed representation of A, indicating that A is to be selected for an upcoming operation

RIP - the user introduces a spatial discontinuity into a portion of the device, indicating that the upcoming operation is to be a copy ("carrying away" some of the data).

PINCH - the user pinches the upper left corner of the device, indicating that the copies are to be stapled.

SQUEEZE - the user presses on the front and back of the device, indicating that the copy is to be two-sided.

STRETCH - the user stretches the device, indicating that the copy is to be an enlargement to the next greater size.

FACE - the device typically has its paper emitter on the bottom, preventing users from making copies accidentally. By facing the device such that the emitter is on the side, the copying operation is initiated.

LIGHT BASED CONTROL SENTENCE

[0130] Consider a device which can display documents. Suppose the user is using the document while seated on a train, and wishes the document to display itself with a backlight when the train enters a tunnel, and wishes the document to display itself in a larger font when the train rumbles over rough tracks. Then a gestural sequence to support this could be

SQUEEZE - the user squeezes on the device, indicating that a loss of light is to be compensated for by a backlight.

LIGHT - as the train enters a tunnel, the LIGHT gesture is made, and the device turns on the backlight.

WHACK - the user briskly raps the device against

the palm of their hand, indicating that their desired preference for adjusting hard-to-read documents is to increase the font size.

VIBRATE - as the train goes over a bridge, the vibratory gesture is sensed. Because of the position of this VIBRATE morpheme (after the preceding WHACK gesture) in this morphemic sentence, the device now increases the font size on the displayed text.

LIGHT - the user puts the device into his suitcase, making the LIGHT gesture. In this context (with no SQUEEZE before it), the LIGHT gesture causes the device to power-off its display.

To better appreciate utility and construction of devices in accordance with the present invention, several examples of devices are now described:

PORTABLE COMPUTER WITH SQUEEZE AND TILT CONTROL

[0131] A handheld portable computer 500 (e.g. a 3Com® PalmPilot®) capable of being fitted with deformable, pressure sensitive edging 504 is schematically illustrated in Figures 35 and 36. The computer 500 supports a name and address software application, providing a user viewable name-address entry field on display 503. In this embodiment, a user can squeeze the deformable, pressure sensitive edging 504 (squeeze arrows 507) of the computer 500. In response, the name and address software application causes the display 503 to animate by slowly incrementing (scrolling) through the name list from "A" towards "Z" entries. When the user squeezes edging 504 again, the software application stops the scrolling animation. Scrolling functionality is further enhanced by the use of a tilt sensor, which allows the computer's behavior to mimic conventional rotatable address books. If the computer 500 is tilted away from the 45 degree angle at which someone might typically hold it, the scrolling rate is increased. In this application, the closer the computer 500 was tilted towards the user (as indicated by arrow 506 of Fig. 36), the faster the scroll rate toward "Z". However, if a user tilted the computer 500 back past the neutral 45 degree position (as indicated by arrow 506 in Figure 36), the animation would move backwards with a velocity related to the magnitude of tilt. In this way it was possible for a user to search for items in a long list in a very natural way, while only using one hand.

[0132] In an alternative mode schematically illustrated in Figure 37, scrolling speed can be completely controlled by pressure. The greater the squeeze pressure (arrows 537), the faster the list scrolls. Release of the applied pressure causes the scrolling to halt. In this alternative user interface strategy, application tilt (as indicated by orthogonal tilt arrows 530 and 532) could be used to change the direction of the scrolling through the list, allowing a user to search portions of a large two dimensional data set (schematically illustrated as a data

plane 520) that is not entirely visible either horizontally or vertically on display 503. By simply tilting the display 503 of computer 500 as if it were a window through which the data plane 520 can be viewed, any particular portion of the data plane (for example, data subset 524) can be viewed. As will be appreciated, in both the foregoing modes the speed of scrolling, the specific neutral tilt angle, and required pressures to initiate scrolling changes can be adjusted to fit a particular user.

PORTABLE COMPUTER WITH HANDEDNESS DETECTION

[0133] Pressure sensors have been added to augment a conventional keyboard 551 enabled user interface to a hand holdable Windows® CE class computer 550 (i.e. a Cassio® Cassiopia®) schematically illustrated in Figures 38 and 39. In this embodiment, user handedness was determined by using pressure sensors positioned on a right back-edge and a left back-edge of computer 550. User studies have found that the difference in pressure between the right and left side gave a direct indication of handedness of a user. As respectively illustrated in Figures 38 and 39, handedness was used to justify formatted text 554 to the left (Fig. 38) or right (Fig. 39), thereby allowing more space 555 on display 553 for an electronic annotation pen to be used to mark-up the text.

[0134] For both the embodiment of the invention illustrated by Figures 35-37, and the foregoing embodiment illustrated in Figures 38 and 39, material deformation of a spongy, elastic, or otherwise deformable material must be measured. Although various techniques can be used to measure material deformation, including those based on imaging or fluid volumetric changes, one particularly useful technique is based on the use of pressure transducers. Commercially available sensors measure pressure (indicative of material deformation) by converting a pressure change to a change in electrical characteristics. For example, inexpensive sensors that change resistance in response to pressure can be obtained in a variety of shapes and sizes, including paper thin sensors, and easily bendable sensor strips. Sensors of this kind can be customized to any particular shape or form that a gestural UI might require. The change in resistance is usually linearly related to pressure, with the sensor generally being placed in a potential divider network to model the pressure as a change in potential. For a practical circuit the resulting signal needs to be amplified, buffered and translated such that the change in value from minimum pressure to maximum pressure spans a useful range. The modified signal can now be fed into an analog to digital converter (ADC) to produce a digital representation of pressure. An 8-bit ADC can typically be used for most applications, however, if greater sensitivity to pressure changes is required, a higher resolution ADC (e.g 16-bit ADC) can be used. As will be appreciated, the ADC could be memory

mapped into the processor's address space as a peripheral, or alternatively supplied as a retrofitted pressure interface to existing computers capable of benefiting from this system. Since an RS232 connection is an interface that is almost universally available on portable computers, one strategy is to have the parallel output of the ADC converted into a serial RS232 frame using a serializer such as a UART and then level-shift and buffer the signal as specified by the RS232 standard. At the computer end of the serial interface, another level-shifter and UART, the output of which is readable by the processor, performs the serial-to-parallel conversion.

[0135] As described with reference to Figure 40, in realizing a working system a microcontroller 564 (a Signetics 87c752) with an ADC built in to combine many of the I/O tasks in a single chip can be used in combination with level shifter 566 (a MAX3223). This approach has the advantage that intelligent processing of the input signal is possible with software. Tilt measurement was provided by a tilt sensor 567 connected to a buffer/amp 562 to supply an analog signal to microcontroller 564. The pressure measurement can also be encoded within a protocol across the serial link. This particular microcontroller 564 has five ADC inputs, but by making use of eight digital control lines, it is possible to use only one ADC input and one buffer amplifier 561, to measure up to eight pressure points with pressure sensors 565. This is achieved by using the control lines to select only one sensor at a time and take a reading for each using a single input to the ADC. After eight sensors have been selected, eight readings are acquired in memory. The design is practical because the microcontroller can take measurements and make analog to digital conversions at a rate far higher than is needed to communicate with a host computer 569.

[0136] For scrolling or handedness based software applications, 16 levels were determined to be adequate for representing a pressure measurement. In order to have a high data throughput to the host computer 569, each measurement was encoded in one byte of an RS232 frame such that the four lowest bits were the pressure representation and the highest four bits were the sensor ID. Each frame of the RS232 data was therefore completely self contained. Of course any protocol that limits itself to a specific number of devices in its address space will eventually have the problem that someday applications might be designed that need to reference far more devices than are supported. The solution used in this protocol is to reserve the sensor ID number 15 as a special value that can extend the semantics of the encoding to include an arbitrary number of bytes representing a sensor or value. For the described software applications, the commonly used RS232 frame format (1 start, 8 data no parity, 1 stop bit at a baud rate of 9600) was chosen.

[0137] In operation, the host computer 569 determined handedness by utilizing information about the current pressure exerted on two subregions - one, on

the back of the device, occupying roughly the left half, and the other, also on the back of the device, occupying the right half. The current pressure values were converted from analog to digital form, such that a digital value of 0 (zero) represents no pressure, and a digital value of, for example, 15 represents maximum pressure. The detection circuitry then proceeds:

```

    if (left_sensor is high AND right_sensor is high) then
        conclude that the user is gripping the device
        with both hands
    else if (left_sensor is high AND right_sensor is low)
        then
            conclude that the user is gripping the device
            with the left hand

```

only

```

    else if (left_sensor is low AND right_sensor is high)
        then
            conclude that the user is gripping the device
            with the right hand

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only

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    else if (left_sensor is low AND right_sensor is low)
        then
            conclude that the user is gripping the device
            with neither hand

```

Also, to optimize communication, pressure values are only sent when they change. In order to account for jitter and error in the pressure sensors, a sensor is only considered 'high' if its value is higher than some minimum threshold (e.g. '2' on the 0 to 15 range).

SCANNER/PRINTER/COPIER SUPPORTING EDGE DEFORMABLE DISPLAY

[0138] A scanner/printer/copier device 570 is schematically illustrated in Figure 41. As seen in Figure 41 (and in more detail in Figure 42) the device 570 supports a display 574 having a deformable edge 572, with the combination roughly shaped like a piece of paper. In operation, a user can place a written document in the device 570 for scanning. An electronic version of the scanned document is displayed (i.e. as text 575 in Figure 42) on the display 574. By outwardly pulling the deformable edge 572 as indicated by arrow 577, a user can instruct the device 570 to resize the document before printing or copying. Pinching opposing sides of the deformable edge 572 (arrows 578) can further instruct the device 570 to print double sided copies. As will be appreciated, various other morphemes can be used to provide a simple interface for interacting with device 570.

TILEABLE AND STACKABLE PORTABLE DISPLAYS

[0139] Multiple autonomous display tiles having an onboard display controller and at least one surface consisting substantially of a conventional display are particularly useful for the practice of various aspects of the present invention. Such tiles can be interconnected in response to various morphemes such as TOUCH, FLICK, RELATIVELY ALIGN, or WHACK, or even can be operated without substantial user mediated morphemic input in certain situations.

[0140] Advantageously, tile positioning can be used as an interface specifier in and of itself. For example, each display tile can contain a video segment in independent memory. Shuffling or reorganizing the tiles can allow users to physically manipulate the sequence of video segments to affect a physically manipulatable video editing system. Using the card analogy, tiles can be used to re-sequence documents, pages within a document, audio annotations, voice mail, or other temporal media contained within the tiles. The resultant sequence can then be played as a whole by using the tiled structure as a unit.

[0141] For purposes of the present invention, display tile array configurations can be categorized as follows:

[0142] Close-packed display tile array 600 (Figure 43) in which tiles 602 are arranged to span a surface 610 in closely abutting, but not overlapping relationship, such that the continuous display area is maximized (i.e. seamlessly). As will be appreciated, the tiles could themselves form a freestanding continuous surface, or they could be disposed on a table or other suitable support. Each of the tiles 602 supports a display 604 sized to substantially cover a front surface of each tile 602. In certain embodiments, a back surface of each tile 602 can also support a display. Advantageously, this would allow for creation of free standing displays with images visible on the front and back. The surface 610 can be a plane, a sphere, or any arbitrary shape that permits tiling.

[0143] Loose-packed display tile array 620 (each tile 622 having a display 624 as seen in Figure 44) in which tiles 622 are slotted into a lattice pattern (indicated by dotted lines 625). Each tile can be considered to be situated in a regular bounded lattice slot (namely, the lattice slot that contains a defined center of each of the tiles) within the lattice where the dimensions of the bounded slot are no more than a few times the maximum dimension of the tile, and there is no more than one tile in any slot. Within the lattice regions any of the tiles can be positioned arbitrarily and still retain the same interrelationship with the group. It is still possible for tiles to touch one another at the boundaries of two or more lattice slots, however, this is not a requirement.

[0144] Free-format display tiles 630 (each tile 632 having a display 634 as seen in Figure 45) are similar to loose-packed display tiles 620 where the size and shape of the lattice slots may vary freely (e.g. the dimen-

sion of a lattice slot may be many times the maximum dimension of any of the participating tiles). The only constraint on the arrangement is that there must be no ambiguous relationships about the relative connectivity of the each of the tiles 632. That is to say, a tile that is to display the next piece of information to one side of another tile must be unique and not be confused with the task of another tile in the tiling lattice.

[0145] 3D display tiles (packable display tiles) are created by extending the three foregoing display tile categories. However for close packed tiling of display tiles, packed devices in the center of a 3D structure would not be available as the user interface. This may not matter as the surface of the 3D shape will expose a area that will have unique affordances for some classes of application. For instance, cubic tiles packed into the shape of a large cube can display, using the six faces of the larger cube, the various projections that could be rendered by viewing a 3D CAD drawing from each degree of freedom.

[0146] As will be appreciated, display tiles need not be recti-linear but can be hexagonal, circular, or of arbitrary shape and size. The size of tiles need not be constant for all tiles within a larger structure. Tiles need not be aligned but may require proximity to indicate adjoining points or edges.

[0147] Tiles need not be in physical contact to define they are joined in a group activity but instead this may be a programmed function. The connectivity can also be discovered through a radio network from a coordinating server or from a distributed algorithm that draws in as many computers as necessary for a task, using the wireless network to negotiate the resources it needs. The tiled computers may also be connected by wired networking systems, although in cases where the topology might need to rapidly change, this is not as desirable as a wireless system. An example of a wired networking system of this type is a system that uses the internet to include many computers in a single task, one in which each computer knows its relative position even though they may be separated by rooms or in the extreme cases buildings, cities or countries. However, in general the most useful case of display tiling is when the tiles are proximate enough that they can all be viewed by one person to create a display medium whereby the viewing experience is an enhancement over using a single display. Accordingly, tiles can operate as either a single larger contiguous structure or they can retain individual properties and independent functions or a combination of both. (e.g., jumbo-iron like function, 12x12 small displays as used in a TV studio, or picture-in-picture features found in commercial TVs or editing suites).

[0148] Depending on the type of packing, various schemes can be used to allow for permanent, intermittent, or even one-time communication between display tiles. For example, close packed tiling can make use of wired connectivity between computers or could use a variety of wireless or optical communication technolo-

gies. In the case of wired connectivity, edge mounted conventional plug and socket connectors may be used to create a rigid tiled array. Plug and socket systems lend themselves to parallel connections for bulk and high-speed data transfer. They also provide a convenient method of power distribution, which can allow for one of the tiles providing a power source that supports the rest of the array. A plug and socket connection between tiled computers 692 in a tiled computer array 690 (with both data and power transfer shown) is schematically illustrated by lines 695 in Figure 48.

[0149] The exact design and locations of electrical connectors depends on the intended use, and subsequently, the shape of tile components. For applications where large seams between displays are acceptable, simple rigid connectors could be attached to the center of each edge, providing connectivity to all the surrounding tiles. Other applications might require a more complex design. For example, applications which require high-quality information display on a seamless array surface (i.e. tiled blueprints), might employ spring-loaded contacts on the four edge connectors. The spring mechanism allows all array connections to be made below the display surface, while tiles can still be inserted and removed from the interior of the array. Removal of tiles could be triggered by some host signal which actuates a release of the spring and pops the tile out of the array.

[0150] Serial connectivity can also be used in a close packed arrangement such as that illustrated in Figure 43. It has the advantage that fewer connections have to be made and in practice it might be more reliable. However the net bandwidth between tiles will be less than a parallel system. Serial communication lends itself to optical and wireless systems thus removing the need for any physical connections. For optical technologies alignment of the transmitter and receiver is still important although the clever use of light pipes and lens capture techniques can introduce more flexibility. Wireless systems can use many different bands of the EM spectrum (kHz, MHz, GHz), utilizing a variety of modulation techniques (amplitude modulated, frequency modulated, or those based on code division multiple access) and operate at a range of transmitter powers. There is no longer a need for direct alignment if the system is designed with suitable communication tolerances. The transmitter range plays a crucial part in the design. If there is only enough power in an emitted signal to be picked up within a few millimeters of a tile edge, then the signals will be isolated, the topology will be defined by the physical connectivity and the complexity of designing the system to avoid interference from neighboring signal sources will be minimized. However, an alternative design is to use more powerful radios. In this case all tiles will be able to contact all other tiles and inter-tile connectivity needs to be defined by another parameter. Signal strength can be used or, more deliberately, information that relates the ID of a tile to a spatial map (per-

haps held in one master tile) describing the position of all tiles in the tile array. In this system it is also necessary to minimize inter-tile interference. For digital packet-data systems that operate at the same frequency, carrier sense multiple access (CSMA-CD or CSMA-CA) systems are well known techniques to solve this problem. Other solutions involve tiles using different frequencies, with frequencies reused depending on the power of the transmitters. This is the technique used by traditional cellular telephones. Yet another approach is to use Code Division Multiple Access (CDMA) that relies on the overlaying of signals in the same region of the EM spectrum, a technique known as spread spectrum modulation.

[0151] For loose packed display tiles, the wireless techniques described above in connection with close packed tiling generally become essential to the implementation. However, a special case of loose packing exists in which each edge of a tile does make contact with every other surrounding tile, except that it may only be a single point of contact and not at an accurately defined place. A wired version of this system can be built in which the entire edge of each tile is a serial connection including one of the two vertices that define the edge. Communication in each direction can be achieved by a variety of commercially available techniques, including use of a one-wire interface (plus a ground) for bidirectional communication between tags and a reader. Note that the ground connection for a tile arrangement can be derived by sharing a common ground connection through the surface the tiles are laid out on. For example, the surface could be made of a metal sheet. The system may be further enhanced by ensuring that the edge contact is made of a magnetic material and the vertices have a magnet embedded in the end. Such an arrangement ensures that there will be a good electrical contact between the transmitter and the receiver.

[0152] The receiver can also derive power from an electrically transmitted signal by bridge-rectifying it and storing the collected charge in a capacitor for use by its own electronics. Thus, power distribution can also be included in a one-wire interface. In this way flexible connectivity can be achieved to support the rapid and convenient rearrangement of tiles in which only the minimum amount of care needs to be taken in setting up connectivity.

[0153] Loosely packed tile displays such as illustrated in Figure 45 may require that the display surfaces use a best effort algorithm to present a unified display with all the sections of the displayed image bearing the correct spatial arrangement to each other even though, in the case of rectangular tiles, they might not be registered vertically or horizontally and have an offset angle relative to each other. In order to implement the desired tile display algorithm, not only is the relative arrangement of tiles important but the exact offset (distance and angle) from each other is also important. There are several methods that are suitable for automatically deter-

mining offsets between loosely packed tiles. For example, as illustrated with respect to Figure 46 (showing communicating tiles 652 and 654, with respective displays 651 and 653), optical encoding 660 along an edge can be used to identify tile orientation. It is possible to use a binary coded optical pattern along an edge which is regular and encodes the distance from a vertex at any point. A tile that abuts, or is relatively aligned, can read this pattern using optical sensors 658 and 659 and determine the display offset in the direction of the edge. Alternatively, as illustrated by Figure 47 (showing communicating tiles 672 and 674), it is possible to use radio based techniques that rely on signal strength triangulation. Each vertex 675 or 676 of a tile 672 can contain a wireless transmitter and a receiver. If these vertices transmit a short characteristic wireless signal at well known times, a nearby tile 674 can use the receivers situated at its own vertices 680, 681, 682, and 683 to triangulate the position of each transmitting vertex relative to them by measuring the relative delay by which the signal was received. After two of the vertices of the original transmitting tile 672 have signaled, the adjoining tile 674 can determine its exact position and orientation within their local region of a tile array. The transmitting and receiving tiles can now swap roles, with the result that both tiles will know their relative position. This process can be extended across the tile array.

[0154] Free format tiling differs from loose-packed tiling in that there are no proximity, or regular format, constraints. To demonstrate how a free format tiling system might work, the following example is described. Imagine a number of laptop computers each fitted with a Global Positioning System (GPS) and a radio modem. Each laptop can determine its position (with acceptable error) and communicate it to all the other laptops by contacting them through the radio modem. After some period of time the laptops will all know their relative location and absolute location. If any computers changes its location, it can update the local neighbors to ensure there is enough understanding in the array to consider the computers are in a known tiling configuration even though they are not close to each other and in fact they may be in different geographic regions. An application that might use this free format tiling system is one that wishes to ensure information is being correctly sent in a uniform and dispersed fashion across a very large area. For example, the information that each laptop computer receives could be instructions to release an amount of a pesticide used to control an insect that does damage to commercial crops. If the pesticide is released in too high a concentration in any locality, it may be hazardous to human health. The tiled approach allows the computers to roam (e.g. in the back of a truck), displaying information as to the type and concentration of pesticide that is to be released given their current relative proximity.

[0155] Various conventional algorithms can be used to support distribution of information between auto-

nous tiled displays. These algorithms assume a system by which there is a master controller generating data to be displayed. There is also a large array of tiled computers that the system will use to display visual data and/or process information. Each computer in the tiled array contains a unique ID. It is the job of the master to split the data into pieces that each computer can display and for this information to be packaged along with the ID of the target computer. The algorithms below describe how the information travels from the master to a destination display tile:

Daisy chain routing

[0156] Display tiles are arranged to have a logical connectivity with each other so that each one only transmits information to the next in a predefined line. The computers are said to be daisy chained to each. Any information sent to the start of the chain contains an ID and the first computer in the chain compares it to its own ID. If it matches, it acts on the data. If not, it sends the data on to the next computer in the chain until it finds its destination.

N-ary routing

[0157] In N-ary routing the path to the destination is contained in the ID of the device. A simple routing example is schematically illustrated with reference to the direction arrows 695 in Figure 4B, which shows quaternary routing in physically connected tileable displays. In quaternary routing, an array is conceptually arranged as a quaternary tree with each node having an input and three outputs. In this system each pair of bits of the ID contains a routing command. A 0 indicates send the packet to the first output, a 1 indicates the second output, a 2 indicates the third output, and 3 indicates no further transmission. There is also a count that gets decremented by each node to tell successive nodes the bit number that is currently being considered and when the packet has reached its destination. In this way packets are forwarded from node to node with a simple choice at each stage until they reach their target display. As will be appreciated, it is possible to design N-ary systems with more than three outputs (a power of two is usually convenient for implementation (e.g. 4, 8, 16 ...)).

Flooding

[0158] Flooding has no predefined routing structure. The computer that takes the first packet from the master checks to see if it has the correct ID. If not, the packet is sent out on all links to which it has not yet sent or received that packet. The result is a flood of copies of the packet across the array eventually reaching its destination. The packets must also have a maximum hop count to ensure they eventually are removed from the system. The disadvantage of this approach is that many

more tiles are burdened with the processing of unwanted data than in the previous two schemes, which may impact the overall efficiency of the system.

Hot Potato

[0159] The Hot Potato algorithm is similar to the Flooding algorithm, except a retransmitted packet is sent out on only one output that is either chosen randomly or is the least busy. The process stops when the packet reaches the correct tile. The time that a packet takes to reach its destination is not deterministic.

Claims

1. A device (10) supporting a manipulatable user interface, the device comprising:

a feedback module (33) for presenting information related to a data structure,
a processor (24) for controlling the feedback module (33) and the data structure, and
a deformable piece (20) including multiple subregions, the deformable piece attached in a vicinity to the feedback module, with the deformable piece contacting at least one sensor (22) that monitors positional changes within multiple subregions of the deformable piece (20), the at least one sensor (22) being connected to the processor (24).

2. A method for inputting information to a device connected to a deformable piece, the method comprising the steps of:

manipulating the deformable piece to provide a first morpheme input to the device, the first morpheme input normally triggering a first default action by the device,
asynchronously manipulating the deformable piece to provide a second morpheme input to the device, with the second morpheme input converting the normally triggered first default action to a second action.

3. A device supporting a manipulatable user interface, the device comprising:

a processor (24) and memory (26), and
a deformable piece (20) including multiple subregions, the deformable piece (20) attached in a vicinity to the processor (24) and memory (26), with the deformable piece (20) contacting a sensor mesh (22) that monitors positional changes within multiple subregions of the deformable piece, the sensor mesh (22) being connected to the processor (24).

4. A device supporting a manipulatable user interface, the device comprising:

a feedback module (33) for presenting information related to a data structure,
a processor (24) for controlling the feedback module (33) and the data structure, and
a detector (20) for determining handedness of a user, the detector being connected to the processor (24) for modifying the displayed data structure based on handedness of a user.

5. A method for inputting information to a device connected to a deformable piece, the method comprising the steps of:

spatially rotating device to provide a first morpheme input to the device, the first morpheme input normally triggering a first default action by the device, and
asynchronously manipulating the deformable piece to provide a second morpheme input to the device, with the second morpheme input converting the normally triggered first default action to a second action.

6. A plurality of tileable devices for transferring data, comprising:

a first device having a processor and a first wireless communication module for transferring data,
a second device having a processor and a second wireless communication module for transferring data,
a third device having a processor and a third wireless communication module for transferring data,
wherein the first device is connected in substantially simultaneous wireless communication with the second device and the third device to pass data based on spatial positions of the respective first device, second device, and third device.

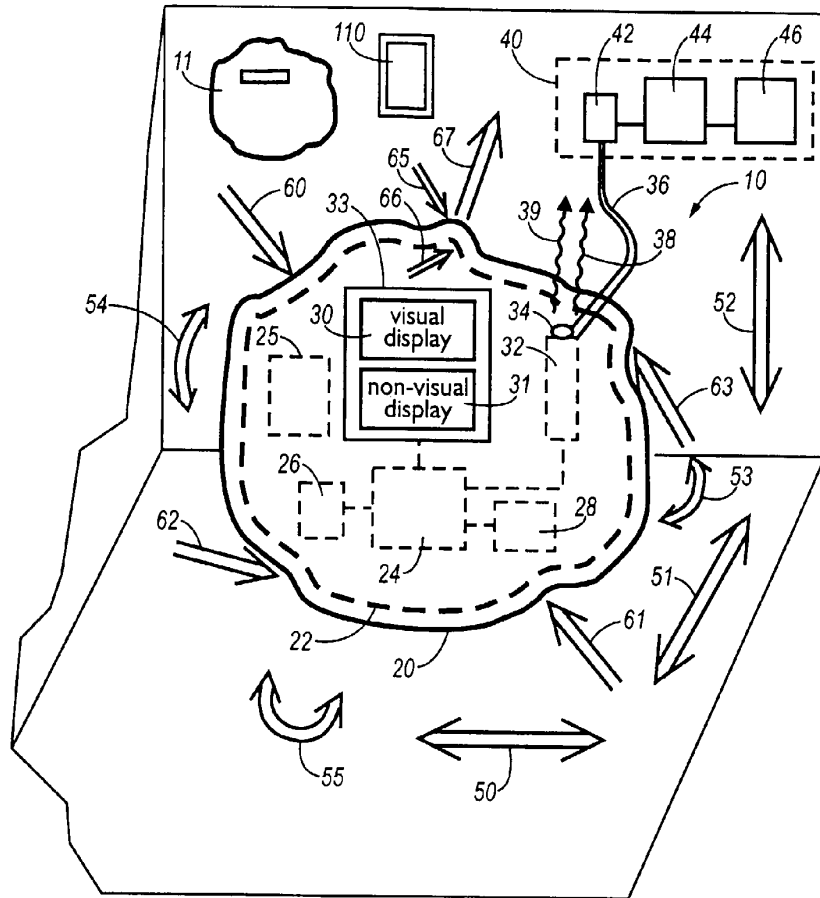


Fig. 1

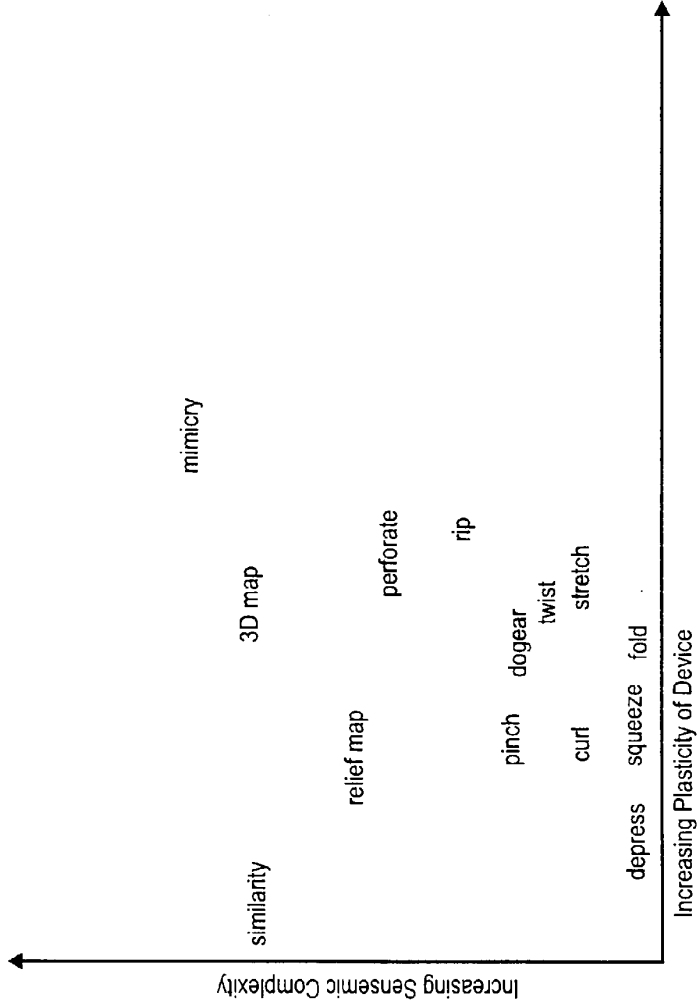


Fig. 2

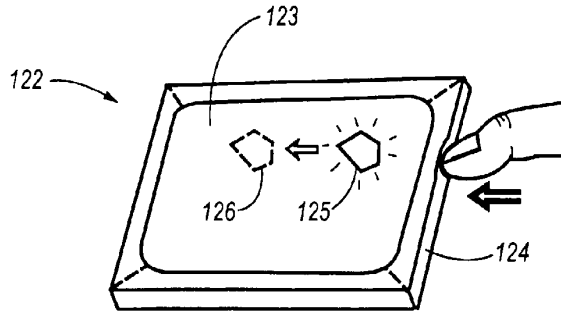


Fig. 3

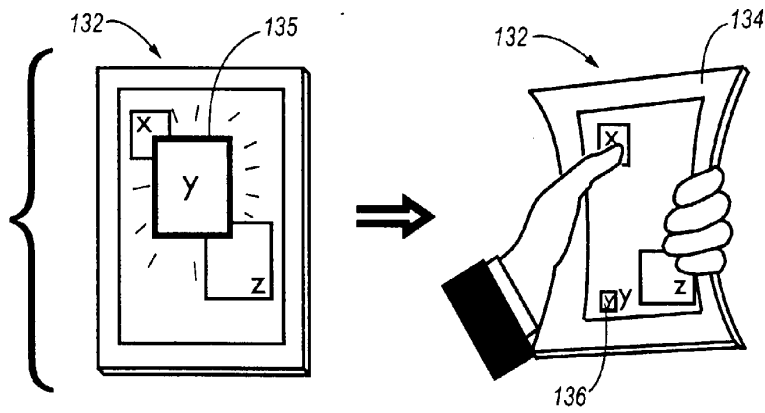


Fig. 4

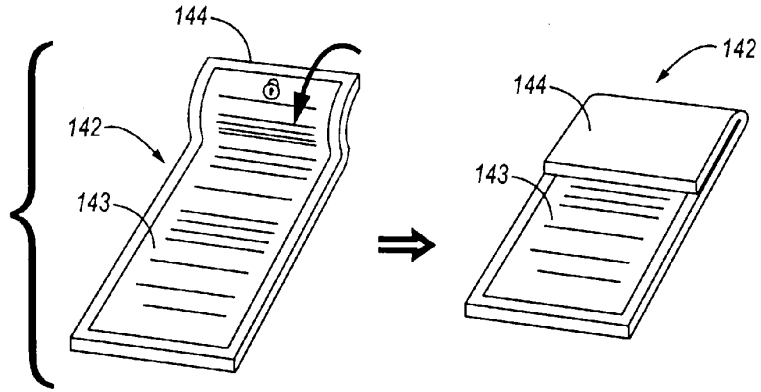


Fig. 5

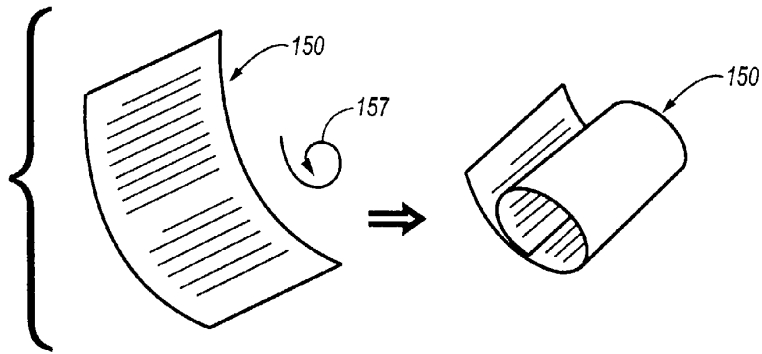


Fig. 6

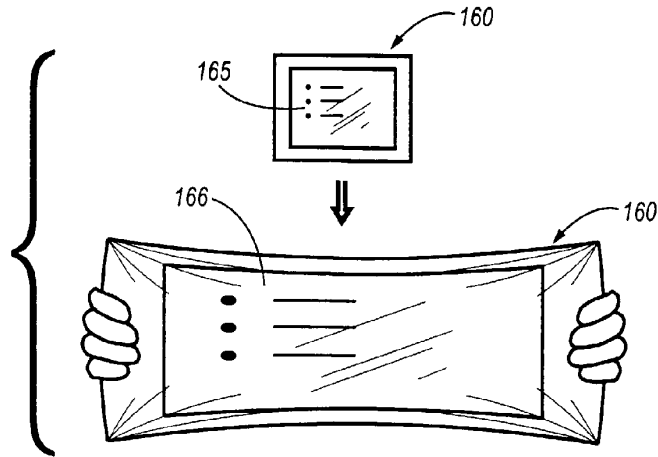


Fig. 7

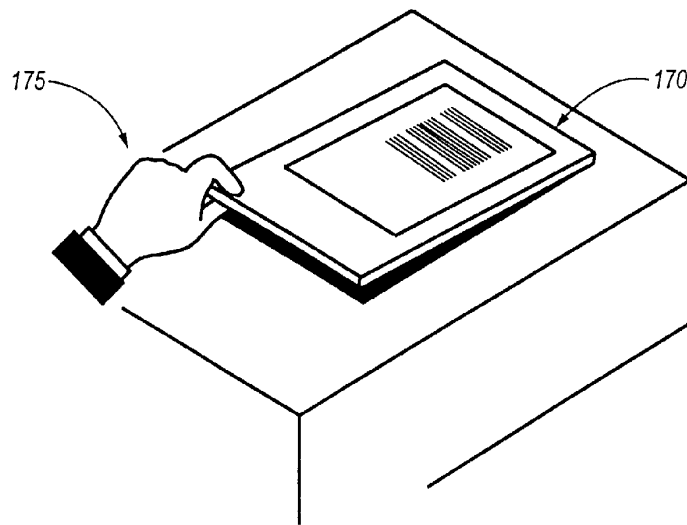


Fig. 8

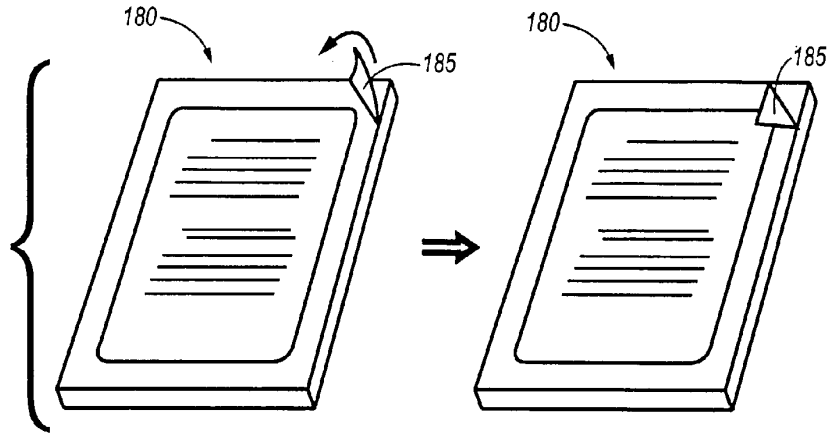


Fig. 9

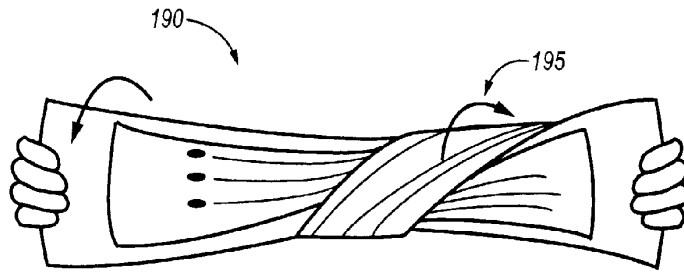


Fig. 10

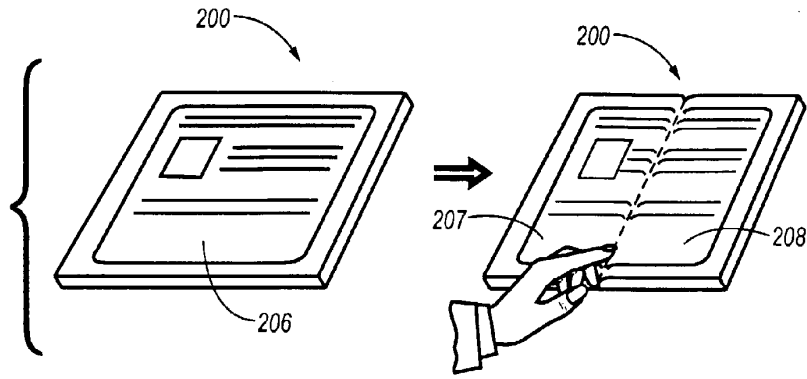


Fig. 11

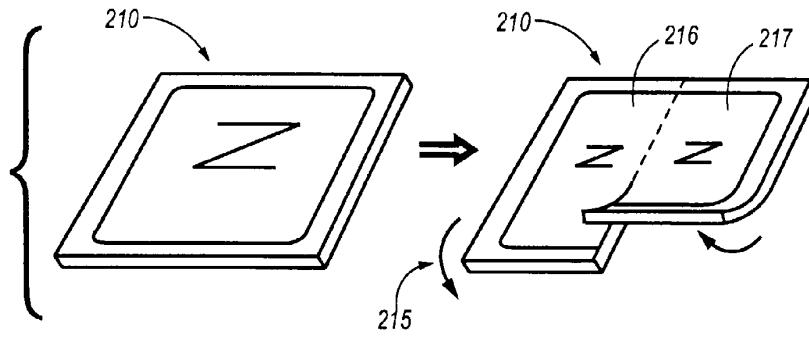


Fig. 12

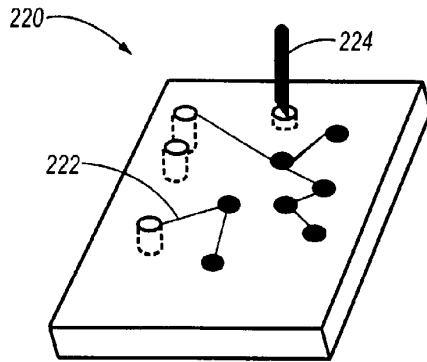


Fig. 13

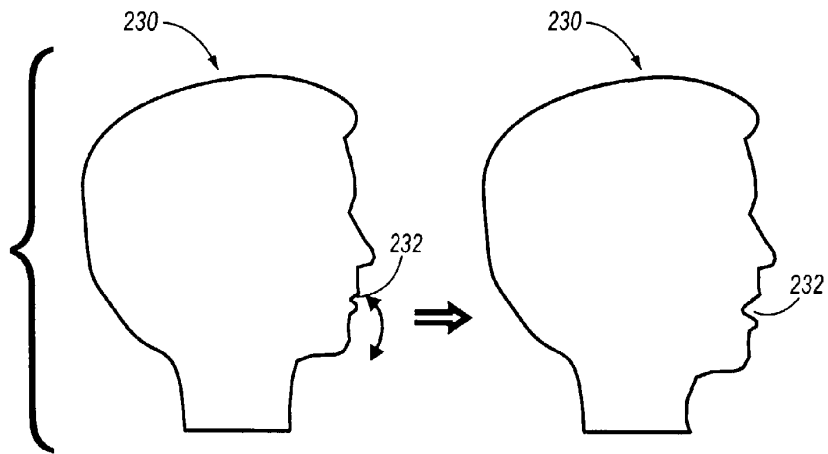


Fig. 14

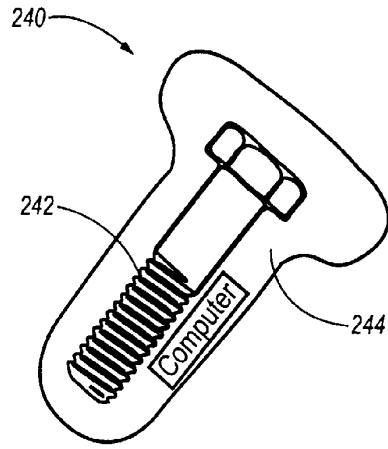


Fig. 15

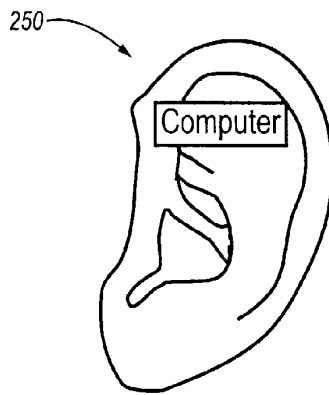


Fig. 16

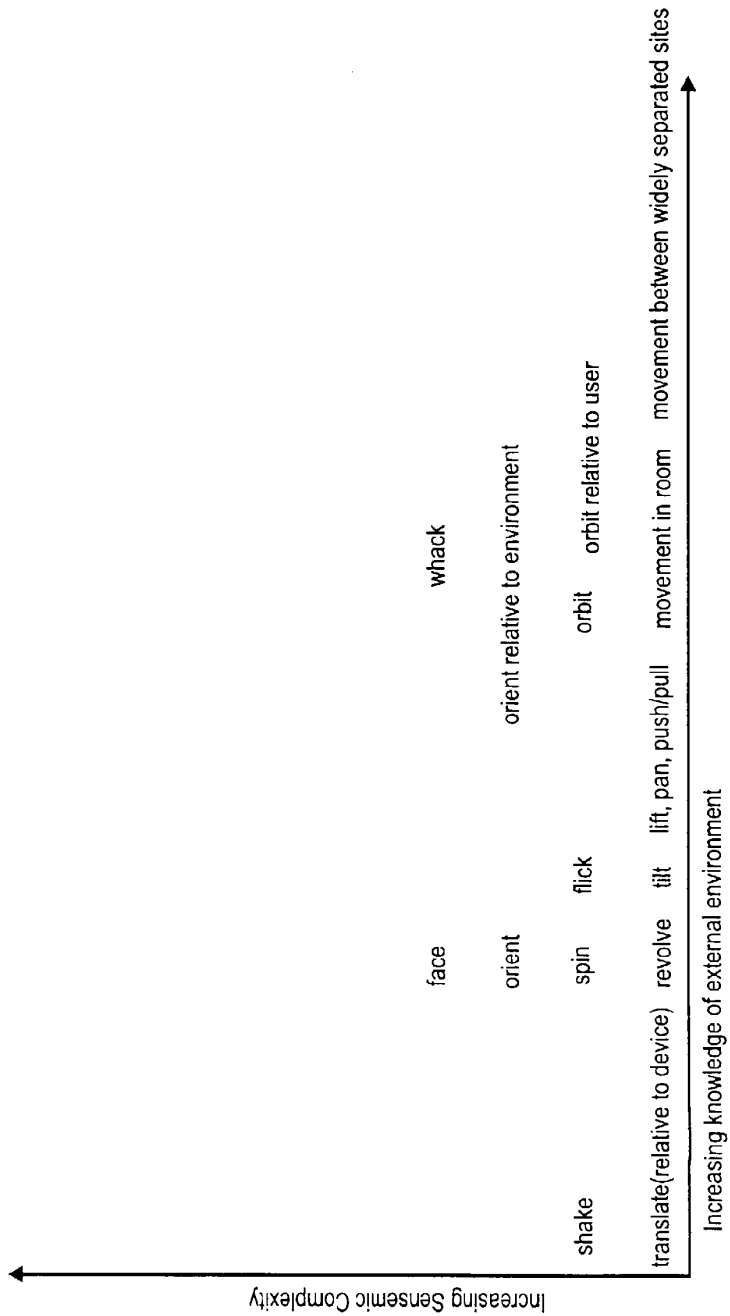


Fig. 17

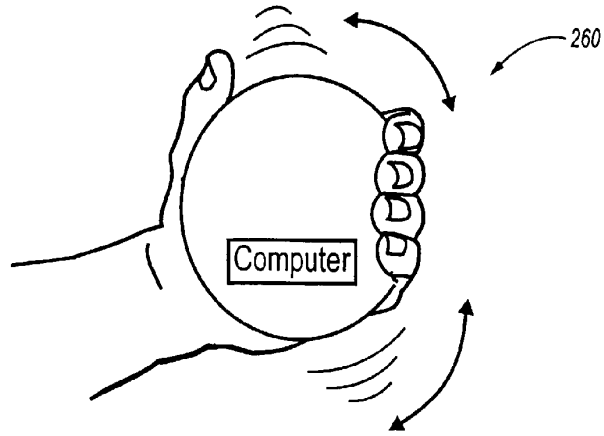


Fig. 18

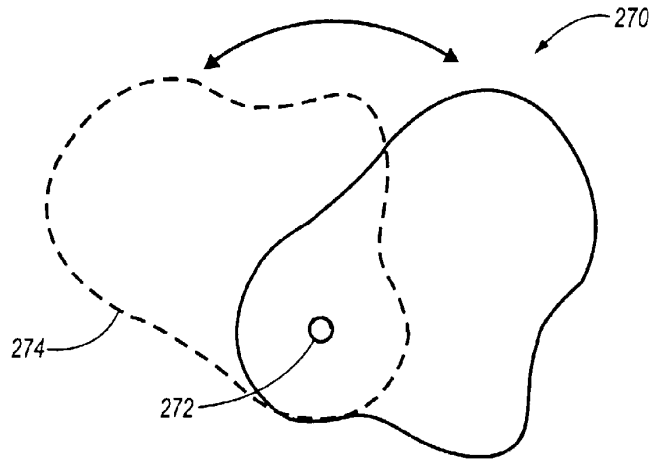


Fig. 19

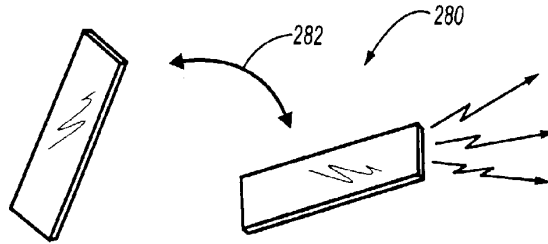


Fig. 20

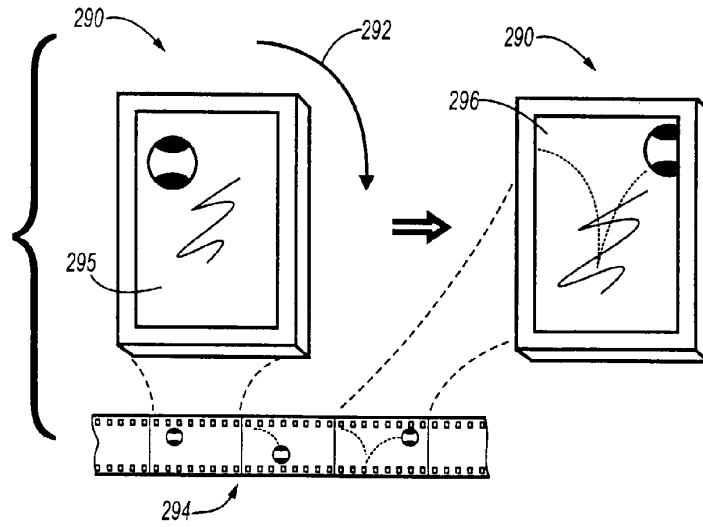


Fig. 21

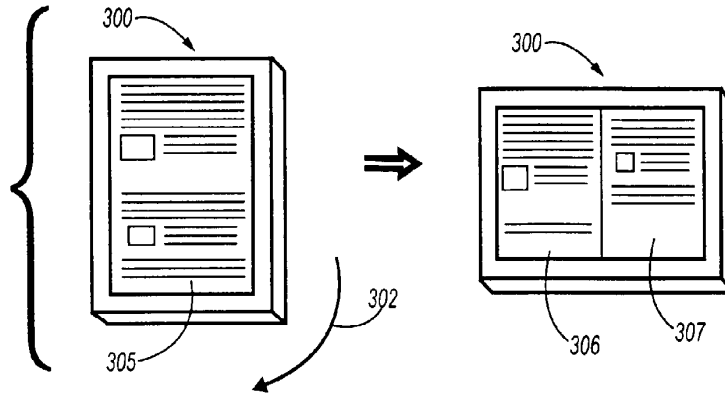


Fig. 22

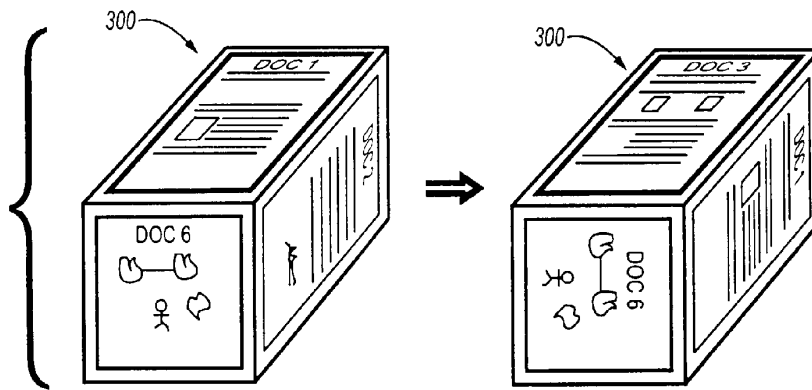


Fig. 23

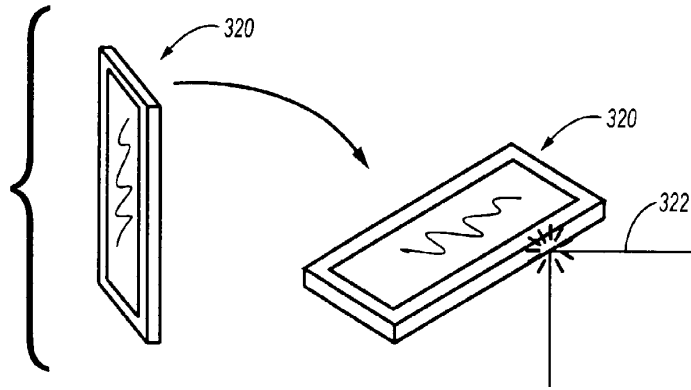


Fig. 24

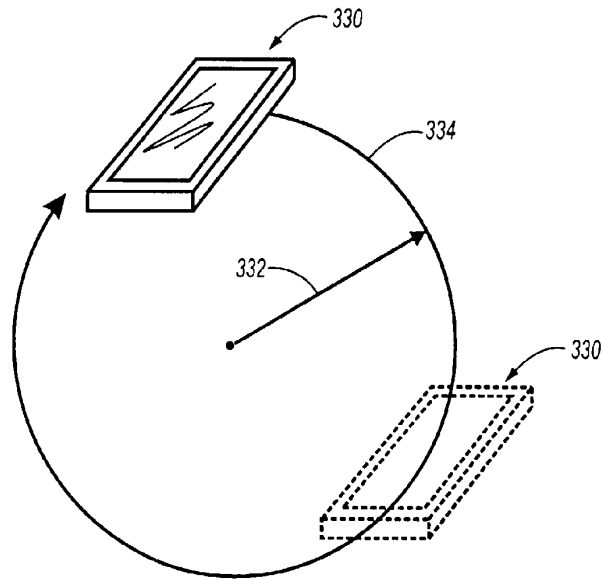


Fig. 25

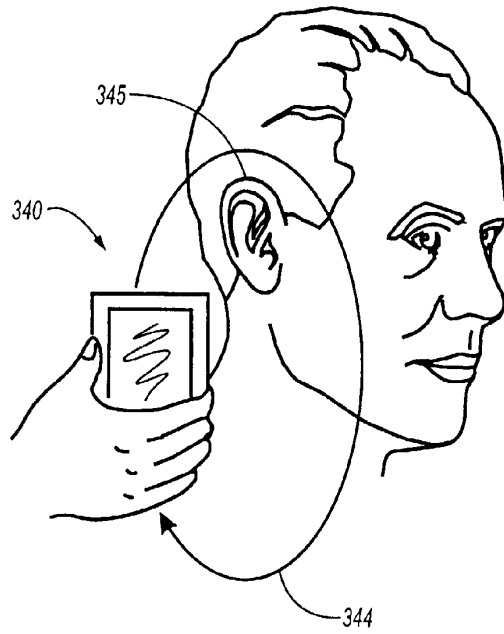


Fig. 26

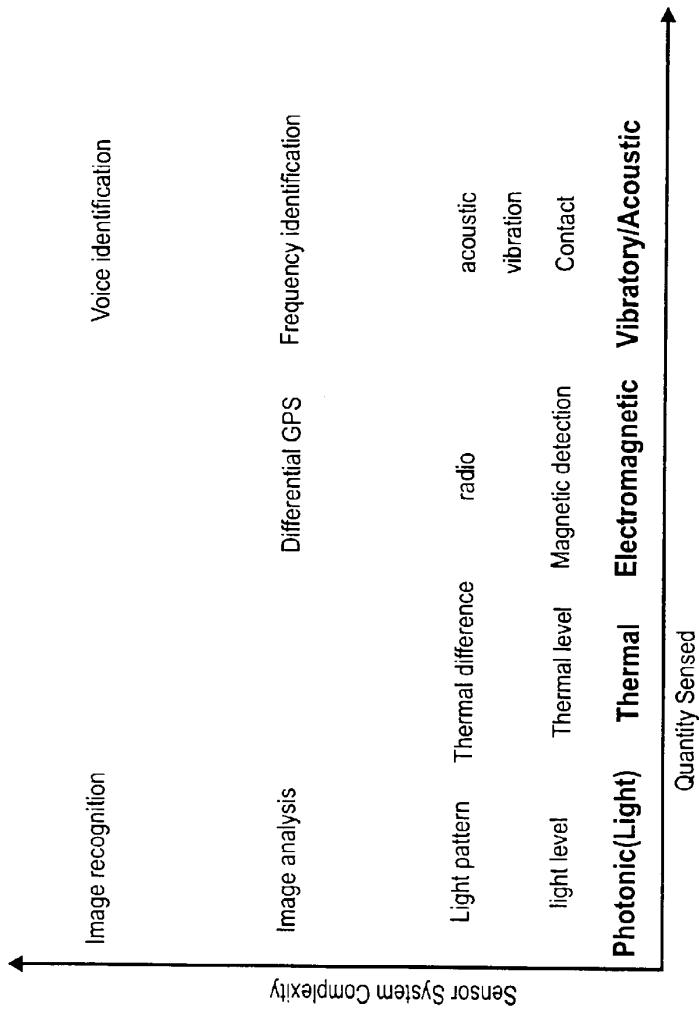


Fig. 27

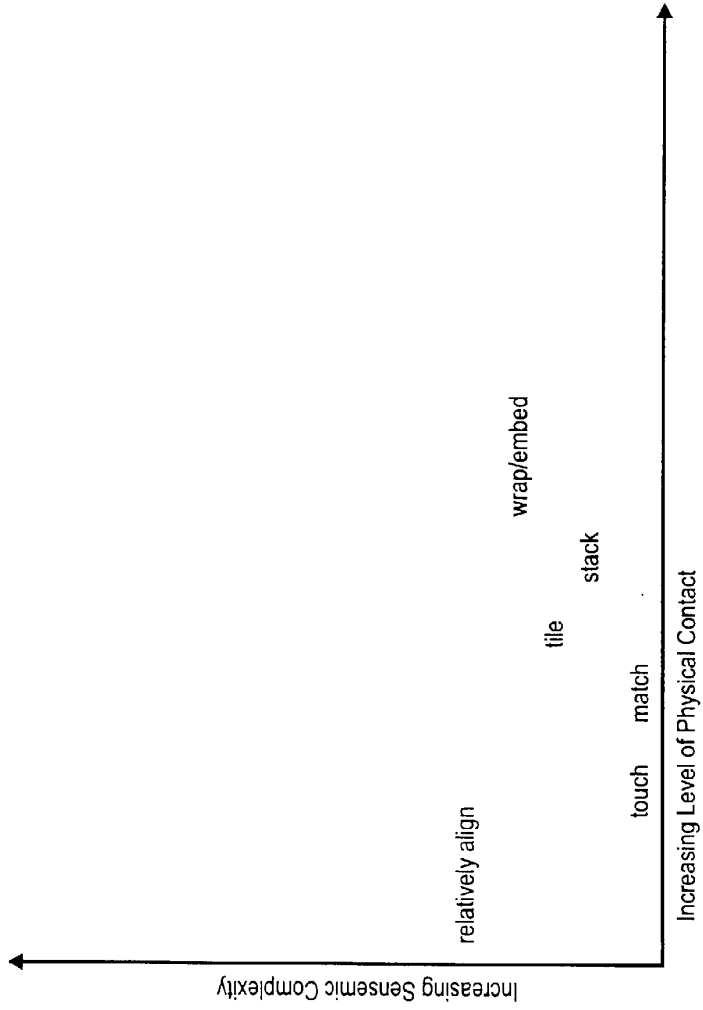


Fig. 28

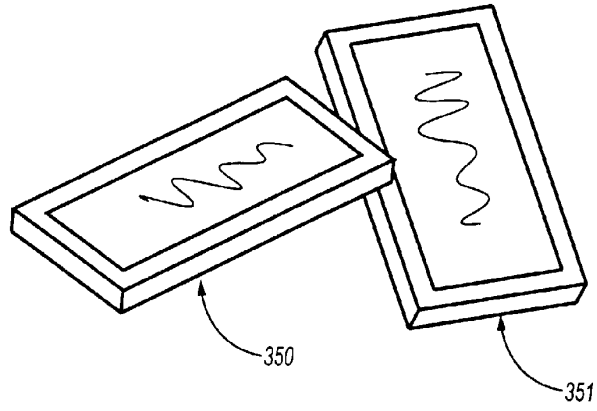


Fig. 29

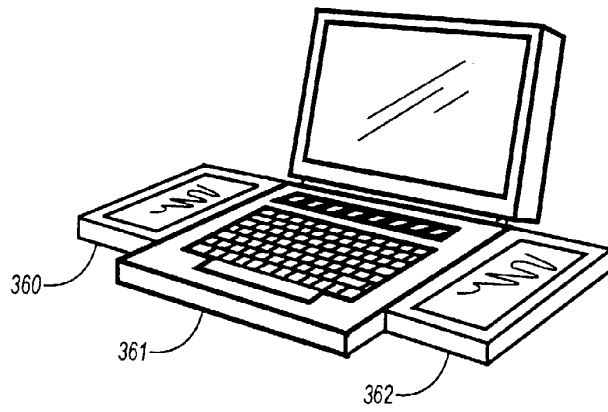


Fig. 30

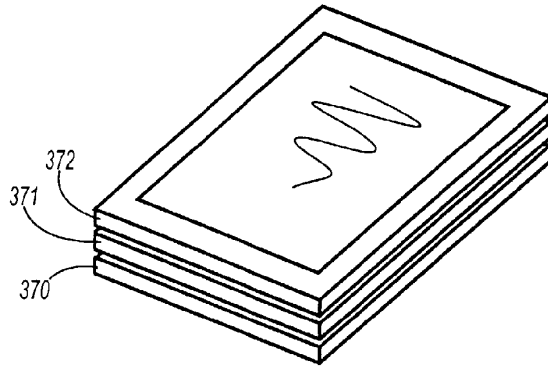


Fig. 31

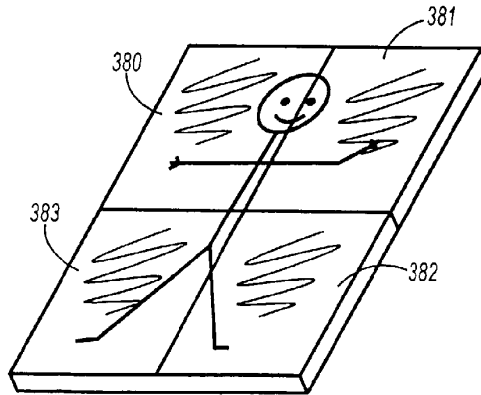


Fig. 32

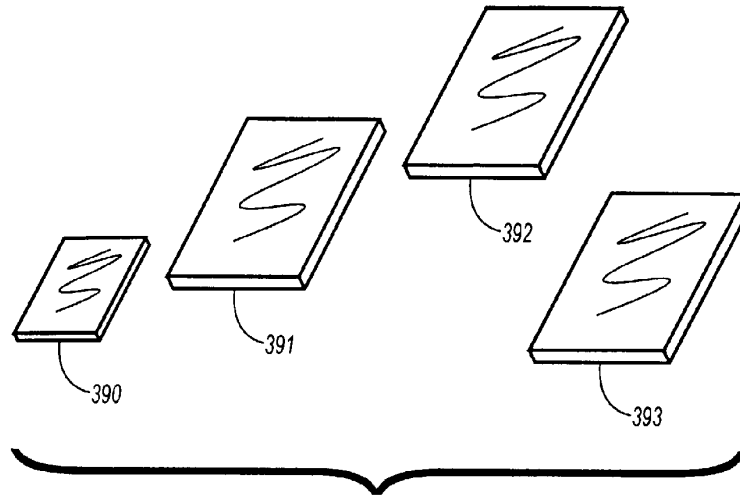


Fig. 33

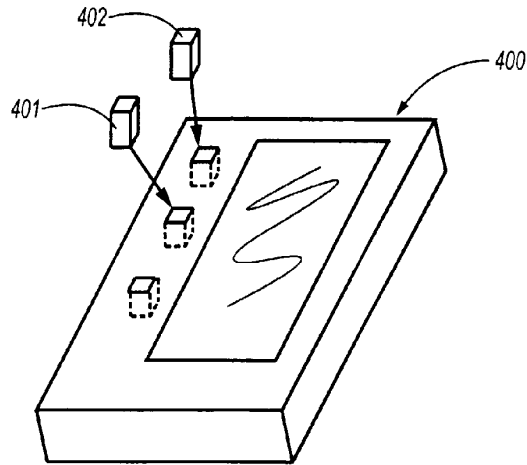


Fig. 34

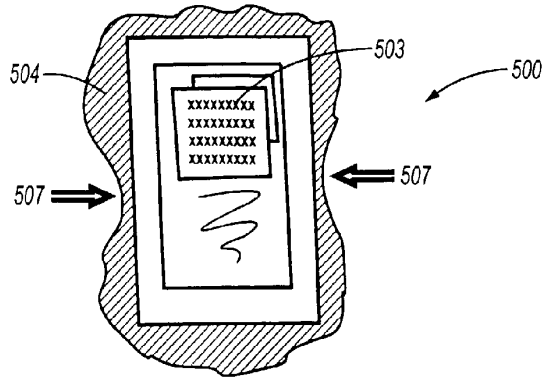


Fig. 35

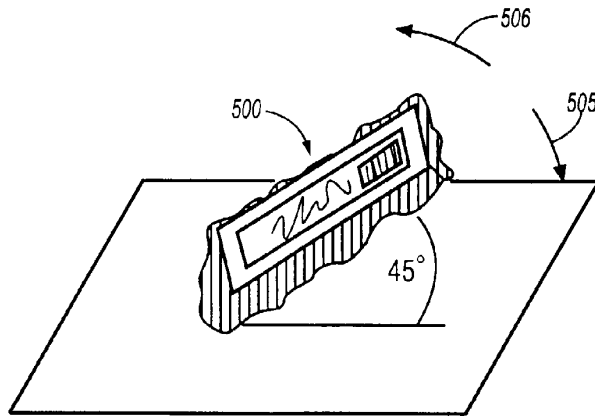


Fig. 36

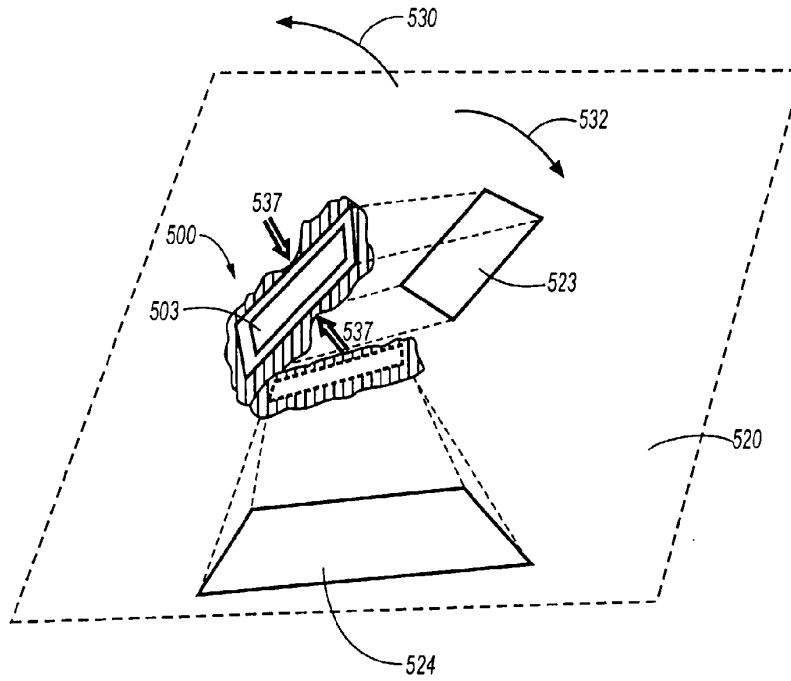


Fig. 37

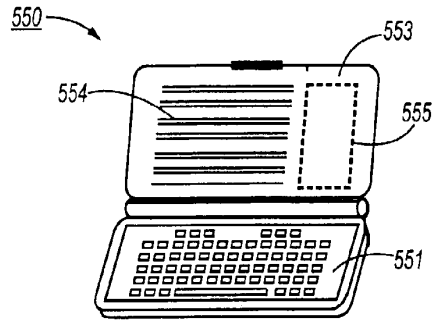


Fig. 38

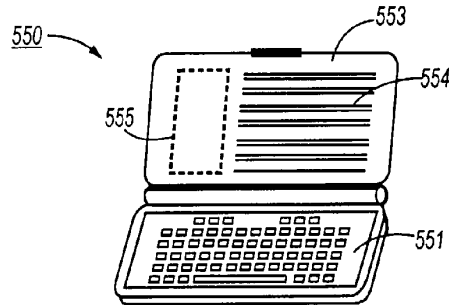


Fig. 39

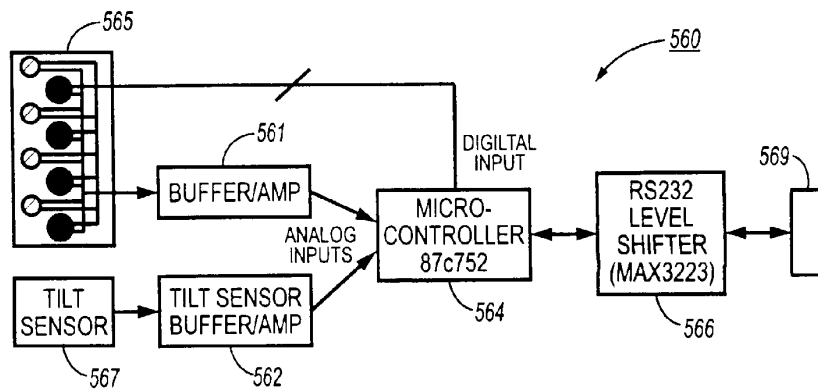


Fig. 40

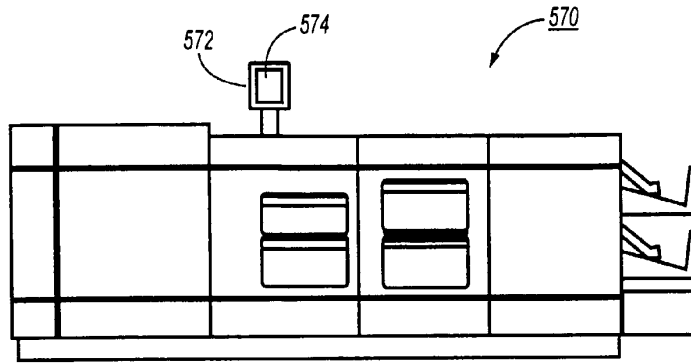


Fig. 41

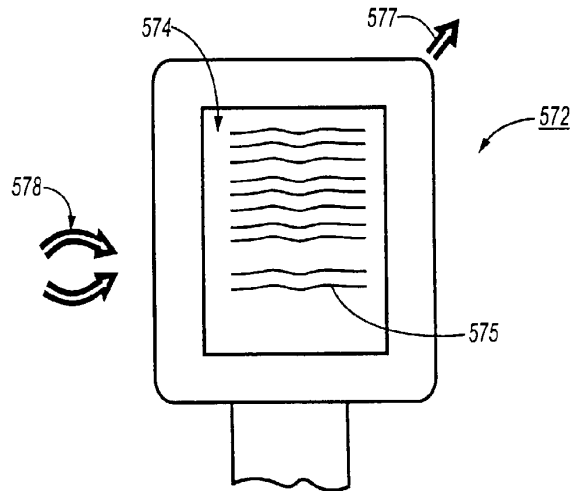


Fig. 42

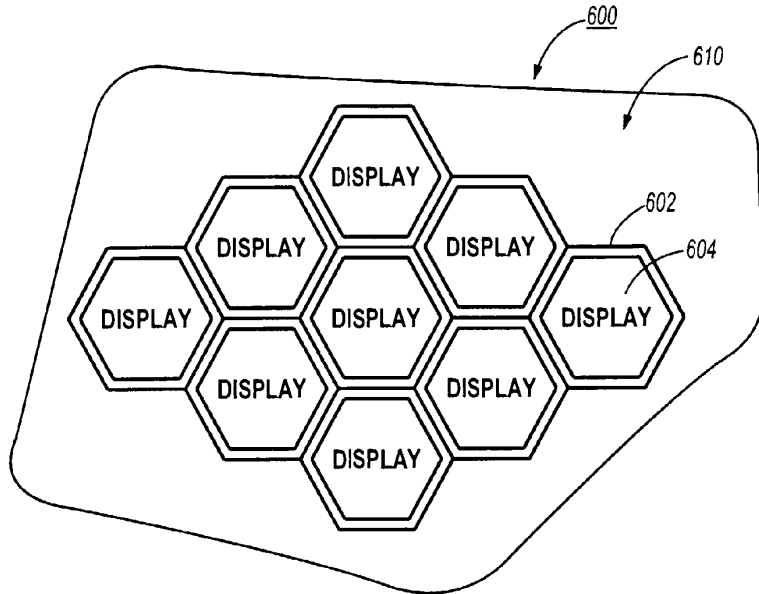


Fig. 43

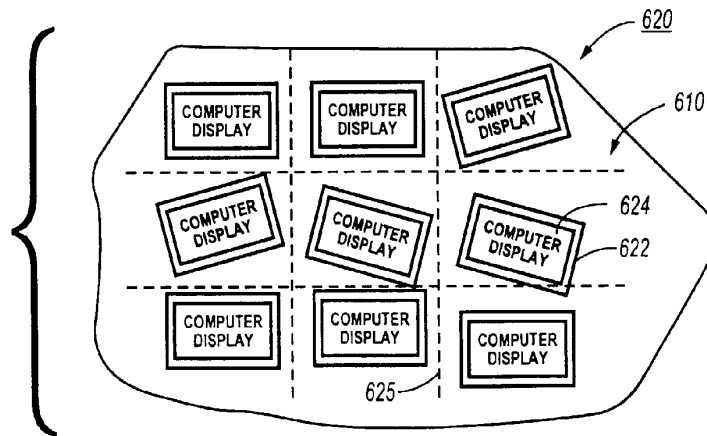


Fig. 44

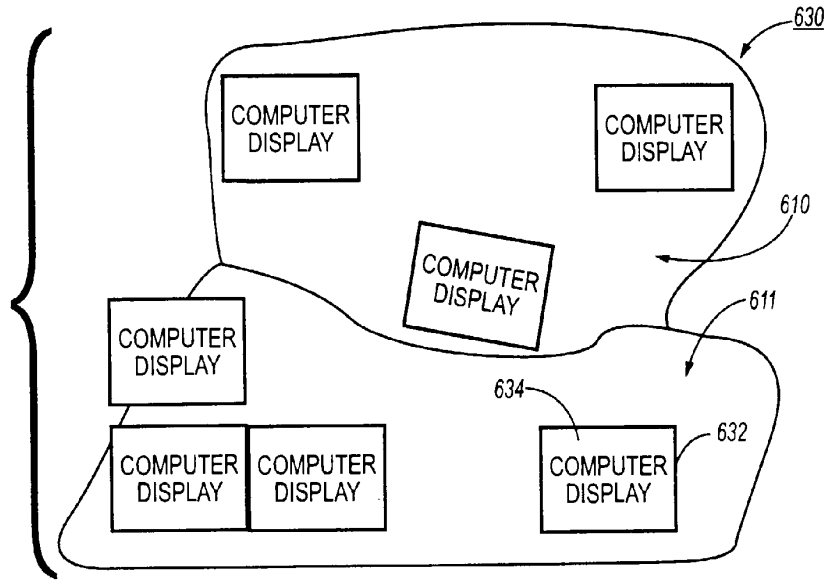


Fig. 45

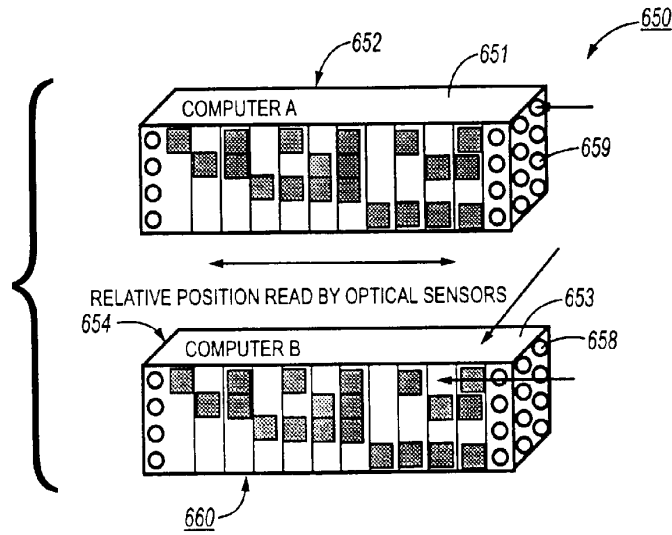


Fig. 46

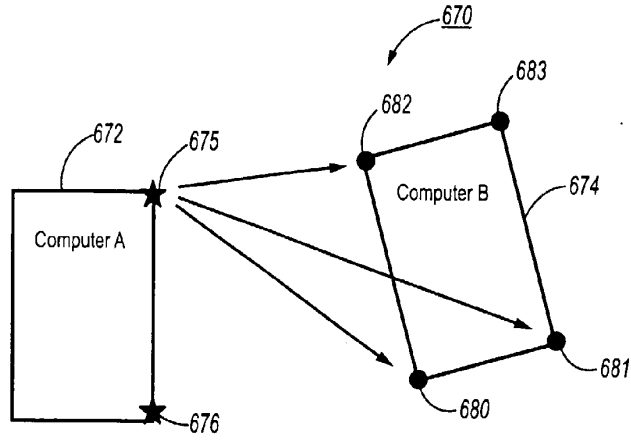


Fig. 47

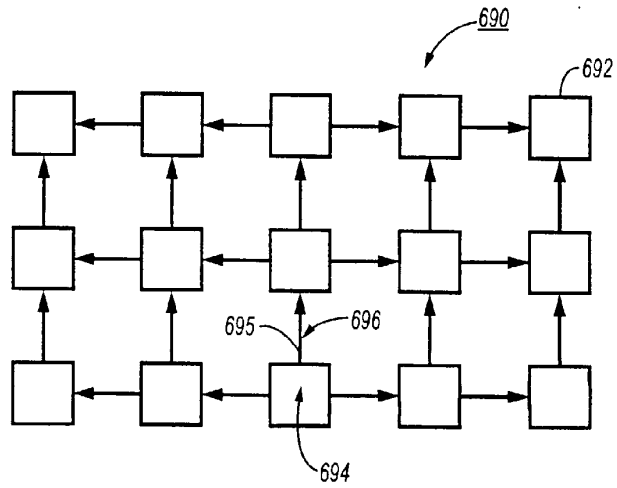


Fig. 48



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(72) Inventor: **Yu, Hyung-Seok**
Paldal-gu Suwon-city Kyungki-do (KR)

(74) Representative: **Grünecker, Kinkeldey,**
Stockmair & Schwanhäusser Anwaltssozietät
Maximilianstrasse 58
80538 München (DE)

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(71) Applicant: **SAMSUNG ELECTRONICS CO., LTD.**
Suwon-City, Kyungki-do (KR)

(54) **Method for giving notice of an incoming call through a specific vibration pattern in a mobile communication terminal**

(57) A method for giving notice of incoming call through vibration of a mobile communication terminal, and more particularly a method for giving notice of an incoming call through various vibration patterns. The method configures various vibration patterns according to a user's selection, sets the vibration patterns in a basic or particular incoming call notification mode of the

mobile communication terminal, and generates vibration based on a set vibration pattern in the basic incoming call notification mode or generates vibration based on a particular vibration pattern mapped to a particular caller telephone number set in the particular incoming call notification mode when the incoming call is received.

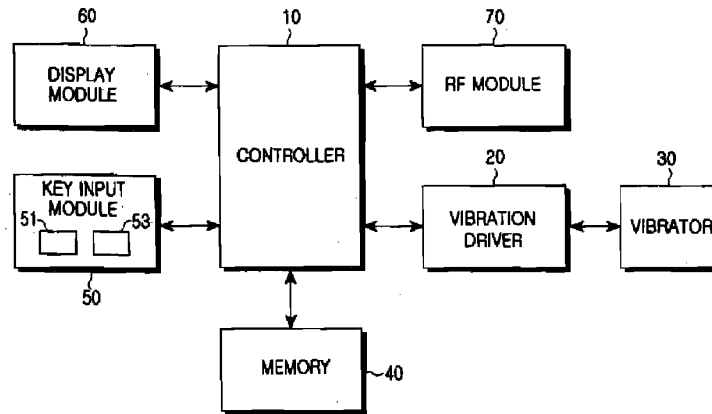


FIG. 1

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Description

[0001] The present invention relates to a method for giving notice of an incoming call in a mobile communication terminal, and more particularly to a method for giving notice of an incoming call through various vibration patterns.

[0002] Conventionally, as a method for giving notice of an incoming call, a mobile communication terminal generates a ring tone, melody, or vibration. In a method for generating the ring tone and melody, the mobile communication terminal generates a predetermined audible indication upon receiving the incoming call. Moreover, in a method for generating the vibration, the mobile communication terminal generates the vibration by driving a vibration motor when the incoming call is received.

[0003] Because the vibration of the mobile communication terminal does not annoy those around a person carrying the mobile communication terminal in public places, for example, a movie theater, the terminal's vibration mode is used for giving notice of an incoming call in the public places. According to a vibration on/off setting, the mobile communication terminal generates vibration based on a fixed vibration pattern.

[0004] As mobile communication terminals are widely used, various supplementary functions are provided to terminal users. One of the supplementary functions, a caller ID service, provides a telephone number of a caller to a mobile communication terminal of a called party. Through the caller ID service, the mobile communication terminal of the called party can display the caller's telephone number received so that the called party can identify the caller of an incoming call. Moreover, the mobile communication terminal can set a sound for particular incoming call notification so that the sound can be mapped to a telephone number previously stored by the user. Thus, the mobile communication terminal can generate the sound for particular incoming call notification according to a received telephone number of a caller. Therefore, the user can identify the caller of the incoming call through the mobile communication terminal without a special operation.

[0005] However, when the conventional mobile communication terminal gives notice of the incoming call by the vibration, a special operation is needed for identifying the caller because a vibration pattern is fixed. In particular, a visually handicapped person can never identify the caller of the incoming call before communicating with the caller.

[0006] It is the object of the present invention to provide a method for giving notice of an incoming call by providing caller information through various vibration patterns.

This object is solved by the subject matters of the independent claims: Preferred embodiments are defined by the dependent claims.

[0007] In accordance with an aspect of the present invention, the above and other objects are accomplished

by a method for giving notice of an incoming call in a mobile communication terminal, comprising the steps of: a) configuring and storing a plurality of vibration patterns according to a user's input, the vibration patterns being made up of information associated with time periods for which vibration generation is maintained, time periods for which vibration generation stops, and intensity of vibration for each time period; b) setting a vibration pattern of the stored vibration patterns for a particular telephone number of previously stored telephone numbers in a particular incoming call notification mode; and c) when an incoming call is received from a caller, generating vibration based on the set vibration pattern if the caller's telephone number matches the particular telephone number.

[0008] The above features and other advantages of the present invention will be more clearly understood from the following detailed description taken in conjunction with the accompanying drawings, in which:

Fig. 1 is a block diagram illustrating a configuration of a mobile communication terminal in accordance with the present invention;

Fig. 2 is a flow chart illustrating a procedure of configuring a vibration pattern in accordance with an embodiment of the present invention;

Fig. 3 is a flow chart illustrating a procedure of setting a configured vibration pattern in accordance with an embodiment of the present invention;

Fig. 4 is a flow chart illustrating a procedure of setting a particular vibration pattern in accordance with an embodiment of the present invention;

Fig. 5 is a flow chart illustrating a procedure of giving notice of an incoming call in accordance with an embodiment of the present invention; and

Fig. 6 is a view illustrating vibration pattern graphs in accordance with an embodiment of the present invention.

[0009] Preferred embodiments of the present invention will be described in detail herein below with reference to the annexed drawings. In the following description, detailed descriptions of known functions and configurations incorporated herein will be omitted when it may make the subject matter of the present invention rather unclear.

[0010] A configuration of a mobile communication terminal to which the present is applied will be described with reference to Fig. 1. Fig. 1 is a block diagram illustrating a configuration of a mobile communication terminal to which the present invention is applied. As illustrated in Fig. 1, the mobile communication terminal includes a controller 10, a vibration driver 20, a vibrator 30, a memory 40, a key input module 50, a display module 60, and a RF (Radio Frequency) module 70.

[0011] The controller 10 carries out an entire control operation of the mobile communication terminal. Under control of the controller 10, the RF module 70 carries

out transmission and reception of voice data and control data, the display module 60 displays various messages; and the vibration driver 20 drives the vibrator 30 so that vibration can be generated. When the vibration is generated in response to an incoming call in accordance with the present invention, intensity of the vibration varies with time for which vibration is generated. The controller 10 controls voltage applied to the vibration driver 20 according to a vibration pattern stored in the memory 40. The vibration driver 20 drives the vibrator 30 on the basis of magnitude of the applied voltage so that the intensity of the vibration can be adjusted.

[0012] The key input module 60 includes a plurality of numeric keys and function keys and outputs key input data corresponding to a key pressed by the user. In accordance with the present invention, the key input module 60 includes an intensity adjustment key 51 and a time adjustment key 53. When a vibration pattern is configured, a function of adjusting intensity of vibration is allocated to the intensity adjustment key 51 and a function of adjusting a time period for which vibration generation is maintained and a time period for which vibration generation stops is allocated to the time adjustment key 53. In accordance with the present invention, numeric keys or direction keys can be employed as the intensity adjustment key 51 and the time adjustment key 53. In accordance with the embodiment of the present invention, volume adjustment keys positioned on a left side of the mobile communication terminal can be allocated as keys having a function of adjusting the intensity for vibration, and left and right direction leys can be allocated as keys having a function of adjusting each time period.

[0013] The memory 40 stores program data necessary for controlling an operation of the mobile communication terminal and stores data generated while the mobile communication terminal is controlled. In accordance with the present invention, the memory 40 additionally stores program data for a "vibration mode menu" and a plurality of vibration patterns. Moreover, the memory 40 stores a list of telephone numbers. Through the vibration mode menu, various vibration patterns can be configured according to the user's selection. Some of the configured vibration patterns can be set in a basic incoming call notification mode.

[0014] Alternatively, a particular telephone number can be mapped to a particular vibration pattern set in a particular incoming call notification mode and the vibration of a corresponding vibration pattern can be generated according to a received telephone number of a caller when the mobile communication terminal receives an incoming call. The vibration mode menu as described above includes a vibration pattern configuration option and a vibration pattern setting sub-menu in accordance with the embodiment of the present invention. The vibration pattern is configured as a first vibration pattern graph 3 and a second vibration pattern graph 5 as illustrated in Fig. 6. The first and second vibration pattern

graphs 3 and 5 show the generation of vibration and the intensity of vibration, varying with time.

[0015] The controller 10 of the mobile communication terminal configures and stores the various vibration patterns in response to the user's selection. The controller 10 can set a vibration pattern of the stored vibration patterns in the basic incoming call notification mode. Alternatively, a particular telephone number can be mapped to a particular vibration pattern set in the particular incoming call notification mode, and the vibration of a corresponding vibration pattern can be generated according to a received telephone number of a caller when the mobile communication terminal receives an incoming call. This procedure will be described with reference to Figs. 2 to 6.

[0016] First, a procedure of configuring a vibration pattern will be described with reference to Figs. 2 and 6. Fig. 2 is a flow chart illustrating a procedure of configuring a vibration pattern in accordance with an embodiment of the present invention, and Fig. 6 is a view illustrating vibration pattern graphs in accordance with an embodiment of the present invention. Referring to Fig. 2, the controller 10 recognizes that a user has selected a vibration pattern configuration option in step 101. In step 103, the controller 10 switches an operating mode to a vibration pattern configuration mode. In step 105, the controller 10 commands the display module 60 to display an initial screen image 1 for a vibration pattern configuration graph as illustrated in Fig. 6. The initial screen image 1 for a vibration pattern configuration graph is a screen image for visually showing a vibration pattern to be configured by the user. The vibration pattern configuration graph includes a time axis T and an intensity axis S. The time axis T shows time periods for which vibration generation is maintained and time periods for which vibration generation stops. A time unit "t" of the time axis T depends upon mechanical characteristics of a vibration motor, a minimum time unit of a timer of an operating system of the mobile communication terminal, etc. An intensity unit "s" of the intensity axis S depends upon intensity of vibration capable of being recognized by the user.

[0017] After the controller 10 commands the display module 60 to display the initial screen image 1, the controller 10 configures a vibration pattern as the vibration pattern graph shown in Fig. 6 according to the intensity adjustment key 51 and the time adjustment key 53 inputted by the user and then commands the display module 60 to display a graph of the configured vibration pattern. For example, through the intensity adjustment key 51 and the time adjustment key 53, the user sets a first time period of "1t" and first intensity of "1s" of vibration to be generated for the first time period of "1t". The user then sets a second time period of "1t" after the first time period and second intensity of "2s" of vibration to be generated for the second time period of "1t". The user then sets a third time period of "2t" after the second time period and third intensity of "4s" of vibration to be gen-

erated for the third time period of "2t". The user then sets a fourth time period of "4t" after the third time period and fourth intensity of "3 s" of vibration to be generated for the fourth time period of "4t". The user then sets a fifth time period of "2t" after the fourth time period and fifth intensity of "1s" of vibration to be generated for the fifth time period of "2t". If the user can input the vibration pattern in the mobile communication terminal by manipulating the keys as described above, the controller 10 of the mobile communication terminal sequentially configures the vibration pattern according to input keys and then commands the display module 60 to display a vibration pattern graph as the first vibration pattern graph 3 shown in Fig. 6. The user can arbitrarily configure the vibration pattern and configure the vibration pattern as the second vibration pattern graph 5 shown in Fig. 6. As described above, the vibration pattern graph is displayed so that the user can configure the vibration pattern.

[0018] Returning to Fig. 2, the controller 10 determines in step 107 whether a key for vibration pattern configuration completion is input and then proceeds to step 109 if the key for vibration pattern configuration completion is input. Otherwise, the controller 10 continues to configure the vibration pattern in the above step 105. In step 109, the controller 10 stores the configured vibration pattern and then registers it to a list of vibration patterns. At this time, a storage format of vibration patterns stored in the memory 40 is as follows.

{(Time Period, Vibration Intensity)}

[0019] A storage format of the second vibration pattern graph shown in Fig. 6 is as follows.

{(1, 1), (1, 5), (2, 4), (3, 2), (2, 0), (3, 3)}

[0020] A procedure of setting the stored vibration patterns in an incoming call notification mode will be described with reference to Figs. 3 and 4. Fig. 3 is a flow chart illustrating a procedure of setting a configured vibration pattern in accordance with an embodiment of the present invention, and Fig. 4 is a flow chart illustrating a procedure of setting a particular vibration pattern in accordance with an embodiment of the present invention.

[0021] Referring to Fig. 3, in step 201 a vibration pattern setting sub-menu is selected by the user. In step 203, the controller 10 switches an operating mode to a vibration pattern setting mode and then commands the display module 60 to display a basic vibration pattern setting option and a particular vibration pattern setting option contained in the vibration pattern setting sub-menu. The basic vibration pattern setting option is for giving notice of an incoming call on the basis of a basic vibration pattern in the basic incoming call notification mode when the mobile communication terminal receives the incoming call. The particular vibration pattern setting option is for giving notice of an incoming call on the basis of a particular vibration pattern mapped to a particular caller telephone number in the particular incoming call notification mode when the mobile commu-

nication terminal receives the incoming call.

[0022] In step 205, the controller 10 determines whether the user selects the basic vibration pattern setting option. The controller 10 proceeds to step 207 if the user selects the basic vibration pattern setting option. Otherwise, the controller 10 proceeds to step 209. In step 207, the controller 10 sets, in the basic incoming call notification mode, a vibration pattern of the vibration patterns previously registered according to the user's selection.

[0023] If, in step 205, the user has selected the particular vibration pattern setting option, i.e., if the user does not select the basic vibration pattern setting option the controller 10 sets, in the particular incoming call notification mode, a vibration pattern of the vibration patterns previously registered for a particular caller telephone number according to the user's selection in step 209.

[0024] A procedure of setting a particular vibration pattern for a particular telephone number in the particular incoming call notification mode in the above step 209 will be described in detail with reference to Fig. 4. Referring to Fig. 4, the controller 10 switches an operating mode to the particular vibration pattern setting mode, if the user selects the particular vibration pattern setting option at the above step 205 of Fig. 3. The controller 10 commands the display module 60 to display a list of telephone numbers previously registered at step 301. The controller 10 recognizes a telephone number selected by the user at the above step 303 and then proceeds to step 305. In step 305, the controller 10 commands the display module 60 to display a list of registered vibration patterns. In step 307, the controller 10 recognizes a vibration pattern selected by the user. In step 309, the controller 10 sets or maps the vibration pattern selected in the above step 307 and the telephone number selected in the above step 303 in the particular incoming call notification mode.

[0025] Hereinafter, a description will be given of an operation of the controller 10 when the incoming call is received after an incoming call notification mode is set through the above-described procedure with reference to Fig. 5. Fig. 5 is a flow chart illustrating a procedure of giving notice of an incoming call in accordance with an embodiment of the present invention. After an incoming call is received in step 401, the controller 10 proceeds to step 403. In step 403, the controller 10 determines whether an operating mode of the mobile communication terminal is currently a vibration mode. If the operating mode of the mobile communication terminal is currently the vibration mode, the controller 10 proceeds to step 405. If the operating mode of the mobile communication terminal is not currently the vibration mode, the controller 10 proceeds to step 417. In step 417, the controller 10 gives notice of the incoming call according to another operating mode set by the user.

[0026] In step 405, the controller 10 determines whether the incoming call notification mode is a basic

incoming call notification mode. If the basic incoming call notification mode is set, the controller 10 proceeds to step 407. If the basic incoming call notification mode is not set, the controller 10 proceeds to step 415. In step 415, the controller 10 controls the vibrator 30 through the vibration driver 20 so that the vibrator 30 can generate vibration based on the set vibration pattern for pre-determined time periods until the user inputs a response to the vibration.

[0027] On the other hand, the controller 10 determines in the above step 407 whether the incoming call notification mode is a particular incoming call notification mode. If the particular incoming call notice is set, the controller 10 proceeds to step 409. If the particular incoming call notice is not set, the controller 10 proceeds to step 413. In step 413, the controller 10 controls the vibrator 30 through the vibration driver 20 so that the vibrator 30 can generate general vibration for a pre-determined period of time until the user gives a response to the vibration.

[0028] In step 409, the controller 10 determines whether a telephone number of an incoming call matches a telephone number mapped to a particular vibration pattern. If a caller's telephone number of an incoming call matches a telephone number mapped to a particular vibration pattern, the controller 10 proceeds to step 411. If a caller's telephone number of an incoming call does not match a telephone number mapped to a particular vibration pattern, the controller 10 proceeds to step 413. In step 411, the controller 10 controls the vibrator 30 through the vibration driver 20 so that the vibrator 30 can generate vibration based on the particular vibration pattern mapped to the caller's telephone number for pre-determined time periods until the user inputs a response to the vibration.

[0029] As is apparent from the description above, the present invention provides a method for giving notice of an incoming call by generating vibrations of different vibration patterns based on a caller's telephone number when the mobile communication terminal receives the incoming call.

[0030] Although preferred embodiments of the present invention have been disclosed for illustrative purposes, those skilled in the art will appreciate that various modifications, additions, and substitutions are possible, without departing from the scope of the invention. Therefore, the present invention is not limited to the above-described embodiments, but the present invention is defined by the claims, which follow along with their full scope of equivalents.

Claims

1. A method for giving notice of an incoming call in a mobile communication terminal, comprising the steps of:

setting a vibration pattern in an incoming call notification mode; and
when an incoming call is received, generating vibration based on the set vibration pattern.

2. The method as set forth in claim 1, wherein the vibration pattern is set for a particular telephone number of previously stored telephone numbers in a particular incoming call notification mode.

3. The method as set forth in claim 1 or 2, wherein the incoming call is received from a caller.

4. The method as set forth in claim 2 or 3, wherein the vibration is generated based on the set vibration pattern if a telephone number of the incoming call matches the particular telephone number.

5. The method as described in one of claims 1 to 4, further comprising configuring and storing a plurality of vibration patterns according to a user's input, the plurality of vibration patterns including information associated with time periods for which vibration generation is maintained, time periods for which vibration generation stops, and intensity of vibration for each time period.

6. The method as set forth in claim 5, wherein the plurality of vibration patterns are configured by inputs of an intensity adjustment key and a time adjustment key from a user.

7. The method as set forth in claim 6, wherein the intensity adjustment key and the time adjustment key are volume adjustment keys of the mobile communication terminal.

8. The method as set forth in claim 5 or 6, wherein the configuring and storing the plurality of vibration patterns according to a user's input comprises the steps of:

displaying a graph corresponding to information associated with time periods for which vibration generation is maintained, time periods for which vibration generation stops, and intensity of vibration for each time period, in response to the inputs of the intensity adjustment key and the time adjustment key from the user; and

storing a vibration pattern based on the displayed graph in response to a configuration completion command from the user.

9. The method as set forth in one of claims 5, 6 or 8, wherein the plurality of vibration patterns are displayed in form of a graph according to a user's request.

10. The method as set forth in one of claims 5, 6, 8 or 9, wherein the plurality of vibration patterns are displayed in text form according to a user's request.

11. A mobile communication terminal adapted to operate according to one of claims 1 to 10.

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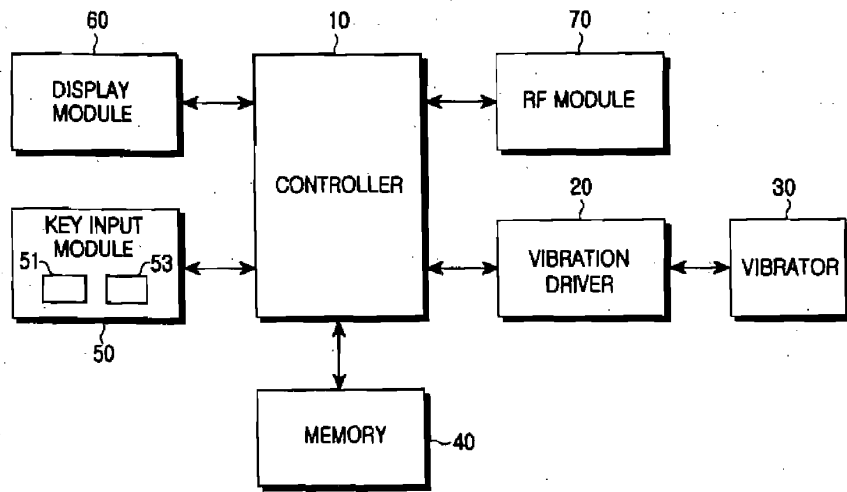


FIG.1

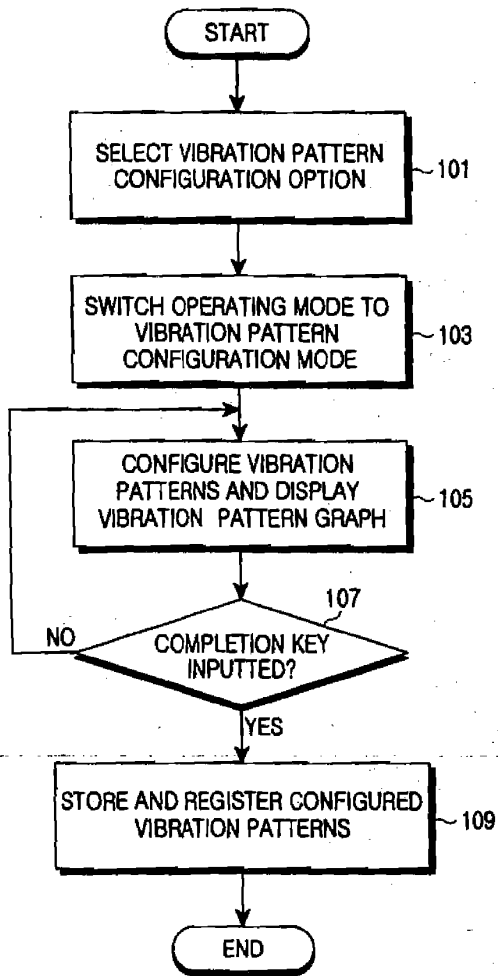


FIG.2

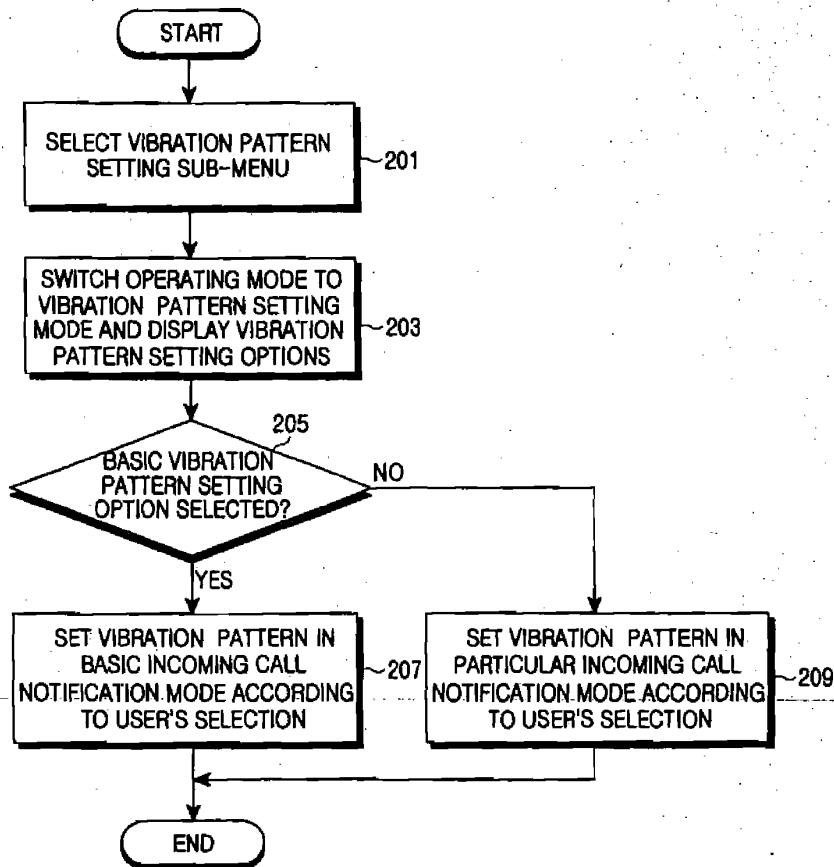


FIG.3

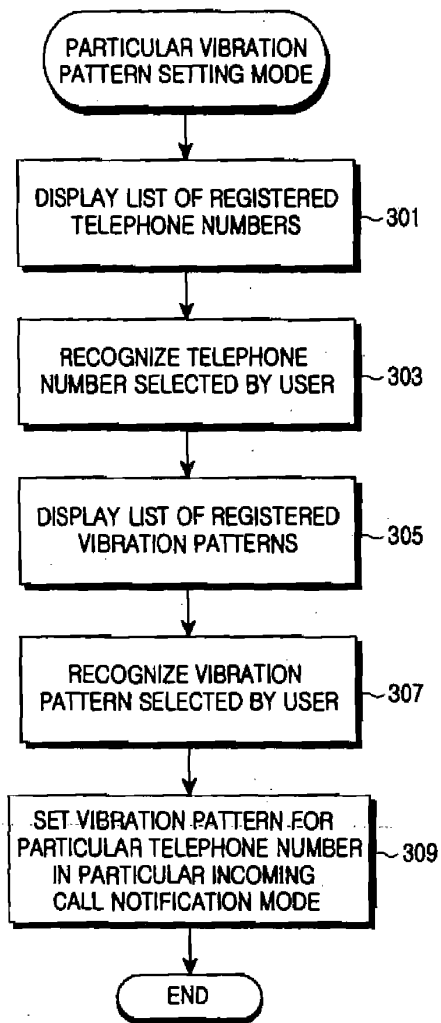


FIG.4

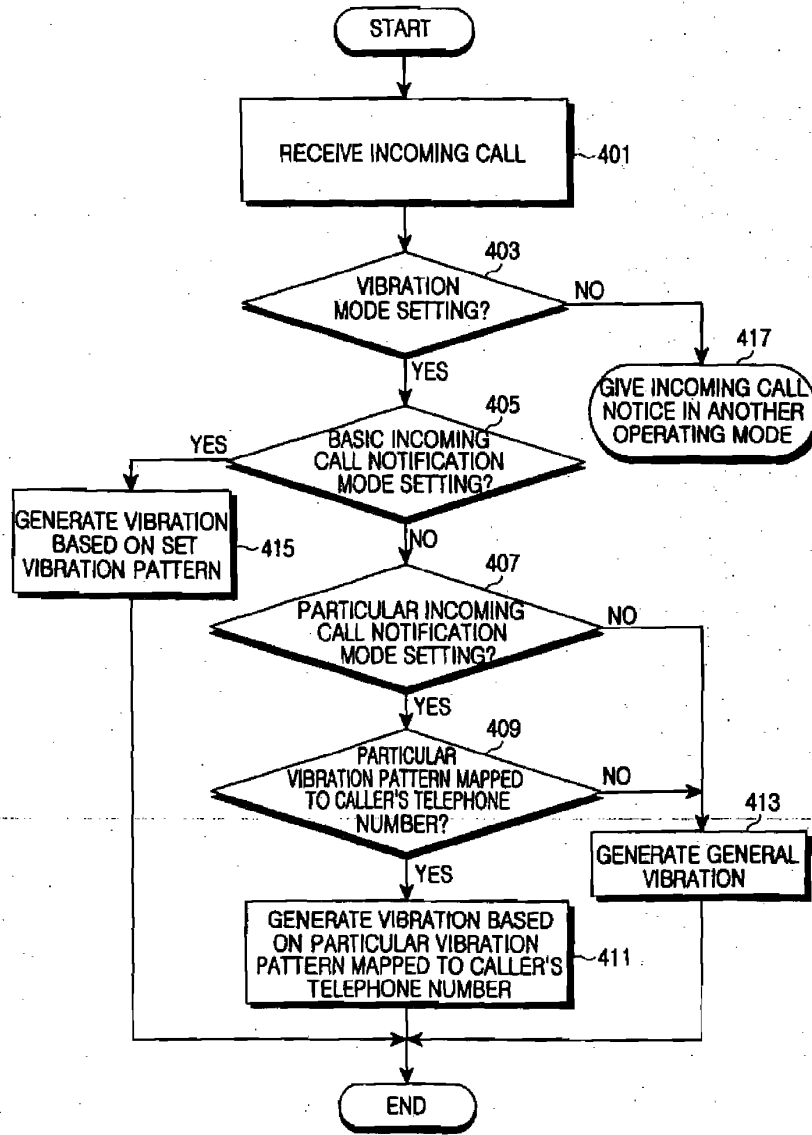
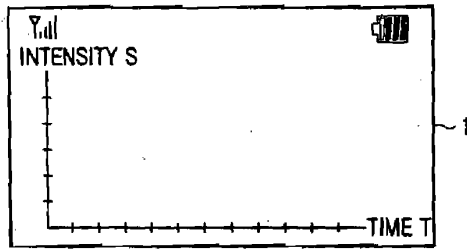
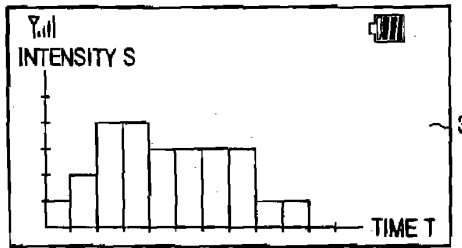


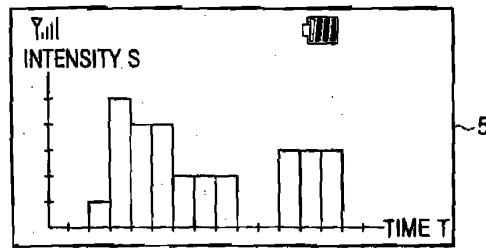
FIG. 5



INITIAL SCREEN IMAGE FOR VIBRATION PATTERN CONFIGURATION



FIRST VIBRATION PATTERN GRAPH



SECOND VIBRATION PATTERN GRAPH

FIG.6

EP 1 401 185 A1



EUROPEAN SEARCH REPORT

Application Number
EP 03 02 1324

DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.7)
X	US 6 160 489 A (PERRY THERESA SUE ET AL) 12 December 2000 (2000-12-12) * abstract * * column 1, line 5-10 * * column 5, line 33 - column 6, line 46 * * figures 2-4 *	1-11	H04M19/04
A	PATENT ABSTRACTS OF JAPAN vol. 1998, no. 02, 30 January 1998 (1998-01-30) & JP 09 261744 A (AIWA CO LTD), 3 October 1997 (1997-10-03) * abstract * * figure 3 *	6,7	
			TECHNICAL FIELDS SEARCHED (Int.Cl.7)
			H04M
The present search report has been drawn up for all claims			
Place of search MUNICH		Date of completion of the search 6 November 2003	Examiner Pohl, M
CATEGORY OF CITED DOCUMENTS			
X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document		T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons Z : member of the same patent family, corresponding document	

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**ANNEX TO THE EUROPEAN SEARCH REPORT
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EP 03 02 1324

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For more details about the annex : see Official Journal of the European Patent Office, No. 12/82



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- **Ive, Jonathan P.**
San Francisco, CA 94114 (US)
- **Rohrbach, Matthew Dean**
San Francisco, CA 94131 (US)
- **Stringer, Christopher J.**
Portola Valley, CA 94028 (US)

(30) Priority: **11.02.2005** **US 57050**

(74) Representative: **Alton, Andrew**
Tower North Central
Merrion Way
Leeds LS2 8PA (GB)

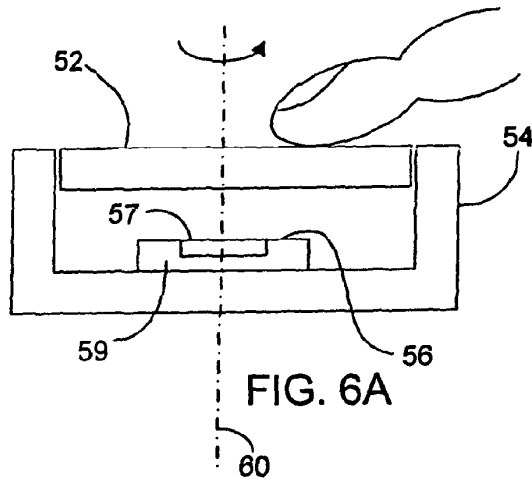
(71) Applicant: **APPLE COMPUTER, INC.**
Cupertino, CA 95014-2084 (US)

(72) Inventors:
 • **Zadesky, Stephen Paul**
San Carlos, CA 94070 (US)

(54) **Display actuator**

(57) A display device that both displays visual information and that serves as a mechanical actuator to generate input signals is disclosed (i.e., display device is not only an output device, but also a mechanically actuated input device). By way of example, the display device, which displays visual information such as text, characters and graphics, may also act like a push or clickable button (s), a sliding toggle button or switch, a rotating dial or

knob, a motion controlling device such as a joystick or navigation pad, and/or the like. The display actuator may be incorporated into any electronic device to control various aspects of the electronic device. Alternatively, the display actuator may be a stand alone device that operatively couples to an electronic devices through wired or wireless connections. In either case, the display actuator can be configured to generate commands, make selections and/or control movements in a display.



Description

[0001] The present invention relates generally to electronic devices. More particularly, the present invention relates to an electronic device having a display having both input and output functionality.

[0002] There exist today many types of consumer electronic devices, each of which utilizes some sort of user interface. The user interface typically includes an output device in the form of a fixed display, such as an Liquid Crystal Display (LCD), and one or more input devices, which can be mechanically actuated as for example, switches, buttons, keys, dials, joysticks, navigation pads, or electrically activated as for example touch pads and touch screens. The display is typically configured to present visual information such as text and graphics, and the input devices are typically configured perform operations such as issuing commands, making selections or moving a cursor or selector in the consumer electronic device. Each of these well known devices has considerations such as size and shape limitations, costs, functionality, complexity, etc. that must be taken into account when designing the consumer electronic device. In most cases, the user interface is positioned on the front face of the electronic device for easy viewing of the display and easy manipulation of the input devices.

[0003] Figs. 1A-1F are diagrams of various handheld electronic devices including for example a telephone 10A (Fig. 1A), a PDA 10B (Fig. 1B), a media player 10C (Fig. 1C), a remote control 10D (Fig. 1D), a camera 10E (Fig. 1E), and a GPS module 10F (Fig. 1F). Figs 1G-1H, on the other hand, are diagrams of other types of electronic devices including for example a laptop computer 10G (Fig. 1G), a stereo 10H (Fig. 1H), and a fax machine 10I (Fig. 1I). In each of these devices 10, a display 12 is secured inside the housing of the device 10. The display 12 can be seen through an opening in the housing, and is typically positioned in a first region of the electronic device 10. One or more input devices 14 are typically positioned in a second region of the electronic device 10 next to the display 12 (excluding touch screens, which are positioned over the display).

[0004] To elaborate, the telephone 10A typically includes a display 12 such as a character or graphical display, and input devices 14 such as a number pad and in some cases a navigation pad. The PDA 10B typically includes a display 12 such as a graphical display, and input devices 14 such as a touch screen and buttons. The media player 10C typically includes a display 12 such as a character or graphic display, and input devices 14 such as buttons or wheels. The iPod brand media player manufactured by Apple Computer, Inc. of Cupertino, CA is one example of a media player that includes both a display and input devices disposed next to the display. (iPod is a trade mark of Apple Computer, Inc. which is registered in some countries.) The remote control 10D typically includes an input device 14 such as a keypad and may or may not have a character display 12. The

camera 10E typically includes a display 12 such as a graphic display and input devices 14 such as buttons. The GPS module 10F typically includes a display 12 such as graphic display and input devices 14 such as buttons, and in some cases a navigation pad. The laptop computer 10G typically includes a display 12 such as a graphic display, and input devices 14 such as a keyboard, a touchpad and in some cases a joystick. The iBook brand notebook computer manufactured by Apple Computer, Inc. of Cupertino, CA is one example of a laptop computer that includes both a display and input devices disposed next to the display as for example in a base. (iBook is a trade mark of Apple Computer Inc which is registered in some countries.) The stereo 10H typically includes a display 12 such as a character display, and input devices such as buttons and dials. The fax machine 10I typically includes a display 12 such as a character display, and input devices 14 such as a number pad and one or more buttons.

[0005] Although the user interface arrangements described above work particularly well, improved user interface devices, particularly ones that can reduce the amount of real estate required and/or ones that can reduce or eliminate input devices, are desired. By reducing or eliminating the input devices, the display of the electronic device can be maximized within the user interface portion of the electronic device, or alternatively the electronic device can be minimized to the size of the display.

[0006] The invention relates, in one aspect, to an integral input/output device. The integral input/output device includes a display that moves relative to a frame. The integral input/output device also includes a movement detection mechanism configured to generate signals when the display is moved. The signals are indicative of at least one predetermined movement of the display.

[0007] The invention relates, in another aspect, to an electronic device having a housing and a display device. The improvement includes constraining the display device within the housing while permitting a least one component of the display device to be moved within the housing so as to signal at least one user input.

[0008] The invention relates, in another aspect, to a hand held electronic device. The hand held electronic device includes a housing enclosing operational components of the hand held electronic device. The hand held electronic device also includes a display actuator disposed at a surface of the housing. The display actuator includes at least a display device and a detection mechanism. The display device is configured to present visual information within a viewing area of the housing. The display device also has a movable component that moves relative to the housing. The detection mechanism is configured to generate signals when the movable component is moved relative to the housing.

[0009] The invention relates, in another aspect, to a method for receiving a user input. The method is implemented on an electronic device having a display. The method includes displaying a graphical user interface on

the display. The method also includes generating one or more input signals when the display is moved. The input signals are used to provide user input to the electronic device.

[0010] The invention relates, in another aspect, to an electronic device. The electronic device includes a housing. The electronic device also includes a movable display apparatus constrained within the housing, wherein physically moving the movable display apparatus within the housing operates to signal at least one user input.

[0011] Embodiments of the invention may will now be described in detail, by way of example only, with reference to the accompanying drawings, in which:

Figs. 1A-1I are diagrams of various electronic devices.

Fig. 2 is a side elevation view, in cross section, of a display actuator, in accordance with one embodiment of the present invention.

Figs. 3A and 3B are side elevation views, in cross section, of a push display button, in accordance with one embodiment of the present invention.

Figs. 4A and 4B are side elevation views, in cross section, of a sliding display switch, in accordance with one embodiment of the present invention.

Figs. 5A - 5C are side elevation views, in cross section, of a clickable display button, in accordance with one embodiment of the present invention.

Figs. 6A and 6B are side elevation views, in cross section, of a display dial, in accordance with one embodiment of the present invention.

Figs. 7A and 7B, are side elevation views, in cross section, of a display actuator with a touch screen, in accordance with one embodiment of the present invention.

Fig. 8 is a simplified perspective diagram of an electronic device, in accordance with one embodiment of the present invention.

Fig. 9 is a side elevation view, in cross section, of an electronic device, in accordance with one embodiment of the present invention.

Figs. 10A-10D are side elevation views, in cross section, of the electronic device shown in Fig. 9, in accordance with one embodiment of the present invention.

Figs. 11A and 11B are side elevation views, in cross section, of an electronic device, in accordance with an alternate embodiment of the present invention.

Fig. 12 is diagram of an electronic device, in accordance with an alternate embodiment of the present invention.

Fig. 13 is a diagram of an electronic device, in accordance with an alternate embodiment of the present invention.

Fig. 14 is a perspective diagram of an electronic device, in accordance with one embodiment of the present invention.

Fig. 15A is a side elevation view, in cross section, of

an electronic device, in accordance with one embodiment of the present invention.

Fig. 15B is a top view, in cross section, of the electronic device shown in Fig. 15A, in accordance with one embodiment of the present invention.

Figs. 16A and 16B are side elevation views, in cross section, of the electronic device shown in Fig. 15A, in accordance with one embodiment of the present invention.

Fig. 17 is a diagram of an electronic device, in accordance with an alternate embodiment of the present invention.

Fig. 18 is a block diagram of an electronic device, in accordance with one embodiment of the present invention.

[0012] The invention relates to a display apparatus that both displays visual information and serves as a mechanical actuator to generate input signals. That is, the display apparatus is not only an output device, but also a mechanically actuated input device. Accordingly, in one embodiment, the display apparatus can be referred to as a display actuator. By way of example, the display apparatus, which displays visual information such as text, characters and/or graphics, may also act like a push or clickable button(s), a sliding toggle button or switch, a rotating dial or knob, a motion controlling device (such as a joystick or navigation pad), and/or the like. The display apparatus may be incorporated into any electronic device to control various aspects of the electronic device. Alternatively, the display apparatus may be a stand alone device that operatively couples to an electronic device through wired or wireless connections. For example, the display apparatus may be a peripheral input/output device that connects to a personal computer. In either case, the display apparatus can be configured to generate commands, make selections and/or control movements in a display.

[0013] Embodiments of the invention are discussed below with reference to Figs. 2-18. However, those skilled in the art will readily appreciate that the detailed description given herein with respect to these figures is for explanatory purposes as the invention extends beyond these limited embodiments.

[0014] Fig. 2 is a display actuator 50, in accordance with one embodiment of the present invention. The display actuator 50 includes a movable display 52 that along with presenting visual information, such as text, characters and graphics via display signals from display control circuitry 53, also causes one or more input signals to be generated when moved. The input signals can be used to initiate commands, make selections, or control motion in a display. The display 52 is typically movable relative to a frame or housing 54 that movably supports the display in its various positions. In some cases, the display 52 is movably coupled to the frame 54, and in other cases the frame movably restrains a floating display. Furthermore, the input signals are typically generated by a de-

tection mechanism 56 that monitors the movements of the display 52 and produces signals indicative of such movements.

[0015] The display 52, which again is configured to display text, characters and/or graphics via one or more display signals, is typically selected from flat panel devices although this is not a requirement and other types of displays may be utilized. Flat panel devices typically provide a rigid planar platform, which is robust and which makes for easy manipulation thereof. By way of example, the display 52 may correspond to a liquid crystal display (LCD) such as character LCDs that are capable of presenting text and symbols or graphical LCDs that are capable of presenting images, video, and graphical user interfaces (GUI). Alternatively, the display 52 may correspond to a display based on organic light emitting diodes (OLED), or a display that is based on electronic inks. More alternatively, the display may be based on plasma and DLP technologies.

[0016] The movements of the display 52 may be widely varied. For example, the movable display 52 may be configured to translate, slide, pivot, and/or rotate relative to the frame 54. As shown in Figs. 3A and 3B, the movable display 52 is configured to translate as, for example, in the z-direction, such that the display 52 is depressible (by a force F) in a manner similar to a push button. For example, the display 52 may translate between an upright and a depressed position in order to generate an input signal via the detection mechanism 56.

[0017] As shown in Figs. 4A and 4B, the movable display 52 is configured to slide in for example the x and/or y directions in a manner similar to a sliding switch. By way of example, the display 52 may slide between a first position and a second position in order to generate one or more user inputs via the detection mechanism 56. In some cases, the display 52 may also be configured to slide in the x/y plane thereby covering both the x and y directions as well as diagonals located therebetween.

[0018] As shown in Fig. 5A - 5C, the movable display 52 is configured to pivot around an axis 58. In such embodiments, the display 52 can provide an action similar to a clickable button. The position of the axis 58 may be placed proximate an edge of the display 52 to form a single tilting action (Fig. 5A) or it may be placed towards the center of the display 52 to form multiple tilting actions (Figs. 5B and 5C). In the first case, a single input is typically generated when the display is tilted while in the later case multiple user inputs may be generated. For example, a first user input may be generated when the display 52 is tilted in the forward direction (Fig. 5B) and a second user input may be generated when the display 52 is tilted in the backward direction (Fig. 5C). Additional axes may also be used to produce even more tilting actions and thus more signals. For example, when a second axis is used, additional signals may be generated when the display 52 is tilted to the right and left sides rather than forward and backward.

[0019] As shown in Figs. 6A and 6B, the display 52 is

configured to rotate as for example about the z axis 60 such that the display 52 operates similarly to a dial or wheel. For example, the display 52 may be rotated clockwise or counterclockwise in order to generate various user inputs via the detection mechanism 56.

[0020] It should be noted that the invention is not limited to the movements shown in Figs. 3-6, and that other movements are possible including for example a combination of the embodiments shown above. When combined, each of the various actions typically generates its own set of user inputs. Alternatively, combined actions may cooperate to produce a new set of user inputs. By way of example, the tilting action shown in Fig. 5 may be combined with the sliding action shown in Fig. 4, or the translating action of Fig. 3 may be combined with the rotating action of Fig. 6. Any combination of actions may be used including more than two. For example, the translating action of Fig. 3 may be combined with the tilting actions and rotating actions of Figs. 5 and 6.

[0021] In order to produce the various movements, the display 52 may be coupled to the frame 54 through various axels, pivot joints, slider joints, ball and socket joints, flexure joints, magnetic joints, roller joints, and/or the like. By way of example, and not by way of limitation, an axel may be used in the embodiment shown in Figs. 6A and 6B, a pivot joint utilizing for example pivot pins or a flexure may be used in the embodiment shown in Figs. 5A-5C, and a slider joint utilizing for example a channel arrangement may be used in the embodiments shown in Figs. 3A, 3B, 4A and 4B. The display 52 may additionally be made movable through a combination of joints such as a pivot/sliding joint, pivot/flexure joint, sliding/flexure joint, pivot/pivot joint, in order to increase the range of motion (e.g., increase the degree of freedom).

[0022] Furthermore, in order to generate signals indicative of the movements, the detection mechanism 56 generally includes one or more movement indicators 57 such as switches, sensors, encoders, and/or the like as well as input control circuitry 59. In one embodiment, the input control circuitry 59 can be embodied in an integrated circuit chip, such as an ASIC. These devices, which can be directly attached to the frame 54 or indirectly through for example a Printed Circuit Board (PCB). The devices may also be placed underneath the display 52 or at the sides of the display 52 in order to monitor the movements of the display 52. Alternatively or additionally, these devices may be attached to the display 52 or some component of the display 52. The movement indicators 57 may be any combination of switches, sensors, encoders, etc.

[0023] Switches are generally configured to provide pulsed or binary data such as activate (on) or deactivate (off). By way of example, an underside portion of the display 52 may be configured to contact or engage (and thus activate) a switch when the user presses on the display 52. Sensors are generally configured to provide continuous or analog data. By way of example, the sensor may be configured to continuously measure the position

or the amount of tilt of the display 52 relative to the frame 54 when a user presses on the display 52. Encoders, on the other hand, typically utilize one or more switches or sensors to measure rotation, for example, rotation of the display 52.

[0024] Any suitable mechanical, electrical and/or optical switch, sensor or encoder may be used. For example, tact switches, force sensitive resistors, pressure sensors, proximity sensors, infrared sensors, mechanical or optical encoders and/or the like may be used in any of the arrangement described above.

[0025] Referring to Figs. 3A-6B, and by way of example and not limitation, an encoder may be used in the embodiment of Figs. 6A and 6B, one or more switches may be used in the embodiments shown in Figs. 3A, 3B, 5A, 5B and 5C, and one or more sensors may be used in the embodiment shown in Figs. 4A and 4B. It should be noted, however, that these particular arrangements are not a limitation and that other arrangements may be used to monitor the movements in the embodiments shown in Figs. 3A-6B.

[0026] Referring to Figs. 7A and 7B, a touch screen 62 may be provided along with the movable display 52 to further increase the functionality of the display actuator 50. The touch screen 62 is a transparent panel that is positioned in front of the movable display 52. Unlike the movable display 52, however, the touch screen 62 generates input signals when an object, such as a finger, touches or is moved across the surface of the touch screen 62 (e.g., linearly, radially, rotary, etc.). The touch screen 62 is typically operatively coupled to input control circuitry 63. the input control circuitry 63 can be implemented as an integrated circuit chip, such as an ASIC. In some cases, the input control circuitry 63 can be combined with the input control circuitry 59 of the detection mechanism 56, while in other cases these components can be kept separate.

[0027] To elaborate, touch screens allow a user to make selections and/or move a cursor by simply touching the display screen via a finger or stylus. For example, a user may make a selection by pointing directly to a graphical object displayed on the display screen. The graphical object may for example correspond to an on-screen button for performing specific actions in the electronic device. In general, the touch screen recognizes the touch and position of the touch on the display and a controller of the electronic device interprets the touch and thereafter performs an action based on the touch event. There are several types of touch screen technologies including resistive, capacitive, infrared and surface acoustic wave.

[0028] In one particular embodiment, the touch screen is a capacitive touch screen that is divided into several independent and spatially distinct sensing points, nodes or regions that are positioned throughout the touch screen. The sensing points, which are typically hidden from view (transparent), are dispersed about the touch screen with each sensing point representing a different position on the surface of the touch screen (or touch

screen plane).

[0029] The sensing points may be positioned in a grid or a pixel array where each pixilated sensing point is capable of generating a signal. In the simplest case, a signal is produced each time an object is positioned over a sensing point. When an object is placed over multiple sensing points or when the object is moved between or over multiple sensing point, multiple signals can be generated. As should be appreciated, the sensing points generally map the touch screen plane into a coordinate system such as a Cartesian coordinate system a Polar coordinate system or some other coordinate system.

[0030] As shown in Fig. 7A, the touch screen 62 generates touch screen signals when an object such as a user's finger is moved over the top surface of the touch screen 62 in the x, y plane. As shown in Fig. 7B, when the display 52 is moved (e.g., depressed), the detection mechanism 56 generates one or more input signals. In some cases, the display actuator 50 is arranged to provide both the touch screen signals and the input signals at the same time, i.e., simultaneously moving the display 52 while implementing a touch action on the touch screen 62. In other cases, the display actuator 50 is arranged to only provide an input signal when the display 52 is moved and a touch screen signal when the display 52 is stationary. Furthermore, the display is configured to present visual information during both display movements and finger movements thereon. That is, while the display actuator 50 is reporting inputs from the touch screen and actuator, it is also receiving inputs for controlling the display.

[0031] In some cases, the display is configured to display information associated with the actuator portion of the display. For example, it may present information indicating how to use the actuator or what function the actuator will implement when the display is moved. The information is typically only presented in the region of relevance. For example, if a forward tilt produces a menu command, then the display may present a title "MENU" in the location of where the forward tilt is implemented. Alternatively, the display may present selectable icons in the region where the actuator will affect selection of one or more of the icons.

[0032] Referring to all the previous Figures, the display actuator 50, which includes both input and output functionality, is typically connected to an electronic device. The display actuator 50 may be a stand alone unit that is operatively coupled to the electronic device through wired or wireless connections. Alternatively, the display actuator 50 may be integrated into the electronic device, i.e., it is a permanent fixture of the electronic device. When a stand alone unit, the display actuator 50 typically has its own enclosure and can be considered a peripheral input device, such as a keyboard or mouse. When integrated with an electronic device, the display actuator 50 typically uses the enclosure of the electronic device and can be considered a permanent fixture of the electronic device.

[0033] The electronic device may correspond to any

consumer related electronic product. By way of example, the electronic device may correspond to computers such as desktop computers, laptop computers or PDAs, media players such as music players, photo players or video players, communication devices such as telephones, cellular phones or mobile radios, peripheral devices such as keyboards, mice, and printers, cameras such as still cameras and video cameras, GPS modules, remote controls, car displays, audio/visual equipment such as televisions, radios, stereos, office equipment such as fax machines and teleconference modules, and the like.

[0034] In essence, the display actuator 50 can be integrated with any electronic device that requires an input means such as buttons, switches, keys, dials, wheels, joysticks/pads, etc. In fact, the display actuator 50 can in some instances completely replace all other input means (as well as output) of the electronic device. By way of example, the display and buttons of the media player shown in Fig. 1C can be replaced by the display actuator 50 thereby producing a device with no visible buttons.

[0035] One of the advantages of the display actuator 50 is that because the display provides user inputs, conventional user input means on electronic devices having displays can be substantially eliminated. Furthermore, the size of the display 52 can be maximized since the real estate is no longer needed for the conventional input means. For example, the display 52 can be configured to substantially fill the entire user interface portion of a hand-held electronic device without impairing the user input functionality. Alternatively, the hand-held electronic device can be minimized to the size of the display 52. In either case, the display 52 is allowed to utilize a greater amount of the real estate of the electronic device.

[0036] Fig. 8 is a simplified perspective diagram of an electronic device 100, in accordance with one embodiment of the present invention. The electronic device 100 includes a display actuator 102 that incorporates the functionality of a mechanical button(s) directly into a display device 104 seated within a housing 106. In other words, the display device 104 acts like a mechanical button(s). In this embodiment, the display device 104 is divided into a plurality of independent and spatially distinct button zones 108. The button zones 108 represent regions of the display device 104 that may be tilted relative to the housing 106 in order to implement distinct clicking actions. Although the display device 104 can be broken up into any number of button zones, in the illustrated embodiment, the display device 104 is separated into four button zones 108A-108D and thus implements four clicking actions.

[0037] The clicking actions are arranged to actuate one or more movement indicators contained inside the housing 106. That is, a particular button zone 108 moving from a first position (e.g., upright) to a second position (e.g., tilted) is caused to actuate a movement indicator. The movement indicators are configured to detect movements of display device 104 during the clicking action and to send signals corresponding to the movements to

a controller of the electronic device. By way of example, the movement indicators may be switches, sensors and/or the like. In most cases, there is a movement indicator for each button zone. It should be noted, however, that this is not a limitation and that button zones do not necessarily require their own movement indicator. For example, a virtual button zone disposed between adjacent button zones can be created when two movement indicators associated with the adjacent button zones are activated at the same time. Using this technique, the four button zones shown in Fig. 8 may be expanded to include eight button zones without increasing the number of movement indicators.

[0038] The tilt of the display device 104 can be provided by a variety of different mechanisms including, for example, ball and socket arrangements, pivot pin arrangements, flexure arrangements, gimbal arrangements and the like. Each of these mechanisms allows the display device 104 to at least pivot about a first axis 110 so that the display device 104 can be tilted in the region of button zones 108A and 108D, and about a second axis 112 so that the display device 104 can be tilted in the region of button zones 108B and 108C.

[0039] Fig. 9 is a side elevation view, in cross section, of an electronic device 120, in accordance with one embodiment of the present invention. The electronic device 120 may, for example, correspond to the electronic device shown in Fig. 8. The electronic device 120 includes a tiltable display device 122 seated within a housing 124. The housing 124 is configured to enclose the electrical components of the electronic device including the tiltable display device 122 and the control circuitry associated therewith. Although enclosed, the housing 124 typically includes an opening 126 for providing access to the display device 122. The tiltable display device 122, on the other hand, includes a display 128 and a touch screen 130 disposed above the display 128. In order to support and protect the display device 122 including the display 128 and touch screen 130 during movements, the display device 122 may additionally include a platform 132 disposed underneath the display 128 and a transparent cover 134 disposed over the touch screen 130.

[0040] The transparent cover 134, which may be formed from a clear plastic material, may be part of the touch screen 130 or it may be a separate component. Furthermore, the platform 132, which is formed from a rigid material such as plastic or steel, may be a part of the display 128 or it may be a separate component. The platform 132 is primarily configured to help form a rigid structure to prevent bowing and flexing of the display device. The platform 132 may also include a printed circuit board to aid the connectivity of the devices coupled thereto. In some cases, all the elements of the display device 122 are attached together to form an integrated stacked unit. In other cases, the cover 134 and platform 132 are configured to encase the display 128 and touch screen 130. In fact, in cases such as this, the cover 134 may be configured to distribute a majority of the load

exerted on the display device 122 to the platform 132 thereby protecting the display 128 and touch screen 130.

[0041] In order to generate input signals based on movements of the display device 122, the electronic device 120 further includes one or more mechanical switches 140 disposed between the display device 122 and the housing 124. The mechanical switches 140 include actuators 142 that generate input signals when depressed by movement of the display device 122. For example, tilting the display device 122 in the region of a mechanical switch 140 compresses the actuator 142 thereby generating input signals. In most cases, the actuators 142 are spring biased so that they extend away from the switch 140 and bias the display device 122 in the upright position. The mechanical switches 140 may be attached to the housing 124 or to the display device 122. In the illustrated embodiment, the mechanical switches 140 are attached to the backside of the display device 122, for example, at the platform 132. As such, the mechanical switches 140 and more particularly the actuators 142 act as legs for supporting the display device 122 in its upright position within the housing 124 (i.e., the actuators rest on the housing or some component mounted to the housing as for example a PCB). By way of example, the mechanical switches may correspond to tact switches and more particularly, enclosed SMT dome switches (dome switch packaged for SMT).

[0042] To elaborate further, the display device 122 is movably restrained within a cavity 144 provided in the housing 124. That is, the display device 122 is capable of moving within the cavity 144 while still being prevented from moving entirely out of the cavity 144 via the walls of the housing 124. In essence, the display device 122 floats in space relative to the housing 124 while still being constrained thereto (the display device is not attached to the housing). This is sometimes referred to as a gimbal.

[0043] As shown, the display device 122 is surrounded by side walls 146, a top wall 148 and bottom wall 150. The side walls 146 are configured to substantially prevent movements in the x and y directions as well as rotations about the z axis (e.g., excluding a small gap that allows a slight amount of play in order to prevent the display from binding with the housing during the tilting action). The top and bottom walls 148 and 150, however, are configured to allow movement (although limited) in the z direction as well as rotation about the x and y axis in order to provide the tilting action. That is, while the top and bottom walls 148 and 150 may constrain the display device 122 to the cavity 144, they also provide enough room for the display device 122 to tilt in order to depress the actuator 142 of the mechanical switches 140. Furthermore, the spring force provided by the mechanical switches 140 places the top surface of the display device 122 into mating engagement with the bottom surface of the top wall 148 of the housing 124 (e.g., upright position). When upright, the display device 122 may be flush with the outer peripheral surface of the housing 124 (as shown), or it may be recessed below the outer peripheral

surface of the housing 124. It is generally believed that a flush mounted display is more aesthetically pleasing.

[0044] Referring to Figs. 10A-10D, one embodiment of Fig. 9 will be described in greater detail. In this particular embodiment, the display device 122 is separated into a plurality of buttons zones 152A-152D similar to the embodiment of Fig. 8. Although not expressly stated in Fig. 9, each of the button zones in Fig. 10 includes a distinct mechanical switch 140 located underneath the display device 122.

[0045] As shown in Figs. 10A-10D, a user simply presses on the top surface of the display device 122 in the location of the desired button zone 152A-152D in order to activate the mechanical switches 140A-140D disposed underneath the display device 122 in the location of the button zones 152A-152D. When activated, the switches 140 generate button signals that may be used by the electronic device. In all of these Figures, the force provided by the finger works against the spring force of the actuator until the switch 140 is activated. Although the display device 122 essentially floats within the cavity 144 of the housing 124, when the user presses on one side of the display device 122, the opposite side contacts the top wall 148 (opposite the press) thus causing the display device 122 to pivot about the contact point 154 without actuating the switch 140 in the region of the contact point 154. In essence, the display device 122 pivots about four different axes.

[0046] As shown in Fig. 10A, the display device 122 pivots about the contact point 154A when a user selects button zone 152A thereby causing the mechanical switch 140A to be activated. As shown in Figs. 10B, the display device 122 pivots about the contact point 154D when a user selects button zone 154D thereby causing the mechanical switch 140D to be activated. As shown in Figs. 10C, the display device 122 pivots about the contact point 154C when a user selects button zone 152C thereby causing the mechanical switch 140C to be activated. As shown in Figs. 10D, the display device 122 pivots about the contact point 154B when a user selects button zone 152B thereby causing the mechanical switch 140B to be activated. As should be appreciated, the signals generated by the various switches 140 may be used by the electronic device to perform various control functions such as initiate commands, make selections, or control motion in a display.

[0047] By way of example, and referring to Figs. 8-10, the first button zone 108A may be associated with a first command, the second button zone 108B may be associated with a second command, the third button zone 108C may be associated with a third command and the fourth button zone 108D may be associated with a fourth command. In the case of a music player, for example, the first button zone 108A may correspond to a menu command, the second button zone 108B may correspond to a seek backwards command, the third button zone 108C may correspond to a seek forward command, and the fourth button zone 108D may correspond to a play/

pause command.

[0048] Alternatively or additionally, the buttons zones 108A-D may be associated with arrow keys such that the actuation of the first button zone 108A initiates upward motion in the display 102, the actuation of the second button zone 108B initiates left side motion in the display 102, the actuation of the third button zone 108C initiates right side motion in the display 102, and the actuation of the fourth button zone 108D initiates downward motion in the display 102. This arrangement may be used to implement cursor control, selector control, scrolling, panning and the like.

[0049] Figs. 11A and 11B are diagrams of an electronic device 160, in accordance with an alternate embodiment of the present invention. This embodiment is similar to those shown in Figs 8-10, however instead of relying on the spring action of a mechanical switch, the electronic device utilizes a separate spring component. As shown, the electronic device 160 includes a display device 122 containing all of its various layers. The display device 122 is coupled to the housing 124 via a spring element 162. The spring element 162, or in some cases flexure, allows the display device 122 to pivot in multiple directions when a force is applied to the display device 122 thereby allowing a plurality of button zones to be created. The spring element 162 also urges the display device 122 into an upright position similar to the previous embodiments.

[0050] When the display device 122 is depressed at a particular button zone (overcoming the spring force), the display device 122 moves into contact with one or more switches 164 positioned underneath the button zone of the display device 122. Upon contact, the switch 164 generates a button signal. The switch 164 may be attached to the display device 122 or the housing 124. In the illustrated embodiment, the switch 164 is attached to the housing 124. In some cases, a seal 166 may be provided to eliminate crack and gaps found between the display device 122 and the housing 124 when the display device is tilted. The spring element 162 may be widely varied. For example, it may be formed from one or more conventional springs, pistons, magnets or compliant members. In the illustrated embodiment, the spring element 162 takes the form of a compliant bumper formed from rubber or foam.

[0051] Fig. 12 is diagram of an electronic device 170, in accordance with an alternate embodiment of the present invention. This embodiment is similar to those shown in Figs 8-10, however instead of relying on a gimbal feature, the electronic device 170 utilizes a ball and socket joint 172 to movably couple the display device 122 to the housing 124. Like the gimbal of Figs. 9-10, or the spring element of Fig. 11, the ball and socket joint 172 allows the display device 122 to pivot in multiple directions when a force is applied to the display device 122 thereby allowing a plurality of button zones to be created.

[0052] Fig. 13 is a diagram of an electronic device 180, in accordance with an alternate embodiment of the

present invention. This embodiment is similar to those shown in Figs. 8-10, however unlike those embodiments, the display 128 and touch screen 130 are fixed. In this particular embodiment, the cover 134 provides the tilting action for engaging the mechanical switches 140. For example, the mechanical switches 140 may be attached to the bottom surface of the cover 134 at the peripheral edge of the cover 134 underneath the top wall 148. Furthermore, the display 128 and touch screen 130 may be supported in a fixed position underneath the tiltable cover 134 via one or more posts 182, which may include shock mounting features.

[0053] Fig. 14 is a perspective diagram of an electronic device 200, in accordance with one embodiment of the present invention. The electronic device 200 is similar to the embodiments described above in that different input signals are generated when moving the display to different positions. However, unlike those electronic devices, the electronic device 200 of Fig. 14 includes a sliding display device 202 rather than a tilting display device. As shown by the arrows, the display device 202 is configured to slide relative to the housing 204 in order to generate various input signals. Although the display device can be slid into an infinite number of positions including various diagonals between the arrows, in the illustrated embodiment, the display device 202 is configured to implement four clicking actions in directions towards the sides 206A-206D.

[0054] The clicking actions are arranged to actuate one or more movement indicators contained inside the housing 204. That is, display device 202 moving from a center position to a side position is caused to actuate a movement indicator. The movement indicators are configured to detect movements of display device 202 during the clicking action and to send signals corresponding to the movements to a controller of the electronic device 200. By way of example, the movement indicators may be switches, sensors and/or the like.

[0055] The sliding action of the display device 202 can be provided by a variety of different mechanisms including for example channel arrangements, roller arrangements, and the like. Each of these mechanisms allows the display device to at least slide in the direction of the arrows A-D, and in some cases may also allow the display device to slide in the x-y plane.

[0056] Figs. 15A and 15B are diagrams of an electronic device 220, in accordance with one embodiment of the present invention. The electronic device 220 may for example correspond to the electronic device shown in Fig. 14. The electronic device 220 includes a display device 222 slidably seated within a housing 224. The housing 224 is configured to enclose the electrical components of the electronic device 200 including the slidable display device 222 and control circuitry associated therewith. Although enclosed, the housing 224 typically includes an opening 226 for providing access to the display device 222. The slidable display device 222, on the other hand, includes a display 228 and a touch screen 230 disposed

above the display 228. In order to support and protect the display device 228 during movements, the display device 228 may additionally include a platform 232 disposed underneath the display 228 and a transparent cover 234 disposed over the touch screen 230.

[0057] The transparent cover 234, which may be formed from a clear plastic material, may be part of the touch screen 230 or it may be a separate component. Furthermore, the platform 232, which is formed from a rigid material such as plastic or steel, may be a part of the display 228 or it may be a separate component. The platform 232 is primarily configured to help form a rigid structure to prevent bowing and flexing of the display device 222. In some cases, all the elements of the display device 222 are attached together to form an integrated stacked unit. In other cases, the cover 234 and platform 232 are configured to encase the display 228 and touch screen 230. In fact, in cases such as this, the cover 234 may be configured to distribute a majority of the load exerted on the display device 222 to the platform 232 thereby protecting the display 228 and touch screen 230.

[0058] In order to produce the sliding action, the display device 222 is disposed within a channel 240. The width of the channel 240 is generally sized and dimensioned to receive the ends of the display device 222 and the depth of the channel 240 is generally sized to constrain the display device 222 to the housing 224 while leaving room for sliding movement. As shown, the channel 240 is formed by a top wall 242 of the housing 224 and a lower support structure 244 that protrudes away from the side wall 246 of the housing 224. The lower support structure 244 may span the entire length of the housing 224 from side to side or it may only span a partial length (as shown). Furthermore, the lower support structure 244 may be an integral component of the housing 224 (as shown) or it may be a separate component attached thereto. Alternatively, only the platform may be disposed within the channel.

[0059] The top surface of the lower support structure 244 may include a frictionless or low friction surface to enhance the sliding action and prevent sticking between the display device 222 and the lower support structure 244 when the display device 222 is slid therebetween. Alternatively or additionally, the bottom surface of the display device 222 may also include a frictionless or low friction surface. Alternatively or additionally, the top surface of the display device in the location of the channel and/or the bottom surface of the top wall 242 may include a frictionless or low friction surface. By way of example, the frictionless or low friction surface may be formed from frictionless or low friction material such as Teflon. Alternatively, roller bearings may be used.

[0060] In most cases, the display device 222 is suspended within the channel 240 via one or more spring elements 250. The spring elements 250 are disposed between the sides of the display device 222 and the side walls of the housing 224. In the illustrated embodiment, there is a spring element 250 located at each of the sides

of the display device 222. In most cases, the spring elements 250 are centered relative to the display device 222 so that the forces exerted by each spring element 250 on the display device 222 are equally balanced. In essence, the spring elements 250 bias the display device 222 so that the display device 222 is centered relative to the opening 226 in the top wall 242. In order to slide the display device 222 from the center position to one of the side positions, the biasing force provided by the spring elements 250 must be overcome.

[0061] In order to generate input signals based on movements of the display device 222, the electronic device 220 further includes one or more sensors 252, such as force sensitive resistors (FSR), strain gauges or load cells, disposed between the display device 222 and the housing 224 in the location of the spring elements 250. These types of sensors 252 monitor the pressure exerted on them by the moving display device 222, and control circuitry generates signals when the force reaches a predetermined limit. By way of example, sliding the display device 222 towards the FSR sensor 252 compresses the FSR sensor 252 and as a result input signals are generated. The sensor 252 may be attached to the housing 224 or to the display device 222. In the illustrated embodiment, the sensors 252 are attached to the housing 224 between the spring element 250 and the housing 224.

[0062] Referring to Figs. 16A and 16B, one embodiment of Fig. 15 will be described in greater detail. In order to select a button feature, a user places their finger on the top surface of the display device 222 and slides the display device 222 in the direction of the desired button feature. During sliding, the force provided by the finger works against the spring force of the spring elements 250 disposed between the display device 222 and the housing 224. Furthermore, one end of the display device 222 is inserted deeper into the channel section 240A while the opposite end is removed, but not entirely from the channel section 240B, which is opposite the channel section 240A. As the display device 222 is inserted deeper into the channel 240A, a greater amount of force is applied to the sensor 252 through the spring element 250. Once a pre-set limit has been reached, the sensor circuit generates a button signal that may be used by the electronic device 220 to perform a control function such as initiating commands, making selections, or controlling motion in a display.

[0063] Fig. 17 is a diagram of an electronic device 280, in accordance with an alternate embodiment of the present invention. This embodiment is similar to those shown in Figs. 14-16, however unlike those embodiments, the display 228 and touch screen 230 are fixed. In this particular embodiment, the cover 234 provides the sliding action for engaging the sensors 252 rather than the entire display device. As shown, the cover 234 is retained within the channels 240 and suspended by the spring elements 250 while the display 228 and touch screen 230 are supported in a fixed position underneath

the slidable cover 234 via one or more posts 282, which may include shock mounting features.

[0064] Fig. 18 is a block diagram of an exemplary electronic device 350, in accordance with one embodiment of the present invention. The electronic device typically includes a processor 356 configured to execute instructions and to carry out operations associated with the electronic device 350. For example, using instructions retrieved for example from memory, the processor 356 may control the reception and manipulation of input and output data between components of the electronic device 350. The processor 356 can be implemented on a single-chip, multiple chips or multiple electrical components. For example, various architectures can be used for the processor 356, including dedicated or embedded processor, single purpose processor, controller, ASIC, and so forth.

[0065] In most cases, the processor 356 together with an operating system operates to execute computer code and produce and use data. The operating system may correspond to well known operating systems such as OS/2, DOS, Unix, Linux, and Palm OS, or alternatively to special purpose operating system, such as those used for limited purpose appliance-type devices (e.g., media players). The operating system, other computer code and data may reside within a memory block 358 that is operatively coupled to the processor 356. Memory block 358 generally provides a place to store computer code and data that are used by the electronic device 350. By way of example, the memory block 358 may include Read-Only Memory (ROM), Random-Access Memory (RAM), hard disk drive and/or the like.

[0066] The electronic device 350 also includes a movable display 368 that is operatively coupled to the processor 356. The display 368 is generally configured to display a graphical user interface (GUI) that provides an easy to use interface between a user of the electronic device 350 and the operating system or application running thereon. The display 368 may for example be a liquid crystal display (LCD).

[0067] The electronic device 350 also includes a touch screen 370 that is operatively coupled to the processor 356. The touch screen 370 is configured to transfer data from the outside world into the electronic device 350. The touch screen 370 may for example be used to perform tracking and to make selections with respect to the GUI on the display 368. The touch screen 370 may also be used to issue commands in the electronic device 350.

[0068] The touch screen 370, which is positioned in front of the display 368, recognizes touches, as well as the position and magnitude of touches on a touch sensitive surface. The touch screen 370 reports the touches to the processor 356 and the processor 356 interprets the touches in accordance with its programming. For example, the processor 356 may initiate a task in accordance with a particular touch. A dedicated processor can be used to process touches locally and reduce demand for the main processor of the electronic device.

[0069] The touch screen 370 may be based on sensing

technologies including but not limited to capacitive sensing, resistive sensing, surface acoustic wave sensing, and/or the like. Furthermore, the touch screen may be based on single point sensing or multipoint sensing. Single point sensing is capable of only distinguishing a single touch, while multipoint sensing is capable of distinguishing multiple touches that occur at the same time. By way of example, a touch screen which can be used herein is shown and described in greater detail in copending and commonly assigned U.S. Patent Application No.: 10/840,862, titled "MULTIPOINT TOUCHSCREEN," filed on May 6, 2004, and which is hereby incorporated herein by reference.

[0070] In some case, the electronic device 350 may be designed to recognize gestures applied to the touch screen 370 and to control aspects of the electronic device 350 based on the gestures. Generally speaking, a gesture is defined as a stylized interaction with an input device that is mapped to one or more specific computing operations. The gestures may be made through various hand, and more particularly finger motions. Alternatively or additionally, the gestures may be made with a stylus. In all of these cases, the touch screen 370 receives the gestures and the processor 356 executes instructions to carry out operations associated with the gestures. In addition, the memory block 358 may include a gesture operational program, which may be part of the operating system or a separate application. The gestural operation program generally includes a set of instructions that recognizes the occurrence of gestures and informs one or more software agents of the gestures and/or what action (s) to take in response to the gestures. By way of example, gesture methods, which can be used herein, are shown and described in greater detail in copending and commonly assigned U.S. Patent Application No.: 10/903,964, titled "GESTURES FOR TOUCH SENSITIVE INPUT DEVICES," filed on July 30, 2004 and which is hereby incorporated herein by reference.

[0071] The electronic device 350 also includes a detection mechanism 380 that is operatively coupled to the processor 356. The detection mechanism 380, utilizing movement indicators 382 such as switches and sensors, is configured to monitor movements of the display 368 or some component thereof (e.g., cover), and to send signals indicative of the movements to the processor 356, which interprets the signals in accordance with its programming. In some cases, a dedicated processor can be used to process the movement signals and reduce demand for the main processor of the electronic device.

[0072] As mentioned above, the movable display 368 is configured to mimic a mechanical actuator such as a clickable button, a sliding switch or a joystick. The display region of the electronic device 350 can therefore be used to transfer data from the outside world into the electronic device 350. The display region may for example be used to issue commands in the electronic device 350 or control motion and make selections with respect to the GUI on the display 368.

[0073] In one particular embodiment of the present invention, the electronic devices described above correspond to hand-held electronic devices with small form factors. As used herein, the term "hand held" means that the electronic device is typically operated while being held in a hand and thus the device is sized and dimension for such use. Examples of hand held devices include PDAs, Cellular Phones, Media players (e.g., music players, video players, game players), Cameras, GPS receivers, Remote Controls, and the like.

[0074] Hand held electronic devices may be directed at one-handed operation or two-handed operation. In one-handed operation, a single hand is used to both support the device as well as to perform operations with the user interface during use. Cellular phones such as handsets, and media players such as music players are examples of hand held devices that can be operated solely with one hand. In either case, a user may grasp the device in one hand between the fingers and the palm and use the thumb to make entries using keys, buttons or a navigation pad. In two-handed operation, one hand is used to support the device while the other hand performs operations with a user interface during use or alternatively both hands support the device as well as perform operations during use. PDA's and game players are examples of hand held device that are typically operated with two hands. In the case of the PDA, for example, the user may grasp the device with one hand and make entries using the other hand, as for example using a stylus. In the case of the game player, the user typically grasps the device in both hands and makes entries using either or both hands while holding the device.

[0075] The display actuator of the present invention is a perfect fit for small form factor devices such as hand held devices, which have limited space available for input interfaces, and which require central placement of input interfaces to permit operation while being carried around. This is especially true when you consider that the functionality of handheld devices have begun to merge into a single hand held device (e.g., smart phones). At some point, there is not enough real estate on the device for housing all the necessary buttons and switches without decreasing the size of the display or increasing the size of the device, both of which leave a negative impression on the user. In fact, increasing the size of the device may lead to devices, which are no longer considered "hand-held."

[0076] When the display is incorporated into the hand held device (e.g., integrated into the device housing), the display presents the visual information associated with the hand-held electronic device, while the mechanical action of the display and possibly the touch sensitivity of the touch screen provides the input means necessary to interact with the hand-held electronic device. The display actuator can therefore reduce the number of input devices needed to support the device and in many cases completely eliminate input devices other than the display actuator. As a result, the hand-held electronic device may

appear to only have a display and no input means (or very few). The device is therefore more aesthetically pleasing (e.g., smooth surface with no breaks gaps or lines), and in many cases can be made smaller without sacrificing screen size and input functionality, which is very beneficial for hand-held electronic device especially those hand-held electronic device that are operated using one hand (some hand-held electronic device require two handed operation while others do not). Alternatively, the screen size can be made larger without affecting the size of the device and input functionality, i.e., the display can be made to substantially fill the entire front surface of the hand held device.

[0077] In one particular implementation, the hand held device is a music player and the display actuator is configured to substantially fill the entire front surface of the music player. The display actuator is the primary input means of the music player and in some cases is the only input means. Furthermore, the display actuator is configured to generate control signals associated with a music player. For example, the display actuator may include button functions including, Select, Play/Pause, Next, Previous and Menu. Alternatively or additionally, the button functions may include volume up and volume down.

[0078] While this invention has been described in terms of several preferred embodiments, there are alterations, permutations, and equivalents, which fall within the scope of this invention. It should also be noted that there are many alternative ways of implementing the methods and apparatuses of the present invention.

Claims

1. An integral input/output device, comprising:
 - a display that moves relative to a frame; and
 - a movement detection mechanism configured to generate signals when the display is moved, the signals being indicative of at least one predetermined movement of the display.
2. An electronic device having a housing and a display device, wherein the improvement comprises constraining the display device within the housing while permitting a least one component of the display device to be moved within the housing so as to signal at least one user input.
3. An electronic device as recited in claim 2, wherein the at least one component of the display device can be moved in a plurality of different positions so as to signal a plurality of different user inputs.
4. An electronic device as recited in claim 2, wherein the display device serves as a primary user input mechanism for the electronic device.

5. An electronic device as recited in claim 2, wherein the display device serves as the only user input mechanism for the electronic device.
6. An electronic device as recited in claim 2, wherein the electronic device is a handheld electronic device.
7. A hand held electronic device, comprising:
- a housing enclosing operational components of the hand held electronic device; and
- a display actuator disposed at a surface of the housing, the display actuator including at least:
- a display device configured to present visual information within a viewing area of the housing, the display device having a movable component that moves relative to the housing, and
- a detection mechanism configured to generate signals when the movable component is moved relative to the housing.
8. The hand held electronic device as recited in claim 7 wherein the display device includes a display, the display being configured to present text, characters or graphics.
9. The hand held electronic device as recited in claim 8 wherein the display is a liquid crystal display.
10. The hand held electronic device as recited in claim 8 wherein the display is the movable component.
11. The hand held electronic device as recited in claim 8 wherein the display device includes a transparent cover positioned over the display, and wherein the transparent cover and the display cooperate to form the movable component.
12. The hand held electronic device as recited in claim 11 wherein the display device includes a touch screen positioned between the display and the transparent cover, and wherein the transparent cover, touch screen and display cooperate to form the movable component of the display device.
13. The hand held electronic device as recited in claim 8 wherein the display device includes a transparent cover positioned over the display, and wherein the transparent cover is the only movable component of the display device.
14. The hand held electronic device as recited in claim 8 wherein the display device includes a platform disposed below the display, a touch screen positioned over the display, and a transparent cover positioned over the touch screen, and wherein the display, touch screen, transparent cover and platform cooperate to form the movable component of the display device.
15. The hand held electronic device as recited in claim 7 wherein the movable component translates between an upright and a depressed position relative to the housing in order to generate an input signal via the detection mechanism.
16. The hand held electronic device as recited in claim 7 wherein the movable component slides between a first position and a second position relative to the housing in order to generate an input signal via the detection mechanism.
17. The hand held electronic device as recited in claim 7 wherein the movable component is pivoted between an upright position and a tilted position relative to the housing in order to generate an input signal via the detection mechanism.
18. The hand held electronic device as recited in claim 7 wherein the movable component is rotated about an axis relative to the housing in order to generate an input signal via the detection mechanism.
19. The hand held electronic device as recited in claim 7 wherein the detection mechanism includes one or more movement indicators that generate signals indicative of the movements of the movable component, the movement indicators being selected from switches, sensors or encoders.
20. The hand held electronic device as recited in claim 7 wherein the housing includes an opening for providing access to the display device, the display device being tiltably seated within the housing, and the detection mechanism including one or more mechanical switches disposed between the display device and the housing, the mechanical switches generating input signals when the display device is tilted in the region of the mechanical switch.
21. The hand held electronic device as recited in claim 7 wherein the housing includes an opening for facilitating user interaction with the display device, the display device being slidably seated within the housing, and the detection mechanism including one or more sensors disposed between the display device and the housing, the sensors generating input signals when the display device is slid in the region of the sensor, the sensors being selected from force sensitive resistors, strain gauges or load cells.
22. The hand held electronic device as recited in claim 21 wherein the housing includes a channel and wherein the display device is disposed within the

- channel in order to permit a sliding action of the display device relative to the housing, and wherein the display device is suspended within the channel via one or more spring elements.
23. A method for receiving a user input, said method being implemented on an electronic device having a display, said method comprising:
- displaying a graphical user interface on the display; and
 - generating one or more input signals when the display is moved, the input signals being used to provide user input to the electronic device.
24. A method as recited in claim 23, wherein the display is movable.
25. A method as recited in claim 23, wherein the electronic device includes a housing, and wherein the display is movable within the housing.
26. An electronic device, comprising:
- a housing; and
 - a movable display apparatus constrained within the housing, wherein physically moving the movable display apparatus within the housing operates to signal at least one user input.
27. The electronic device as recited in claim 26 wherein the movable display apparatus translates, slides, pivots or rotates relative to the housing.
28. The electronic device as recited in claim 26 wherein the electronic device is a hand held media player, and wherein the at least one user input is a media control input.
29. The electronic device as recited in claim 26 wherein the movable display apparatus is the only input means of the electronic device.
30. The electronic device as recited in claim 26 wherein the movable display apparatus is the primary input means of the electronic device.
31. A handheld media player, comprising:
- a housing for enclosing internally various functional components for operating the handheld media player, the housing including an opening; a display capable of presenting text and/or graphics covering the opening and including internal circuitry, the display cooperating with the housing to form the peripheral surfaces of the handheld media player, the display having a flat outer touchable surface that is exposed to a user
- of the handheld media player, display being configured to tilt to at least four positions relative to the housing, the at least four positions including a top tilt position, a bottom tilt position, a left tilt position and a right tilt position; and a plurality of mechanical switches located within the housing and underneath the display, the plurality of mechanical switches including at least four mechanical switches that cooperate with the tilting of the display to provide at least four distinct user inputs, the four mechanical switches including a first mechanical switch, a second mechanical switch, a third mechanical switch and a fourth mechanical switch, the first mechanical switch being located underneath a top portion of the display, the second mechanical switch being located underneath a bottom portion of the display, the third mechanical switch being located underneath a left portion of the display, and the fourth mechanical switch being located underneath a right portion of the display, the first mechanical switch generating a first switch signal when the display is tilted to the top tilt position, the second mechanical switch generating a second switch signal when the display is tilted to the bottom tilt position, the third mechanical switch generating a third switch signal when the display is tilted to the left tilt position, the fourth mechanical switch generating a fourth switch signal when the display is tilted to the right tilt position.
32. A handheld media player as recited in claim 31, wherein the handheld media player further comprises a circuit board having one or more electrical components mounted thereon, and wherein display electrically couples to one or more electrical components mounted on the circuit board.
33. A handheld media player as recited in claim 32, wherein the circuit board is provided internal to said housing such that the circuit board is beneath the display.
34. A handheld media player as recited in claim 33, wherein the first, second, third and fourth mechanical switches are mounted on different sides of one surface of the circuit board.
35. A handheld media player as recited in claim 31, wherein the display includes at least a circuit board having one or more electrical components mounted thereon.
36. A handheld media player as recited in claim 31, wherein depressing a side of the display causes a corresponding one of the mechanical switches to provide a switch signal.

- 37. A handheld media player as recited in claim 31, wherein the display can be depressed inward substantially uniformly such that two or more of the first, second, third and fourth mechanical switches provide their corresponding switch signals. 5

- 38. A handheld media player as recited in claim 31, wherein the display is a liquid crystal display.

- 39. A handheld media player as recited in claim 31, wherein the housing has a front surface, and wherein the opening of the housing is at the front surface. 10

- 40. A handheld media player as recited in claim 39, wherein the display consumes substantially all of the front surface of the housing. 15

- 41. A handheld media player as recited in claim 31, wherein the handheld media player stores media items that can be presented to the user by the handheld media player, and wherein interaction with the display by the user of the handheld media player enables the user of the handheld media player to make media selections from the media items. 20

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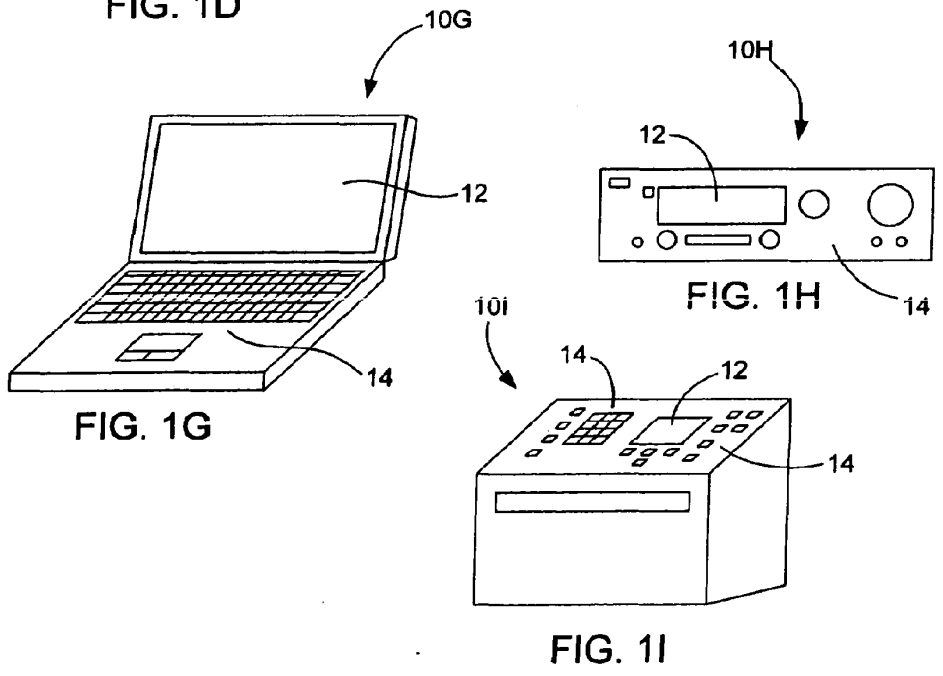
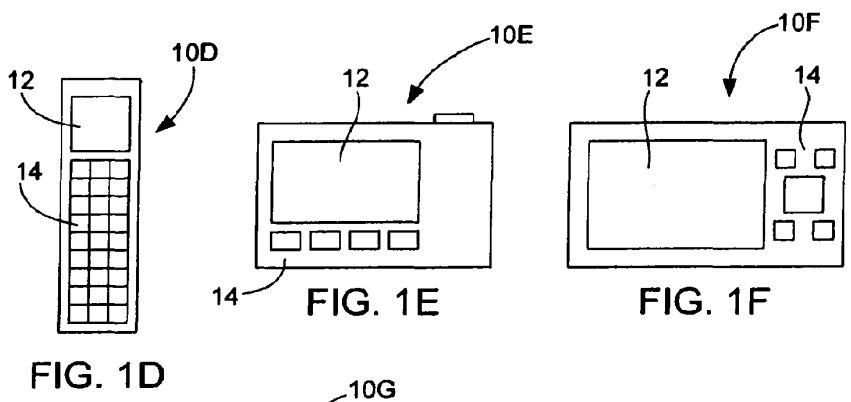
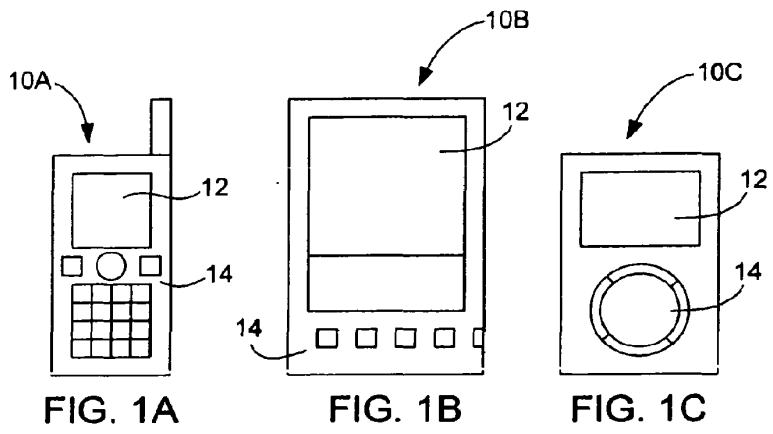
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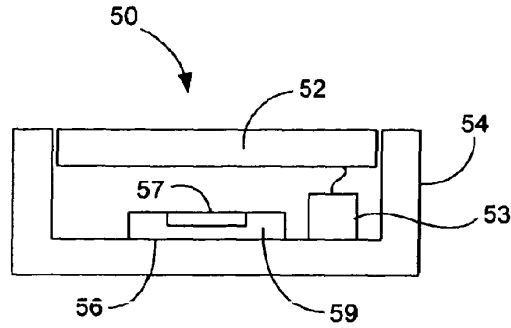


FIG. 2

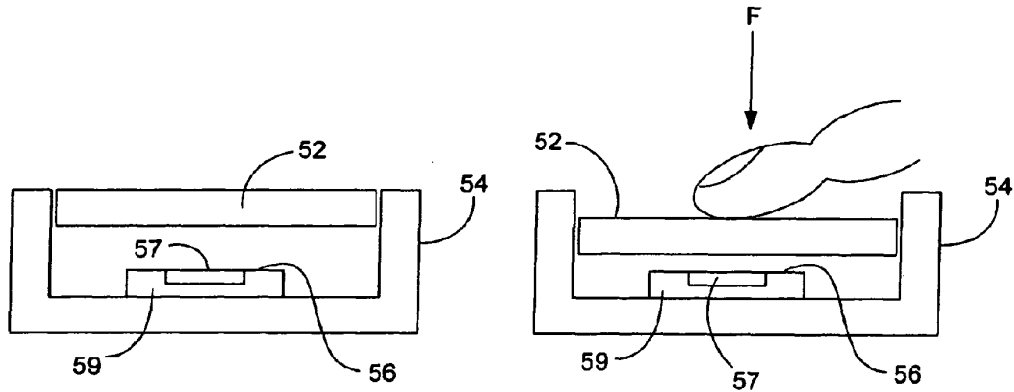


FIG. 3A

FIG. 3B

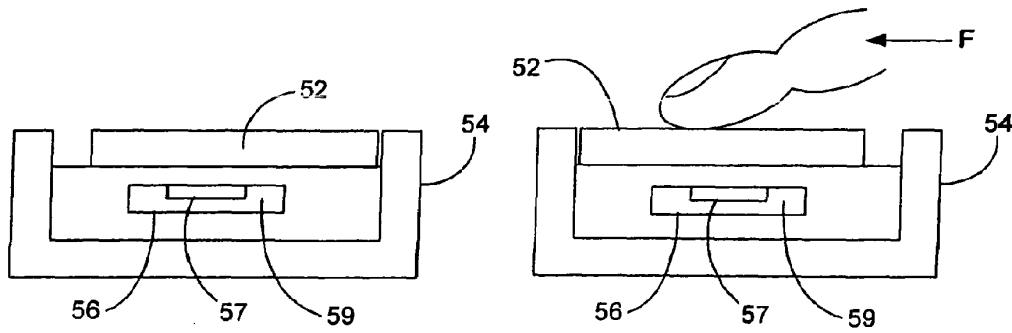
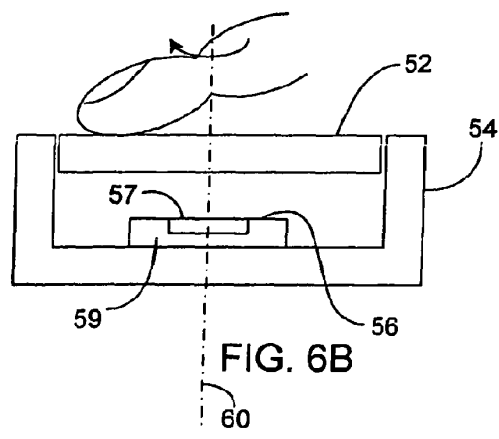
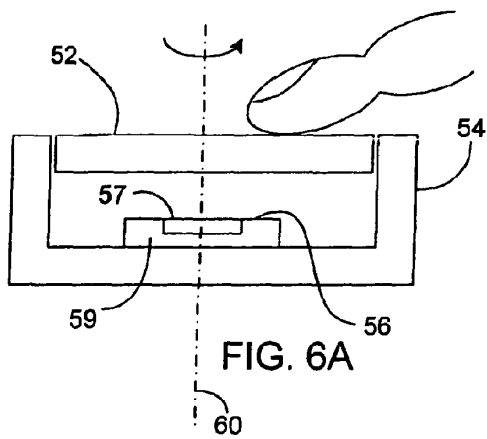
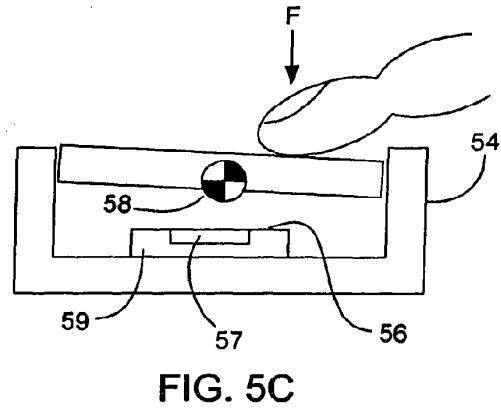
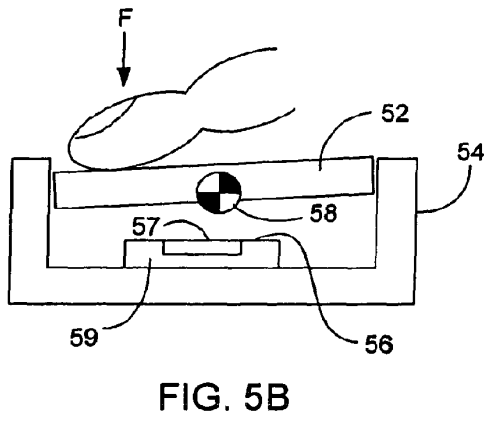
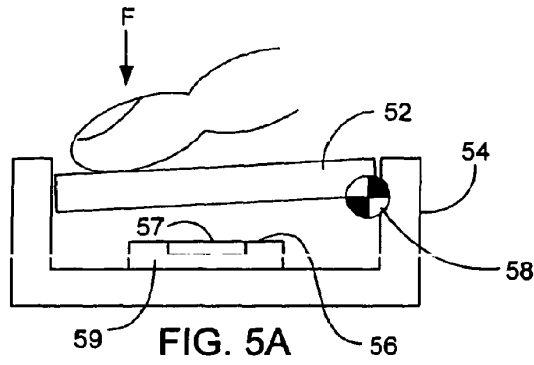
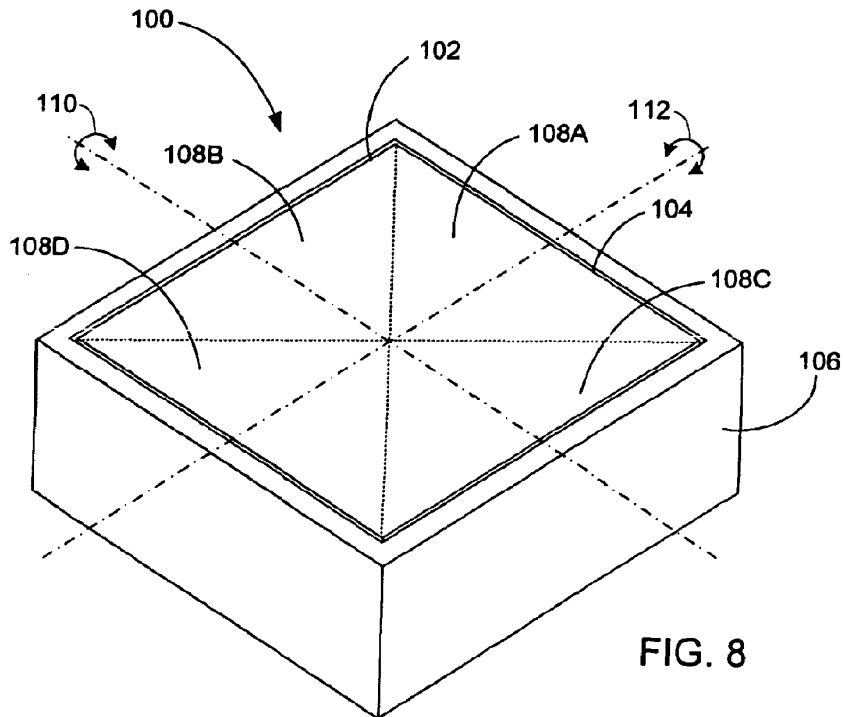
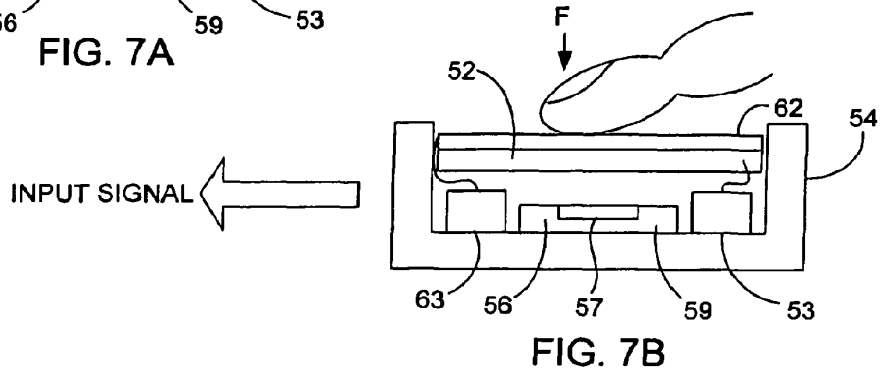
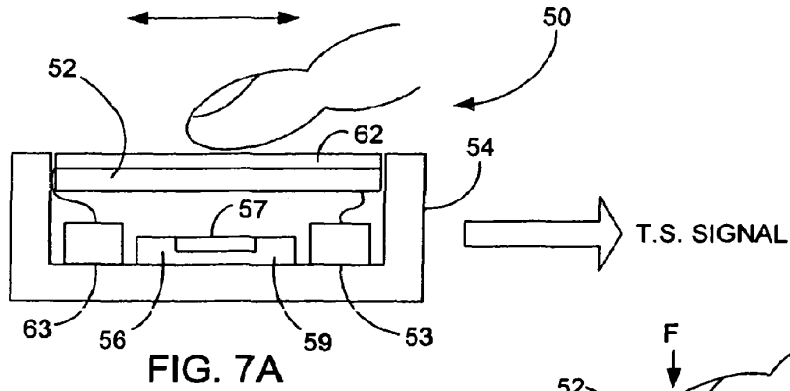
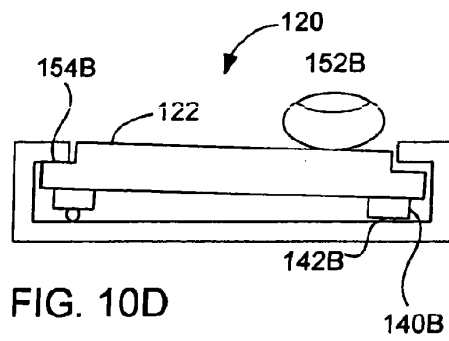
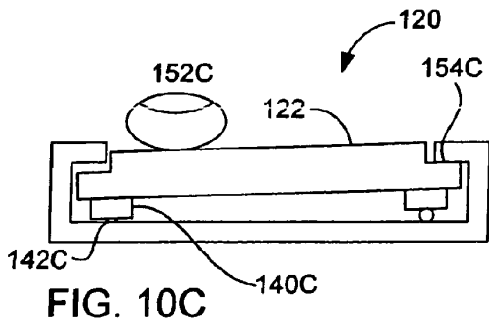
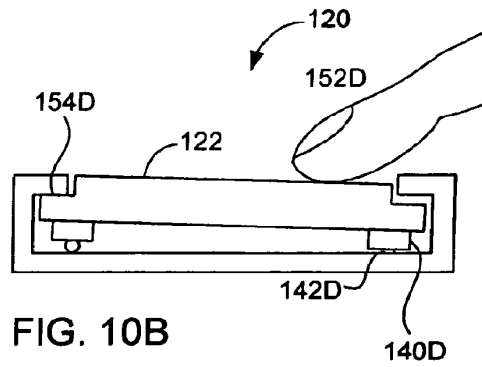
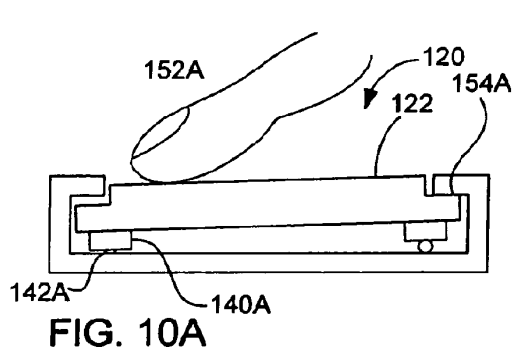
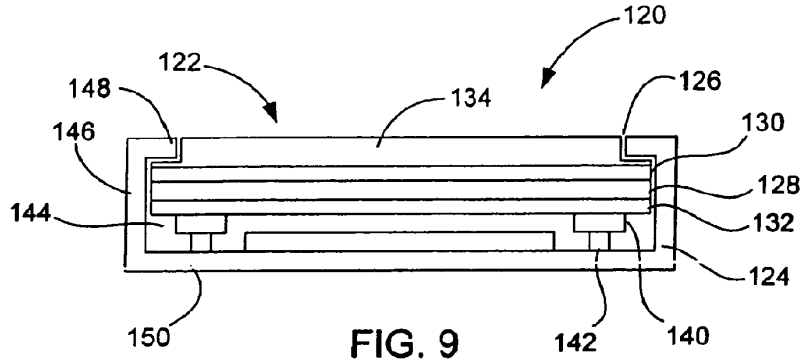


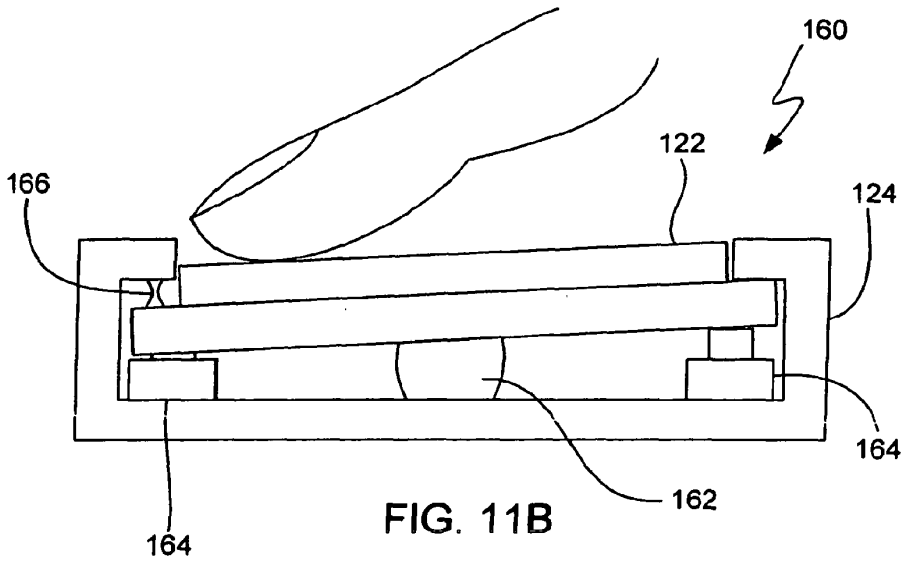
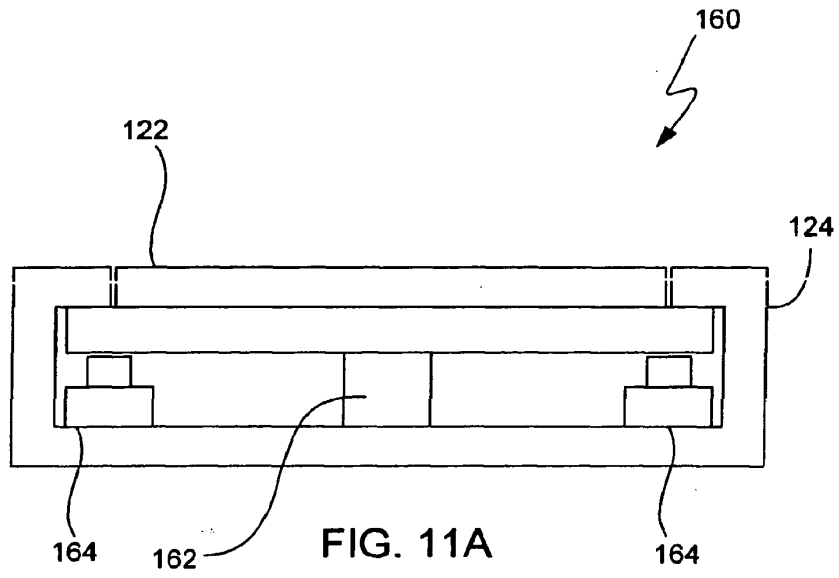
FIG. 4A

FIG. 4B









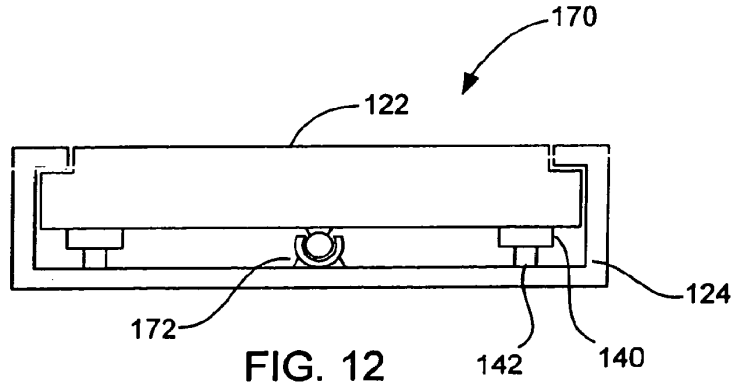


FIG. 12

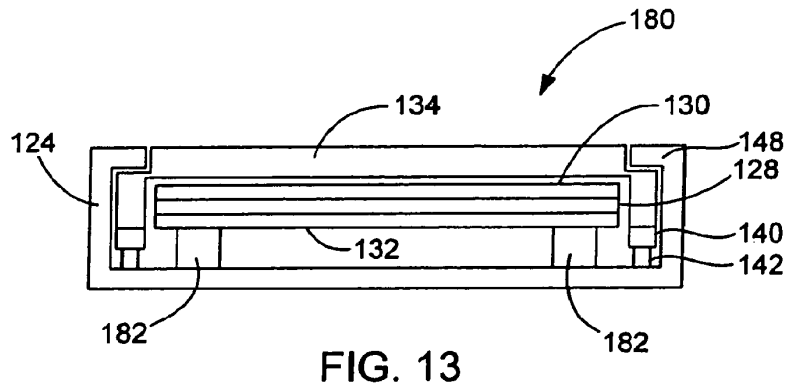
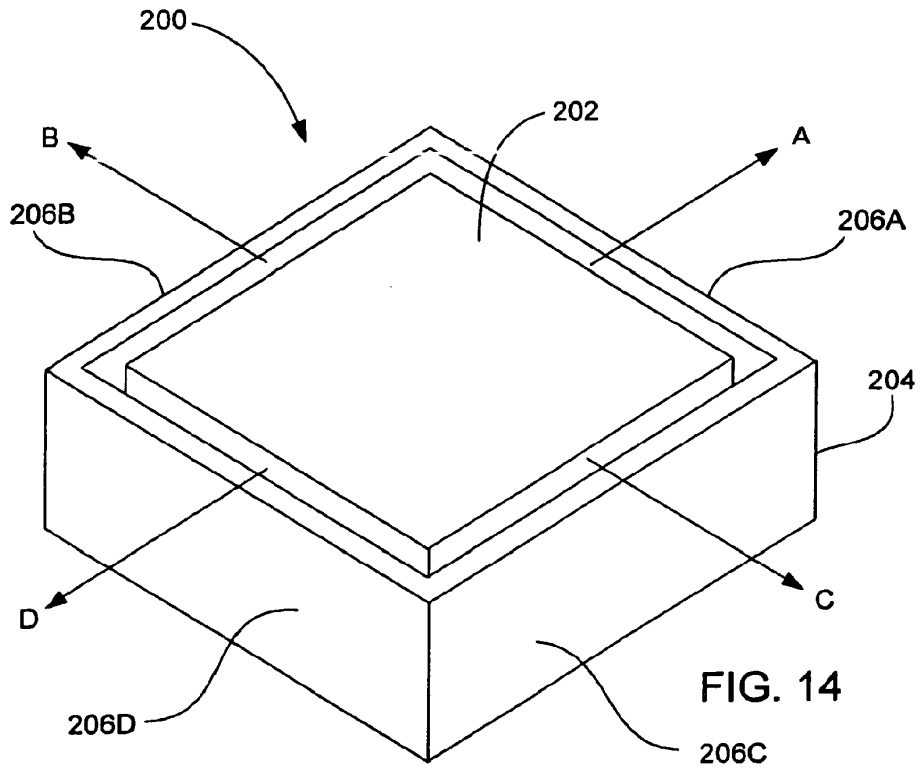


FIG. 13



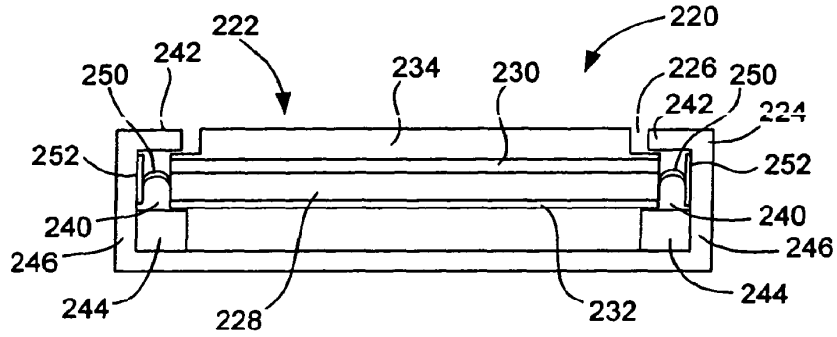


FIG. 15A

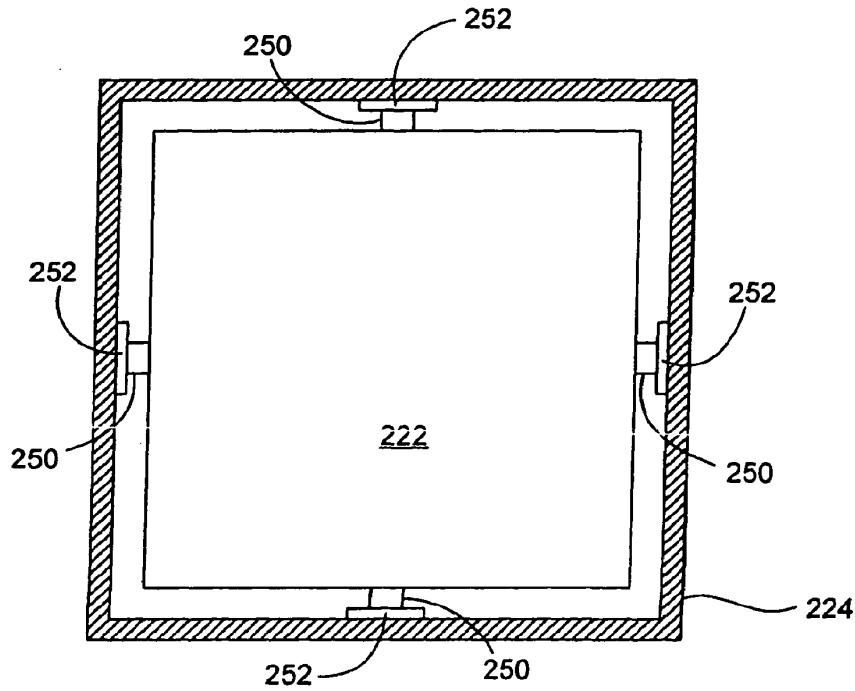


FIG. 15B

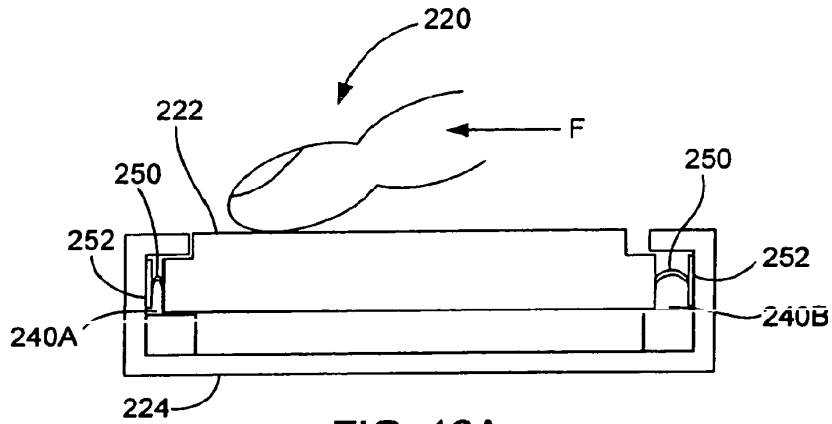


FIG. 16A

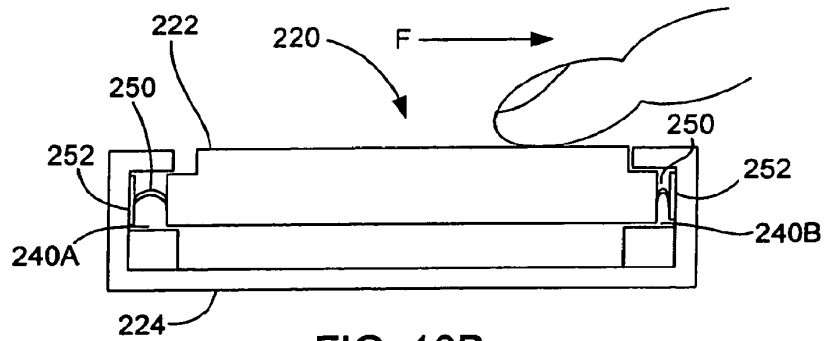


FIG. 16B

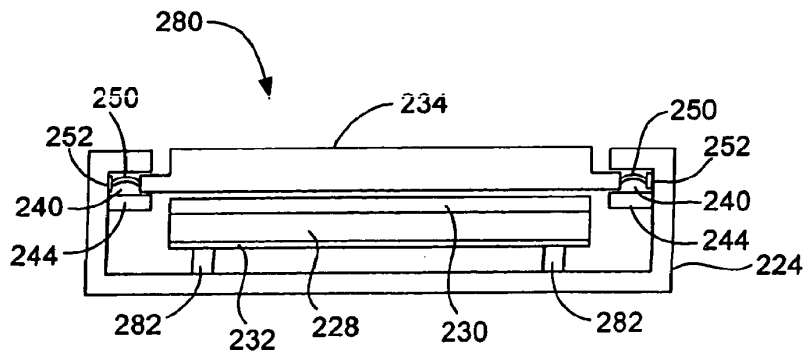


FIG. 17

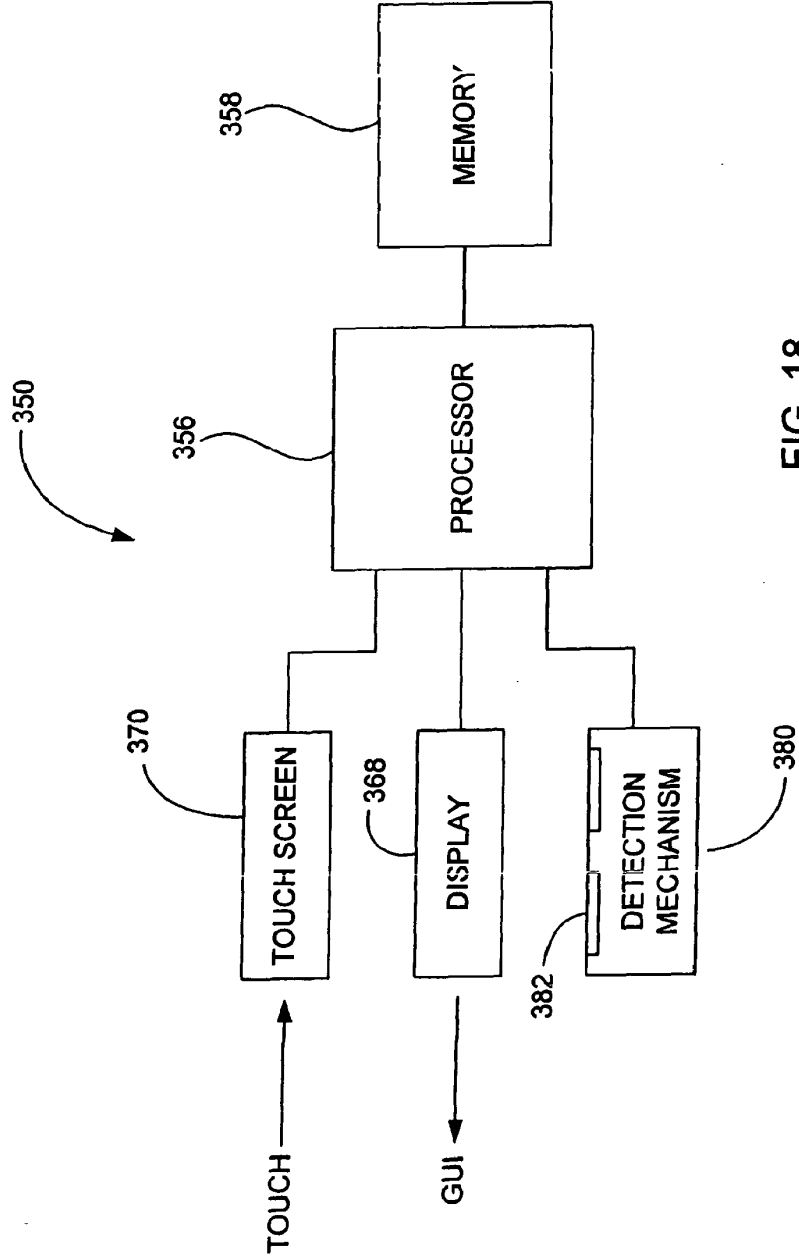


FIG. 18



European Patent Office

EUROPEAN SEARCH REPORT

Application Number
EP 05 25 5454

DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
X	DE 200 19 074 U1 (SIEMENS AG) 18 January 2001 (2001-01-18) * page 2, line 24 - page 3, line 7 * * page 3, line 35 - page 7, line 29 * * page 8, line 24 - page 9, line 5 * * page 10, line 36 - page 14, line 28; figures 1-6 *	1-15,17, 19,20, 23-41	G06F3/033 G06F1/16
X	US 2003/206202 A1 (MORIYA TAKASHIRO) 6 November 2003 (2003-11-06) * paragraph [0012] * * paragraph [0023] - paragraph [0030]; figures 1-3 *	1-14,16, 19-30	
X	GB 2 402 105 A (* THEREFORE LIMITED) 1 December 2004 (2004-12-01) * page 3, line 1 - page 9, line 3; figures 1-5 *	1-15, 17-20, 23-30	
X	US 6 248 017 B1 (ROACH ALAN P) 19 June 2001 (2001-06-19) * column 2, line 37 - column 4, line 24; figures 1-5 * * column 6, line 40 - line 50; figure 7 *	7-14,18, 19	TECHNICAL FIELDS SEARCHED (IPC) G06F H04M
X	US 2004/253989 A1 (TUPLER AMY M ET AL) 16 December 2004 (2004-12-16) * paragraph [0002] - paragraph [0015]; figures 1-3 *	2,7,18	
A	US 2004/224638 A1 (FADELL ANTHONY M ET AL) 11 November 2004 (2004-11-11) * paragraph [0044] - paragraph [0053]; figure 1 *	31-41	
The present search report has been drawn up for all claims			
Place of search The Hague		Date of completion of the search 3 March 2006	Examiner Legrand, J-C
<p>CATEGORY OF CITED DOCUMENTS</p> <p>X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document</p> <p>T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document</p>			

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EPC FORM 1503 03.02 (P04C01)

**ANNEX TO THE EUROPEAN SEARCH REPORT
ON EUROPEAN PATENT APPLICATION NO.**

EP 05 25 5454

This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report. The members are as contained in the European Patent Office EDP file on
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03-03-2006

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EPC FORM P0459

For more details about this annex : see Official Journal of the European Patent Office, No. 12/82



(12) **EUROPEAN PATENT APPLICATION**
 published in accordance with Art. 158(3) EPC

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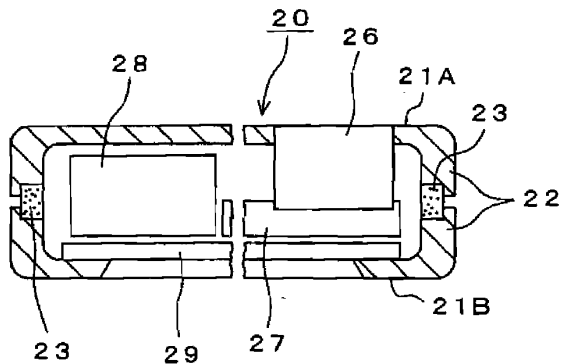
<p>(84) Designated Contracting States: DE FR GB</p> <p>(30) Priority: 26.03.2004 JP 2004093711</p> <p>(71) Applicant: SONY CORPORATION Tokyo 141-0001 (JP)</p> <p>(72) Inventors: <ul style="list-style-type: none"> • TAKASHIMA, Kouichiro; Shinagawa-ku, Tokyo 1410001; (JP) • TAKENAKA, Mikio; Shinagawa-ku, Tokyo 1410001; (JP) </p>	<ul style="list-style-type: none"> • MARUYAMA, Shigeaki; Shinagawa-ku, Tokyo 1410001; (JP) • KAWAGUCHI, Hiroto; Shinagawa-ku, Tokyo 1410001; (JP) • SEKINE, Junichi; Shinagawa-ku, Tokyo 1410001; (JP) <p>(74) Representative: Horner, David Richard D Young & Co 120 Holborn London EC1N 2DY (GB)</p>
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(54) **INPUT DEVICE HAVING TACTILE FUNCTION, INFORMATION INPUT METHOD, AND ELECTRONIC DEVICE**

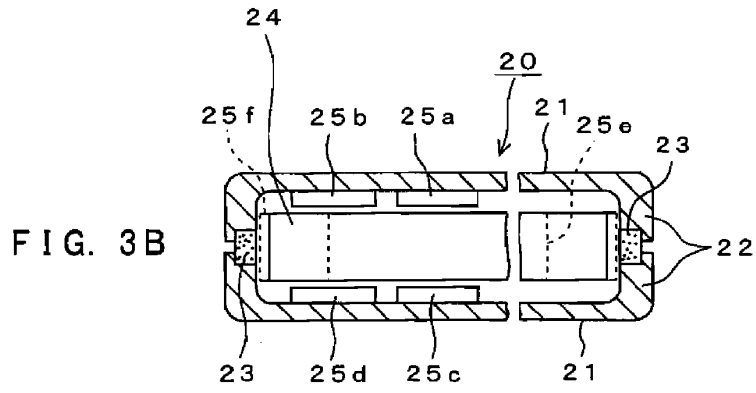
(57) Digital camera (100) shown in FIG. 4 has input detection section (24), which has an input detection plane, that detects a touching position of a finger (30a) of an operator and a sliding speed of the finger (30a), (32) that computes a vibration pattern based on the sliding speed detected by the input detection section (24),

and vibration section that vibrates the input detection plane based on the vibration pattern thus computed. The (32) computes a vibration pattern of the input detection plane to generate vibrations from its low frequency and small amplitude to its high frequency and large amplitude, as the finger (30a) goes away from a position where it has touched the input detection plane.

FIG. 3A



EP 1 731 993 A1



Description**TECHNICAL FIELD**

5 [0001] The present invention relates to an input device having a haptic function, an information input method, and an electronic device that are well applicable to a digital camera, information-processing apparatus, portable telephone, information portable terminal unit, etc. to which information is input by performing haptic operation on an input detection plane in a sliding manner. More specifically, it relates to those having vibration means for vibrating the input detection plane by using a vibration pattern computed on the basis of a haptic position by an operation body on this input detection plane and a sliding speed of this operation body, thereby enabling to be generated plural kinds of vibrations which have different period of vibration time (amplitude, frequency, and the number of times of vibrations) for each separate operator and which correspond to a sliding speed or a sliding lapse of time of the finger etc. of the operator, which is the operation body.

15 **BACKGROUND ART**

[0002] Recently, users (operators) have come to photograph a subject by using a digital camera having many kinds of operation modes and to take various contents into a portable terminal unit such as a portable telephone or a personal digital assistant (PDA) and utilize the contents. These digital camera, portable terminal unit, etc. each has an input device. As the input device, a keyboard and a touch panel having both of input means such as a JOG dial and display portion and the like are used in many cases.

20 [0003] As for this kind of digital camera, portable terminal unit, etc., a portable information terminal and programs thereof have been disclosed in Patent Literature 1 of Japan (Japanese Patent Application Laid Open Publication No. 2003-256120, pp. 2-3, FIG. 1). This portable information terminal has a display portion on its terminal unit body and a JOG dial at approximately middle of the body. The JOG dial is provided at a position different from that of the display portion. This JOG dial is rotated clockwise or counterclockwise so that an image on the display portion may be rotated as interlocked with this rotation. Moreover, by pressing the JOG dial toward the body, an image range is changed. By configuring an information terminal in such a manner, a variety of kinds of operations can be performed more comfortably. That is, the JOG dial employs a mechanical structure so that the operator may be given a haptic sense synchronized with any changes in contents displayed on the display portion for each time when he or she selects an input item on the display portion.

30 [0004] Further, some other portable terminal units having a haptic input function has an input function-provided display portion that combines any ones of various types of touch panels and display portions. By this type of portable terminal unit, an operator selects an input item by directly touching an icon display position in a space of two dimensions other than a depth-wise direction of the display portion as viewed from the operator. In such a manner, the operator can perform an input operation through a contacting (inputting, getting a touch of) a variety of icons displayed on the display portion with a smaller eyeball movement than the JOG dial type, thus more directly selecting an input item.

35 [0005] It is to be noted that an electronic device relative to the past examples such as a digital camera, an information processing apparatus, a portable telephone, and an information portable terminal unit that are provided with a haptic input function have the following problems.

- 40
- i. By a portable information terminal in which a display portion and a JOG dial are separated in arrangement as disclosed in Patent Literature 1, an operator can get only a single haptic sense generated by a mechanical structure, so that this haptic sense does not have a large impact on him or her presently.
 - 45 ii. By an input function-provided portable terminal unit that combines any ones of various types of touch panels and display portions, when having selected an icon on the display portion, the operator cannot get a haptic sense synchronized with that selection.
 - iii. In this connection, in the case of configuring a haptic function-provided input device by combining a plurality of vibrators and input means so that a haptic sense may be obtained through an operation to straightly touch its input operation surface, it is predicted that mere combination of the mechanism of separately arranging a display portion and input means as disclosed in Patent Literature 1 and an input function that combines various types of touch panels and display portion will not give a sufficient haptic sense if the operator touches the input operation surface at different speeds.
- 50

55 **DISCLOSURE OF THE INVENTION**

[0006] A haptic function-provided input device related to the present invention is a device that performs touch operation to slide on an input detection plane. The input device has input detection means, which has the input detection plane,

for detecting a touching position of an operation body and a sliding speed of the operation body, computation means for computing a vibration pattern based on the sliding speed detected by the input detection means, and vibration means for vibrating the input detection plane based on the vibration pattern computed by the computation means.

5 [0007] According to a haptic function-provided input device related to the present invention, on the assumption that performing touch operation to slide on an input detection plane, input detection means having the input detection plane detects a touching position of finger of an operator, which is one example of an operation body, and a sliding speed of this finger. Computation means computes vibration patterns based on the sliding speed of the finger etc. of the operator detected by the input detection means.

10 [0008] For example, the computation means computes a vibration pattern of the input detection plane to generate vibrations from its low frequency and small amplitude to its high frequency and large amplitude, as the operation body goes away from a position where it has touched the input detection plane. Therefore, it is possible to generate plural kinds of vibrations which have different vibration patterns (amplitude, frequency, and vibration times) for each operator and which correspond to a sliding speed or a sliding lapse of time of the finger of the operator.

15 [0009] An information input method related to the present invention is a method for inputting information by performing touch operation to slide on an input detection plane. The method has the steps of detecting a touched position and a sliding speed of an operation body that touches the input detection plane, computing a vibration pattern based on the touched position and the sliding speed that are detected, and vibrating the input detection plane based on the computed vibration pattern.

20 [0010] According to the information input method related to the present invention, in a case of inputting information by performing touch operation to slide on an input detection plane, it is possible to generate plural kinds of vibrations which have different vibration patterns for each operator and which correspond to a sliding speed or a sliding lapse of time of the finger etc. of the operator, which is the operation body.

25 [0011] An electronic device related to the present invention is an electronic device having a haptic function-provided input device that performs touch operation to slide on an input detection plane and display means for displaying a display image based on information input by the input device. The input device includes input detection means, which has the input detection plane, for detecting a touching position of an operation body and a sliding speed of the operation body, computation means for computing a vibration pattern based on the sliding speed detected by the input detection means, and

vibration means for vibrating the input detection plane based on the vibration pattern computed by the computation means.

30 [0012] According to the electronic device related to the present invention, the haptic function-provided input device related to the present invention is applied thereto, so that in the case of inputting information by performing touch operation to slide on an input detection plane, it is possible to generate plural kinds of vibrations which have different vibration patterns for each operator and which correspond to a sliding speed or a sliding lapse of time of the finger etc. of the operator, which is the operation body.

35

BRIEF DESCRIPTION OF THE DRAWINGS

[0013]

40 FIG. 1 is a perspective view of a digital camera 100 for illustrating a configuration thereof to which a haptic function-provided input device according to each of the embodiments of the present invention is applied;

FIG. 2 is a perspective view of a camera body 20 for illustrating a configuration of a rear thereof;

FIG. 3A is a cross-sectional view of the camera body 20 for illustrating a configuration thereof as viewed from a bottom thereof;

45 FIG. 3B is a cross-sectional of the camera body 20 for illustrating a configuration thereof as viewed from a top thereof;

FIG. 4 is a block diagram for showing an internal configuration of the digital camera 100;

FIG. 5 is a perspective view of an input detection section 24 for showing an example of operation thereof;

FIG. 6A is a diagram for showing an example of setting input positions P1-P5 on the input detection section 24;

50 FIG. 6B is a drawing for showing an example of a relationship between the input detection section 24 and input points P1-P5;

FIG. 7A is a drawing for showing an example of setting input positions P1-P5 in operation case I;

FIG. 7B is a drawing for showing an example of a vibration pattern at time point $Tp2+T\alpha$ between input positions P2 and P4 in operation case I;

55 FIG. 7C is a drawing for showing an example of a vibration pattern at time point $Tp2+T\alpha+T\beta$ between input positions P2 and P4 in operation case I;

FIG. 7D is a drawing for showing an example of a vibration pattern at time point $Tp2+T\alpha+2XT\beta$ between input positions P2 and P4 in operation case I;

FIG. 7E is a drawing for showing an example of a vibration pattern at time point $Tp2+T\alpha+3XT\beta$ between input

positions P2 and P4 in operation case I;
 FIG. 7F is a drawing for showing an example of a vibration pattern at time point $Tp2+T\alpha+4XT\beta$ between input positions P2 and P4 in operation case I;
 FIG. 7G is a drawing for showing an example of a haptic image between input points P2 and P4 in operation case I;
 5 FIG. 8A is a drawing for showing an example of setting input positions P1-P5 in operation case II;
 FIG. 8B is a drawing for showing an example of a vibration pattern at time point $Tp2+T\alpha$ between input positions P2 and P4 in operation case II;
 FIG. 8C is a drawing for showing an example of a vibration pattern at time point $Tp2+T\alpha+Tj$ between input positions P2 and P4 in operation case II;
 10 FIG. 8D is a drawing for showing an example of a vibration pattern at time point $Tp2+T\alpha+2XT\beta$ between input positions P2 and P4 in operation case II;
 FIG. 8E is a drawing for showing an example of a vibration pattern at time point $Tp2+T\alpha+3XT\beta$ between input positions P2 and P4 in operation case II;
 FIG. 8F is a drawing for showing an example of a vibration pattern at time point $Tp2+T\alpha+4XT\beta$ between input positions P2 and P4 in operation case II;
 15 FIG. 8G is a drawing for showing an example of a haptic image between input points P2 and P5 in operation case II;
 FIG. 9A is a drawing for showing an example of a vibration pattern to an actuator 25e when a sliding speed is V1, related to a conventional method;
 FIG. 9B is a drawing for showing an example of a vibration pattern to another actuator 25f when the sliding speed is V1, related to the conventional method;
 20 FIG. 9C is a drawing for showing an example of a long lapse of time of touching an input detection section related to the conventional method;
 FIG. 9D is a drawing for showing an example of a vibration pattern to the actuator 25e when the sliding speed is V2, related to the conventional method;
 25 FIG. 9E is a drawing for showing an example of a vibration pattern to another actuator 25f when the sliding speed is V2, related to the conventional method;
 FIG. 9F is a drawing for showing an example of a short lapse of time of touching the input detection section related to the conventional method;
 FIG. 10A is a drawing for showing an example of a vibration pattern to an actuator 25e when the sliding speed $Vx=V1$, related to a method of the present invention;
 30 FIG. 10B is a drawing for showing an example of a vibration pattern to another actuator 25f when the sliding speed is $Vx=V1$, related to the method of the present invention;
 FIG. 11A is a drawing for showing an example of setting input positions P1-P5 at the time of a sliding speed of V1 when finger moves slow according to the method of the present invention and the conventional method;
 35 FIG. 11B is a drawing for showing an example of a haptic image at the time of the sliding speed of V1 according to the method of the present invention and the conventional method;
 FIG. 11C is a drawing for showing an example of setting input positions P1-P5 at the time of a sliding speed of V2 when the finger moves fast according to the method of the present invention and the conventional method;
 40 FIG. 11D is a drawing for showing an example of a haptic image at the time of the sliding speed of V2 according to the conventional method;
 FIG. 11E is a drawing for showing an example of a haptic image at the time of the sliding speed of V2 according to the method of the present invention;
 FIG. 12A is a conceptual diagram for showing an example of image display before zoom-in in a zoom-in mode;
 FIG. 12B is a conceptual diagram for showing an example of image display during zoom-in;
 45 FIG. 12C is a conceptual diagram for showing an example of image display after zoom-in;
 FIG. 13A is a conceptual diagram for showing an example of operations before adjustment in a volume adjustment mode;
 FIG. 13B is a conceptual diagram for showing an example of operations during adjustment;
 FIG. 13C is a conceptual diagram for showing an example of operations after adjustment;
 50 FIG. 14A is a flowchart showing an information processing example (No. 1) in a digital camera 100 according to a first embodiment;
 FIG. 14B is a flowchart showing an information processing example (No. 2) in the digital camera 100;
 FIG. 14C is a flowchart showing an information processing example (No. 3) in the digital camera 100;
 FIG. 14D is a flowchart showing an information processing example (No. 4) in the digital camera 100;
 55 FIG. 15 is a flowchart (subroutine) showing a processing example in the zoom-in mode; and
 FIG. 16 is a perspective view of a digital camera 200 according to a second embodiment for illustrating an example of a haptic function-provided input mechanism used therein.

BEST MODE FOR CARRYING OUT THE INVENTION

[0014] The present invention has solved the conventional problems, and it is an object of the present invention to provide a haptic function-provided input device, an information input method, and an electronic device that enable to be generated plural kinds of vibrations which have different vibration times for each operator and which correspond to a sliding speed or a lapse of sliding time of the finger etc. of the operator.

[0015] The following will describe one embodiment of the haptic function-provided input device, the information input method, and the electronic device related to the present invention.

10 [First Embodiment]

[0016] In the first embodiment, vibration means for vibrating an input detection plane in accordance with a vibration pattern computed based on a touch position and a sliding speed of an operation body on this input detection plane is provided, thereby enabling to be generated plural kinds of vibrations which have different periods of vibration time (frequency, amplitude, and the number of times) for each operator and which correspond to a sliding speed or a lapse of sliding time of the finger etc. of the operator, which is the operation body.

[0017] A digital camera 100 shown in FIG. 1 is one example of electronic devices to which a haptic function-provided input device related to the present invention is applied. This digital camera 100 has a camera body 20. The camera body 20 is constituted of a chassis 22. The chassis 22 is assembled by causing a front case 21A and a rear case 21B that are roughly box-shaped to abut against each other with a roughly square-shaped shock absorber 23 made of rubber being sandwiched between openings of these respective cases.

[0018] On an upper face plate of the chassis 22, an input detection section 24 constituting a haptic function-provided input device (input detection means) is mounted. The input detection section 24 has the input detection plane and is operated in a slide input mode. The slide input mode is referred to as an operation to perform any touch input to slide on an input detection plane when switching modes such as a playback/fast-forward mode, a zoom-out mode, a zoom-in mode, and a volume adjustment mode. As in this embodiment, besides the slide input mode, other processing modes are prepared. In these other modes, a shutter button operation mode, an erasure button operation mode, a power source button operation mode, an operation mode to switch between a standard mode and a snap mode, etc. are included. As the input detection section 24, a rectangular electrostatic input sheet is used.

[0019] Inside the front case 21A, along a longitudinal direction of the input detection section 24, actuators 25a and 25b constituting the vibration means are provided with a predetermined spacing therebetween and configured to vibrate the input detection plane based on a desired vibration pattern. Similarly, inside the rear case 21B, along a longitudinal direction of the input detection section 24, actuators 25c and 25d are provided with a predetermined spacing therebetween and configured to vibrate the input detection plane based on the desired vibration pattern. In the present embodiment, the actuators 25a and 25c are faced to each other and the actuators 25b and 25d are faced to each other. This forces the vibrations to be made strong.

[0020] Besides, the front case 21A mounts a lens 26, shown in FIG. 1, to have a zoom function so that an image of a subject may be formed when photographing the subject. Further, at the right corner of the front case 21A, an external interface terminal 39 is provided to connect an external device to which any information can be transferred.

[0021] The rear case 21B shown in FIG. 2 is provided with a display portion 29 to display an image to be displayed on the basis of information input by the input detection section 24. The display portion 29 is configured to perform a monitor function as well as other functions such as a finder function. As the display portion 29, a liquid crystal display (LCD) is used which has a resolution of about 640 pixels by 480 pixels.

[0022] As can be seen from a bottom of the camera body 20 shown in FIG. 3A, besides the lens 26 and the display portion 29, substrate mounting components 27 and a battery 28 are mounted inside the chassis 22. As can be seen from a top of the camera body 20 shown in FIG. 3B, the input detection section 24 and the actuators 25a-25f are mounted inside the chassis 22. The input detection section 24 shown in FIG. 3B is constituted of an electrostatic capacitive input sheet. One sheet of electrostatic capacitive input sheet is constituted of a roughly rectangular sheet, so that by pressing a plurality of predetermined positions of this electrostatic capacitive sheet, the above-described mode buttons function respectively.

[0023] In the present embodiment, at right and left positions under the input detection section 24, besides the actuators 25a-25d mounted inside the front case 21A and the rear case 21B, the actuators 25e and 25f are also mounted to vibrate the input detection plane based on a desired vibration pattern so that vibrations may propagate to, for example, an operation direction. Each of the actuators 25a-25f is constituted of a piezoelectric sheet or a piezoelectric element.

[0024] Next, a haptic function-provided input device, the digital camera 100, and a haptic feedback input method in the digital camera 100 of the present invention will be described. FIG. 4 is a block diagram for showing an internal configuration of the digital camera 100, indicating blocks of important sections of the functions constituted of the substrate mounting components 27 etc. in the chassis shown in FIGS. 1, 2, and 3A, and 3B. Like components in FIGS. 4 and 2

are indicated by the same symbols.

[0025] The digital camera 100 shown in FIG. 4 is provided with the input detection section 24, the display portion 29, an A/D driver 31, a CPU 32, a power source unit 33, a camera 34, other devices 35, a speaker 36, and a vibration section 40.

[0026] The input detection section 24 has the input detection face as shown in FIG. 2 etc. and is configured to detect a touch position by the finger 30a of the operator as the operation body and a degree of sliding (moving speed) of the finger 30a of this operator. Although, in FIG. 2, an electrostatic capacitive input device has been described as the electrostatic capacitive sheet as for this input detection section 24, the present invention is not limited to that; any device may be used as far as it can distinguish between a cursoring and a selection function.

[0027] For example, the input detection section 24 may be an input device such as a resistance film typed one, a surface acoustic wave (AW) typed one, an optical typed one, or a multiple-stage typed tact switch. Preferably, any input device may be used as far as it is configured to be able to give position information and force information to the CPU 32. The above-described input detection section 24 is supplied with at least position information S1 and force information S2 (pressing force), which provides an input quantity, via the operator's finger 30a.

[0028] The display portion 29 is configured to display an image to be displayed based on information input by the input detection section 24. The display portion 29 is set to perform a monitor function as well as such functions as a finder function. For example, the display portion 29 displays icons of the zoom-in mode, the zoom-out mode, the playback/fast-forward mode, the volume (Vol) adjustment mode, etc. based on control information (command D) from the CPU 32.

[0029] The input detection section 24 has the A/D driver 31 connected thereto, to receive the position information S1 and the input quantity S2 output from the input detection section 24 and perform analog-to-digital conversion thereof. For example, the A/D driver 31 converts an analog signal comprised of the position information S1 and the input quantity S2 into digital data in order to distinguish between the cursoring and the selection function. Along with it, the A/D driver 31 detects, through computation, which is cursoring input or selection information and supplies the CPU 32 with data D3 constituted of a flag indicating either cursoring or selection, position detection data D1 or input quantity data D2. Those computations may be performed in the CPU 32.

[0030] The A/D driver 31 is connected with the CPU 32 which is one example of computation means, and receives an input signal from the A/D driver 31 and supplies a command D to devices of the power source unit 33, the camera section 34, the other devices 35, the display portion 29, the speaker 36, and an actuator drive section 37.

[0031] For example, the CPU 32 has a function (algorithm) to process a sine waveform generated in the actuator drive circuit 37 by using a sliding speed of an operator 30 as a parameter in the same vibration mode. The CPU 32 is configured to compute a vibration pattern based on the sliding speed detected by the input detection section 24. In the present embodiment, the CPU 32 computes a vibration pattern of the input detection plane such that as the finger 30a of the operator goes away from a point where it has touched the input detection plane originally, the input detection plane can generate vibration pattern from low frequency and small amplitude to high frequency and large amplitude.

[0032] Further, the CPU 32 constitutes control means, and conducts variable control on input information based on the sliding speed. For example, the CPU 32 conducts such a control as to set a larger quantity of input information when the operator's finger has been slid faster than a quantity of input information when it has been slid at a standard sliding speed.

[0033] The vibration section 40 is constituted of the actuator drive circuit 37 and the actuators 25a-25f, to vibrate the input detection plane based on a vibration pattern computed by the CPU 32 in such a manner that vibrations may propagate to an operation direction thereof. The above-described CPU 32 is connected to the actuator drive circuit 37 to generate vibration control signals Sa-Sf in accordance with each command D from the CPU 32 and supply the plural actuators 25a, 25b, 25c, 25d, 25e, and 25f with the vibration control signals Sa-Sf. The vibration control signals Sa-Sf have, for example, output waveforms W1-W3, ... with sine wave shape. This enables to be driven the six actuators 25a-25f.

[0034] Further, the CPU 32 is connected to the camera 34 to photograph a subject through the above-described lens 26 in accordance with the command D. As the camera 34, an imaging device (CCD), not shown, is used to output photographed data obtained through photographing of the subject.

[0035] The other devices 35 include a storage device, an external terminal, etc. For example, the storage device stores photographed data and reads this photographed data in accordance with the command D from the CPU 32. The external terminal includes the external interface terminal 39 shown in FIG. 1, to output the command D from the CPU 32 to an external device such as a printer so that a printer mode, not shown, may be activated. The speaker 36 produces icon confirmation sound or device-handling announcing sound in accordance with the command D from the CPU 32.

[0036] The power source unit 33 is connected to the battery 28 described earlier and supplies power to the input detection section 24, the display portion 29, the A/D driver 31, the CPU 32, the camera 34, the other devices (storage device, external terminal, etc.) 35, the vibration section 40, etc.

[0037] By configuring the digital camera 100 as the above, it is possible to generate plural kinds of vibrations which correspond to a sliding speed or a lapse of sliding time of the operator's finger 30a and which have different vibration patterns (amplitude, frequency, and vibration times) for each operator. The operator 30 senses function-specific vibrations from the CPU as a haptic sense when having received vibrations through his or her finger 30a. Also, contents displayed

on the display portion 29 are utilized so that each function can be decided through visual perception by operator's eyes and a sound produced by speaker 36 is utilized so that each function can be decided through auditory perception of his ears.

5 **[0038]** Next, an operation example will be described in which the operator gets a haptic sense from the camera body 20 with him or her sliding his or her finger 30a on the input operation face. FIG. 5 is a perspective view of the input detection section 24 for showing an example of operation on the input detection section 24, in which a portion of the operator's finger 30a is expanded.

10 **[0039]** In the present embodiment, the input detection section 24 shown in FIG. 5 has an input operation face PR and is operated in such a manner that the operator's finger 30a may be slid (go over) on this input operation face PR at a predetermined speed from, for example, a left bottom portion to a right top portion in the figure in a condition where that the finger 30a is in contact with that face PR through constant force. The input operation face PR is defined to be a region enclosed by a broken line including an upper of the chassis to which the input detection section 24 is projected.

15 **[0040]** In the present embodiment, on the right and left sides of the input detection section 24 shown in FIG. 6A, the actuators 25f and 25e are respectively provided. The input detection section 24 and the actuators 25a, 25b, 25e, 25f, etc. are all fixed to the chassis 22 by adhesive 27. As the input detection section 24, an electrostatic capacitive sheet (touch panel) and the like are used to detect a sliding speed of the operator's finger 30a.

20 **[0041]** In FIG. 6B, five points of positions P1-P5 are set on the input operation face PR. In the present embodiment, an example is employed in which one end of the input detection section 24 is arranged between positions P1 and P2 and the other end of the input detection section 24 is arranged between positions P4 and P5. The operator goes over the input operation face PR at a sliding speed V_0 in a direction from position P1 to position P5. In this case, the CPU 32 calculates a rate of change V_x , which is detected by the input detection section 24, in input positions P1 through P5 on a time axis thereof, that is, a sliding speed V_x of the operator's finger 30a.

25 **[0042]** In the present embodiment, the input detection section 24 prepares beforehand a haptic waveform W_0 when a standard rate of change in input positions P1 through P5 along the time axis thereof, that is, a standard sliding speed of the operator's finger 30a is set to V_0 . Table 1 shows contents of the haptic waveform W_0 with respect to the standard sliding speed V_0 .

Table 1

haptic waveform W_0 with respect to rate of change V_0 in position along a basic time axis	
Frequency f_x	H1, H2, H3, H4,
Amplitude A_x	A1, A2, A3, A4,
The number of times N_x	n1, n2, n3, n4,

35 **[0043]** In Table 1, f_x indicates a frequency of the haptic waveform W_0 , A_x indicates its amplitude, and N_x indicates the number of times (of its waves). At the first stage of a vibration pattern, the haptic waveform W_0 has a frequency $f_x=H1$ [Hz], an amplitude $A_x=A1$ [μm], the number of times $N_x=n1$. Similarly, at the second stage thereof, it has $f_x=H2$, the amplitude $A_x=A2$, and the number of times $N_x=n2$; at the third stage thereof, it has $f_x=H3$, the amplitude $A_x=A3$, and the number of times $N_x=n3$; at the fourth stage thereof, it has $f_x=H4$, the amplitude $A_x=A4$, and the number of times $N_x=n4$,..., where units are omitted.

40 **[0044]** Further, in the present embodiment, a sliding speed V_x in a case where the finger goes over on the input operation face PR at the standard sliding speed V_0 or slower ($V_1 < V_0$) is set equal to V_1 ($V_x=V_1$). This is defined to be operation case I. Table 2 shows contents of a haptic waveform W_v with respect to sliding speed V_1 .

Table 2

haptic waveform W_v with respect to rate of change V_x in position along a detected time axis	
Frequency f_x	H1, H2, H3, H4,
Amplitude A_x	A1, A2, A3, A4,
The number of times N_x	$n1 \cdot \frac{V_0}{V_x}$, $n2 \cdot \frac{V_0}{V_x}$, $n3 \cdot \frac{V_0}{V_x}$, $n4 \cdot \frac{V_0}{V_x}$, ...

55 **[0045]** In the operation case I shown in Table 2, f_x indicates a frequency of the haptic waveform W_v , A_x indicates its amplitude, and N_x indicates the number of times of its waves. At the first stage of a vibration pattern, the haptic waveform

Wv has a frequency $f_x=H1$ [Hz], an amplitude $A_x=A1$ [μm], the number of times $N_x=n1 \cdot V_0/V_x$. Similarly, at the second stage thereof, it has $f_x=H2$, the amplitude $A_x=A2$, and the number of times $N_x=n2 \cdot V_0/V_x$; at the third stage thereof, it has $f_x=H3$, the amplitude $A_x=A3$, and the number of times $N_x=n3 \cdot V_0/V_x$; at the fourth stage thereof, it has $f_x=H4$, the amplitude $A_x=A4$, and the number of times $N_x=n4 \cdot V_0/V_x, \dots$, where units are omitted.

[0046] Furthermore, in the present embodiment, a sliding speed V_x in a case where the finger goes over faster than the standard sliding speed V_0 ($V_2 > V_0$) is set equal to V_2 ($V_1 < V_2$). This is defined to be operation case II. Table 3 shows contents of the haptic waveform Wv with respect to the sliding speed V_2 .

Table 3

haptic waveform Wv when $N_x > (V_0/V_x)$	
Frequency f_x	H1, H2, H3, H4,
Amplitude A_x	A1, A2, A3, A4,
The number of times N_x	1, 1, 1, 1,

[0047] In Table 3, f_x indicates a frequency of the haptic waveform Wv, A_x indicates its amplitude, and N_x indicates the number of times of its waves. In this case, however, these contents are employed only when at least one of the number of times $N_x=n1 \cdot V_0/V_x, N_x=n2 \cdot V_0/V_x, N_x=n3 \cdot V_0/V_x, N_x=n4 \cdot V_0/V_x, \dots$ takes a value below one (1). At the first stage of a vibration pattern, the haptic waveform Wv has a frequency $f_x=H1$ [Hz], an amplitude $A_x=A1$ [μm], and the number of times $N_x=1$. Similarly, at the second stage thereof, it has $f_x=H2$, the amplitude $A_x=A2$, and the number of times $N_x=2$; at the third stage thereof, it has $f_x=H3$, the amplitude $A_x=A3$, and the number of times $N_x=3$; at the fourth stage thereof, it has $f_x=H4$, the amplitude $A_x=A4$, and the number of times $N_x=4, \dots$, where units are omitted.

[0048] In this case, if the number of times N_x is set to $n_x \cdot V_0/V_x$ ($x=1, 2, 3, 4, \dots$) when distinguishing between the operation cases I and II, the CPU 32 decides whether $n_x \cdot V_0/V_x \geq 1$ with respect to the standard sliding speed V_0 . By using a result of this decision, the digital camera 100 can generate plural kinds of haptic senses having the same haptic image but different periods of vibration time in the same vibration mode.

[0049] Next, an example of a vibration pattern and an example of a haptic image in the operation case I will be described. Along a horizontal axis shown in FIG. 7A, input positions P1-P5 related to operation case I are given. Vertical axes shown in FIG. 7B-7G all give amplitude A_x and horizontal axes thereof all give time t . Each graduation of the time axis corresponds to 0.1[s]. Each graduation of the input position axis corresponds to 1cm. This example exemplifies the case of moving from input positions P1 to P5 by taking 2[s], that is, the case of moving over a distance of all sections of 4cm at a sliding speed of 2cm/s (operation case I).

[0050] FIG. 7A shows the operation case I, that is, a case where the operator's finger 30a has gone over the input operation face PR at a sliding speed of V_1 of the operator's finger 30a that is the standard sliding speed V_0 or slower ($V_1 \leq V_0$). In this case, during a lapse of time when the operator's finger 30a moves from input positions P1 to P3, the input detection section 24 detects the sliding speed V_1 of the operator's finger 30a.

[0051] Based on a rate of change V_x with respect to the time axis in the input positions P1-P5, which is detected by the input detection section 24, the CPU 32 detects and recognizes that a sliding speed of $V_1=2\text{cm/s}$ at which the operator's finger 30 has gone over the input operation face PR is the same as the standard speed V_0 or slower than that ($V_1 \leq V_0$). If having detected operation case I, the CPU 32 supplies the actuator drive circuit 37 with such a command D (control information) as to generate the vibration pattern shown in Table 2.

[0052] In FIG. 7B showing a vibration pattern example at $TP2+T\alpha$, $TP2$ indicates an input detection time when the input detection section 24 detects an input position P2. In FIG. 7B, $T\alpha$ indicates a vibration delay time, that is, a time lag from input detection time $TP2$ to excitation-starting time. In this case, it is about 0.1s.

[0053] At this input detection time $TP2$, the actuator drive circuit 37 shown in FIG. 4 outputs such vibration control signals Sa-Sf as to generate the vibration pattern shown in Table 2 based on the command D. The actuator 25a is supplied with the vibration control signal Sa; the actuator 25b is supplied with the vibration control signal Sb; the actuator 25c is supplied with the vibration control signal Sc; the actuator 25d is supplied with the vibration control signal Sd; the actuator 25e is supplied with the vibration control signal Se; and the actuator 25f is supplied with the vibration control signal Sf, respectively.

[0054] Of course, this invention is not limited to this; for example, drive signals of four patterns may be supplied such that the actuators 25a and 25c are supplied with the vibration control signal Sa having the same contents; the actuators 25b and 25d are supplied with the vibration control signal Sb; the actuator 25e is supplied with the vibration control signal Sc; and the actuator 25f is supplied with the vibration control signal Sd.

[0055] The actuators 25a-25f vibrate for about 0.8s based on the vibration control signals Sa-Sd. Specifically, in the vibration waveform shown in FIG. 7B, they vibrate in accordance with a vibration pattern having frequency $f_x=50\text{Hz}$,

amplitude $A_x=5\mu\text{m}$, and the number of times $N_x=10$ for about 0.2s at the first stage i thereof. Hereinafter, this pattern is described as $[f_x A_x N_x]=[50\ 5\ 10]$. Similarly, they vibrate in accordance with vibration pattern $[f_x A_x N_x]=[100\ 10\ 20]$ for about 0.2s at the second stage ii thereof too. At the third stage iii thereof too, they vibrate in accordance with vibration pattern $[f_x A_x N_x]=[200\ 20\ 40]$ for about 0.2s. At the fourth stage iv thereof too, they vibrate in accordance with vibration pattern $[f_x A_x N_x]=[400\ 30\ 80]$ for about 0.2s.

[0056] Further, in FIG. 7C showing a vibration pattern example at $TP2+T\alpha+T\beta$, $T\beta$ indicates vibration propagation delay time, that is, slight delay time with respect to the vibration delay time $T\alpha$. That is, in a vibration pattern constituted of the first through fourth stages i-iv shown in FIG. 7C, vibration propagates later than that of FIG. 7B by the vibration propagation delay time $T\beta$.

[0057] Further, relative to FIG. 7D showing a vibration pattern example at $TP2+T\alpha+2XT\beta$, in a vibration pattern constituted of the first through fourth stages i-iv, vibration propagates later than that of FIG. 7C further by the vibration propagation delay time $T\beta$. Relative to FIG. 7E showing a vibration pattern example at $TP2+T\alpha+3XT\beta$, in a vibration pattern constituted of the first through fourth stages i-iv, vibration propagates later than that of FIG. 7D further by the vibration propagation delay time $T\beta$.

[0058] Relative to FIG. 7F showing a vibration pattern example at $TP2+T\alpha+4XT\beta$, in a vibration pattern constituted of the first through fourth stages i-iv, vibration propagates later than that of FIG. 7E further by the vibration propagation delay time $T\beta$.

[0059] According to a haptic image obtained through the operator's finger 30a in operation case I shown in FIG. 7G, in a period of time when the finger moves from input positions P2 to P4, it is possible to obtain a haptic sense based on the vibration patterns shown in FIGS. 7B-7F. At the input position P2, in about 0.2s of its first stage i, the haptic sense based on the vibration pattern $[f_x A_x N_x]=[50\ 5\ 10]$ is obtained and in about 0.2s of its second stage ii, the haptic sense based on the vibration pattern $[f_x A_x N_x]=[100\ 10\ 20]$ is obtained, and in about 0.2s of its following third stage iii, the haptic sense based on the vibration pattern $[f_x A_x N_x]=[200\ 20\ 40]$ is obtained and in about 0.2s of its fourth stage iv, the haptic sense based on the vibration pattern $[f_x A_x N_x]=[400\ 30\ 80]$ is obtained.

[0060] Next, an example of a vibration pattern and an example of a haptic image in operation case II will be described. Along a horizontal axis shown in FIG. 8A, input positions P1-P5 in operation case II are given.

[0061] Vertical axes shown in FIG. 8B-8G all give amplitude A_x and horizontal axes thereof all give time t. Each graduation of the time axis corresponds to 0.1[s]. Each graduation of the input position axis corresponds to 1cm. This example exemplifies the case of moving from the input position P1 to the input position P2 by taking 0.5[s], moving from the input position P2 to the input position P4 by taking 0.5s, and moving from the input position P4 to the input position P5 by taking 0.5s again, that is, the case of moving over a distance from input position P1 to the input position P2 at a sliding speed of 2cm/s, a distance from the input position P2 to the input position P4 at a sliding speed of 4cm/s, and a distance from input position P4 to the input position P5 at a sliding speed of 2.0cm/s again of a moving distance of all sections of 4 cm (operation case II).

[0062] FIG. 8A shows the operation case II, that is, a case where a sliding speed $V2$ of the operator's finger 30a at which the operator's finger 30a has gone on the input operation face PR is faster than the standard sliding speed V_0 ($V2>V_0$). In this case too, during a lapse of time when the operator's finger 30a moves from input positions P1 to P3, the input detection section 24 detects a sliding speed $V2$ of the operator's finger 30a.

[0063] Based on a rate of change V_x in input positions P1-P5 with respect to the time axis detected by the input detection section 24, the CPU 32 detects and recognizes that a sliding speed of $V2=4\text{cm/s}$ of the operator's finger 30a at which the operator's finger 30a has gone on the input operation face PR is faster than the standard speed V_0 ($V2\leq V_0$). If having detected operation case II, the CPU 32 supplies the actuator drive circuit 37 with the command D (control information) to generate the vibration pattern shown in Table 3.

[0064] Further, in FIG. 8B showing a vibration pattern example at $TP2+T\alpha$, $TP2$ indicates an input detection time when the input detection section 24 detects the input position P2. In FIG. 8B, $T\alpha$ indicates vibration delay time, that is, a time lag from input detection time $TP2$ to excitation-starting time. In this case, it is about 0.1s.

[0065] At this input detection time $TP2$, the actuator drive circuit 37 shown in FIG. 4 outputs such vibration control signals Sa-Sf as to generate the vibration pattern shown in Table 3 based on the command D. The actuator 25a is supplied with the vibration control signal Sa; the actuator 25b is supplied with the vibration control signal Sb; the actuator 25c is supplied with the vibration control signal Sc; the actuator 25d is supplied with the vibration control signal Sd; the actuator 25e is supplied with the vibration control signal Se; and the actuator 25f is supplied with the vibration control signal Sf, respectively.

[0066] The actuators 25a-25f vibrate the input detection plane for about 0.4s based on the vibration control signals Sa-Sf. Specifically, in the vibration waveform shown in FIG. 8B, they vibrate in accordance with a vibration pattern having a frequency $f_x=50\text{Hz}$, amplitude $A_x=5\mu\text{m}$, and the number of times $N_x=5$ for about 0.1s at the first stage i thereof. Hereinafter, this pattern is described as $[f_x A_x N_x]=[50\ 5\ 5]$. Similarly, they vibrate in accordance with vibration pattern $[f_x A_x N_x]=[100\ 10\ 10]$ for about 0.1s at the second stage ii thereof too. At the third stage iii thereof too, they vibrate in accordance with vibration pattern $[f_x A_x N_x]=[200\ 20\ 20]$ for about 0.1s. At the fourth stage iv thereof too, they vibrate

in accordance with vibration pattern [fx Ax Nx]=[400 30 40] for about 0.1s.

[0067] Further, in FIG. 8C showing a vibration pattern example at $TP2+T\alpha+T\beta$, $T\beta$ indicates vibration propagation delay time, that is, slight delay time with respect to the vibration delay time $T\alpha$. That is, in the vibration pattern constituted of the first through fourth stages i-iv shown in FIG. 8C, vibration propagates later than that of FIG. 8B by the vibration propagation delay time $T\beta$.

[0068] Relative to FIG. 8D showing a vibration pattern example at $TP2+T\alpha+2XT\beta$, in a vibration pattern constituted of the first through fourth stages i-iv, vibration propagates later than that of FIG. 8C further by the vibration propagation delay time $T\beta$. Further, relative to FIG. 8E showing a vibration pattern example at $TP2+T\alpha+3XT\beta$, in a vibration pattern constituted of the first through fourth stages i-iv, vibration propagates later than that of FIG. 8D further by the vibration propagation delay time $T\beta$. Relative to FIG. 8F showing a vibration pattern example at $TP2+T\alpha+4XT\beta$, in a vibration pattern constituted of the first through fourth stages i-iv, vibration propagates later than that of FIG. 8E further by the vibration propagation delay time $T\beta$.

[0069] According to a haptic image obtained through the operator's finger 30a in operation case II shown in FIG. 8G, in a period of time when the finger moves from input positions P2 to P4, it is possible to obtain a haptic sense based on the vibration patterns shown in FIGS. 8B-8F. At the input position P2, in about 0.1s of its first stage i, the haptic sense based on the vibration pattern [fx Ax Nx]=[50 5 5] is obtained and in about 0.1s of its second stage ii, the haptic sense based on the vibration pattern [fx Ax Nx]=[100 10 10] is obtained, and in about 0.1s of its following third stage iii, the haptic sense based on the vibration pattern [fx Ax Nx]=[200 20 20] is obtained and in about 0.1s of its fourth stage iv, the haptic sense based on the vibration pattern [fx Ax Nx]=[400 30 40] is obtained.

[0070] Accordingly, in a case where the finger 30a moves on the input operation face PR faster than the standard sliding speed V_0 , in the conventional method, the third and fourth stages iii and iv go dead, however, in the embodiment of the present invention, no stage goes dead, so that such a haptic image as shown in FIG. 8G can be obtained.

[0071] FIGS. 9A-9F, FIG. 10A-10B, and FIGS. 11A-11E show a comparison example in which the method of the present invention for obtaining such a haptic sense as shown in FIG. 8G is compared with the conventional method.

[0072] This comparison example exemplifies a case where the input detection section 24 and the actuators 25e and 25f are provided in the same plane such as shown in FIG. 6A. In this case, when performing a mode (hereinafter referred to as "vibration mode") in which a "vibration direction" is transmitted by using the two actuators 25e and 25f, a case to which the method of the present invention is applied for reflecting a sliding speed V_x on a waveform generation timing is compared to the case of the conventional method in which no vibration mode is performed. It is to be noted that explanation of vibration propagation delay time $T\beta$ will be omitted.

[0073] In FIGS. 9A, 9B, 9D, and 9E, their vertical axes represent amplitude A_x of a vibration pattern due to the actuators 25e, 25f, etc. In FIGS. 9A-9E, their horizontal axes all represent time t . Further, in FIGS. 9A, 9B, 9D, and 9E, T represents vibration time difference between the actuators 25e and 25f at the standard sliding speed V_0 .

[0074] In this example, the vibration time difference T is set to a constant value no matter whether the sliding speed V_x of the operator's finger 30a is equal to, smaller than, or larger than the standard sliding speed V_0 . That is, according to the conventional method, no matter whether the sliding speed V_x of the operator's finger 30a is equal to, smaller than, or larger than the standard sliding speed V_0 , the actuator 25e vibrates first and then the actuator 25f vibrates with the vibration time difference T .

[0075] Therefore, if the sliding speed V_1 of the operator's finger 30a is equal to or smaller than the standard sliding speed V_0 , it is possible to obtain a haptic image constituted of the first stage i through the fourth stage iv as shown in FIG. 11B. However, according to the conventional method, if the sliding speed V_2 of the operator's finger 30a exceeds the standard sliding speed V_0 , that is, if the sliding speed V_2 becomes larger than the sliding speed V_1 , it is possible to obtain a haptic image constituted of the first stage i and the second stage ii as shown in FIG. 11D; however, since the vibration time difference T between the third stage iii and the fourth stage iv is fixed, vibration waveforms of the third and fourth stages iii and iv are prevented from sufficiently propagating to the operator's finger 30a, thus disabling obtaining a haptic image.

[0076] According to the method of the present invention, one standard sliding condition is set. In this embodiment, a shift in excitation timing between the two actuators 25e and 25f at the standard sliding speed V_0 , that is, at a standard time thereof is set to a vibration shift time t' . With respect to this, a vibration time difference T between the actuators 25e and 25f varies in accordance with the sliding speed V_x of the operator's finger 30a as shown in FIGS. 10A and 10B.

[0077] The following will describe a vibration pattern when the sliding speed is V_x . In FIG. 10A, a vertical axis represents an amplitude A_x of the vibration pattern of the actuator 25e. In FIG. 10B, a vertical axis represents an amplitude A_x of the vibration pattern of the actuator 25f. Their horizontal axes both represent time t . In the figures, T' indicates vibration time difference and waveform rising time difference between the actuators 25e and 25f.

[0078] According to the method of the present invention, a sliding speed V_x of the operator's finger 30a at a given input position is detected and, by assuming a shift in excitation timing between the two actuators 25e and 25f at the time of this detection to be a vibration time difference T' , discriminant $T'=V_0 \cdot t'/V_x$ is introduced to decide whether operation case I or II is entered. Based on this decision on which one of operation cases I and II is entered, vibration patterns

shown in FIGS. 2 and 3 are created.

[0079] Next, a haptic image in a case where the finger 30a moves slowly in the method of the present invention is compared with that of the conventional method. Further, a haptic image in a case where the finger 30a moves faster in the method of the present invention is compared with that of the conventional method.

5 [0080] According to the conventional method, if the sliding speed V2 of the operator's finger 30a exceeds the standard sliding speed V₀, that is, if the sliding speed V2 becomes larger than the sliding speed V₁, vibration waveforms of the third and fourth stages iii and iv is prevented from sufficiently propagating to the operator's finger 30a because the vibration time difference T between the actuators 25e and 25f is fixed, so that a dead portion 80 occurs, thus disabling obtaining a haptic image.

10 [0081] In contrast, according to the method of the present invention, the vibration time difference T varies in conjugation with the standard sliding speed V₀ as described in FIGS. 10A and 10B, so that even if the sliding speed V2, which represents movements of the operator's finger 30a, exceeds the standard speed V₀, that is, even if the sliding speed V2 is larger than the sliding speed V₁, as shown in FIGS. 11E and 8G, a haptic image of the first stage i through the second stage ii can be obtained and vibration waveforms propagate to the finger 30a of the operator sufficiently, thereby enabling to be obtained a haptic image of the third stage iii through the fourth stage iv.

[0082] Next, relative to an information input method according to the present invention, an information processing example in the digital camera 100 will be described with reference to FIGS. 12A-12C, 13A-13C, 14A-14D and 15.

[0083] In the present embodiment, relative to an example of information processing at the time of sliding operation in the digital camera 100, it is assumed that information is input by performing any touch operation to slide on an input detection plane of the input detection section 24.

20 [0084] In this embodiment, according to an example of image display shown in FIG. 12A, there are buildings on right and left sides of a road shown at a center of an image with a subject such as a person standing on of the road shown at the back center of the image when the sliding function is to be zoomed in.

[0085] In this example, if the input detection section 24 detects an amount of go-over distance over a set amount thereof, that is, if a relationship of $X2 - X1 > x$ is satisfied where X1 is a coordinate value of an input start point; X2 is a coordinate value of a current point; and x is a control threshold value that represents a difference in coordinate values corresponding to the set amount of go-over distance under the condition where an input is continuously provided, the CPU 32 causes the display portion 29 to display a zoom-in mode image having a size corresponding to the sliding speed V_x. In this case, the CPU 32 outputs the command D to the display portion 29, so that the displayed image shown in FIG. 12A can be switched on the display portion to a displayed image such as ones shown in FIG. 12B or 12C.

30 [0086] Further, according to an example of image display in halfway through zoom-in shown in FIG. 12B, if performing touch operation to slide on the input detection plane of the input detection section 24, for example, at the standard sliding speed V₀, after having felt a haptic sense, the operator 30 can confirm an image display of the buildings on the right and left sides of the road at the center of the image and the subject standing on the road and moving toward him or her.

35 [0087] Further, according to an example of post-zoom-in image display shown in FIG. 12C, if performing a touch operation to slide on the input detection plane of the input detection section 24 at the sliding speed V_x=V2 that is faster than the standard sliding speed V₀, after having felt a haptic sense, the operator 30 can confirm an image display of the subject further moving toward him or her than a case shown in FIG. 12B. In this embodiment, it is possible to display a zoom-in mode image having a size corresponding to the speed, and to confirm a display of a close-up image of the face of the subject at the center of the displayed image.

40 [0088] Thus, by making the sliding speed V_x in sliding on the input detection plane larger than the standard sliding speed V₀, it is possible to control a size of an image to be zoomed in. The example of the information processing at the time of sliding operation in the digital camera 100 is not limited to the zoom-in mode but may be applied to the playback/fast-forward mode, the zoom-out mode, the reverse mode, the focus adjustment mode, the sound volume adjustment mode, the channel (CH) change mode, etc. It is to be noted that the digital camera 100 may be configured to be able to detect plural input position differences X2-X1 by one time of sliding or only one input position difference of X2-X1 by one time of sliding.

45 [0089] Next, an example of operations in the sound volume (Vol) adjustment mode will be described. In this example, in a case where a sliding function is set to "Vol adjustment", according to an example of image display before Vol adjustment shown in FIG. 13A, a sound volume adjustment bar 29a is displayed at a lower part of the image. The sound volume adjustment bar 29a has, for example, six adjustment frames in a direction from "-" toward "+". In the figures, a first adjustment frame is indicated by hatching.

50 [0090] In this example, if the input detection section 24 detects an amount of a go-over distance over a set amount thereof, that is, if a relationship of $X2 - X1 > x$ is satisfied where X1 is a coordinate value of an input start point; X2 is a coordinate value of a current point; and x is a control threshold value that is a difference in coordinate values corresponding to the set amount of go-over distance under a condition where an input is continuously provided, the CPU 32 causes the display portion 29 to display a sound volume adjustment image corresponding to the sliding speed V_x. In this case, the CPU 32 outputs the command D to the display portion 29, so that the image shown in FIG. 13A can be switched on

the display portion to an image such as ones shown in FIG. 13B or 13C.

[0091] For example, according to an example of image display in halfway through sound volume adjustment shown in FIG. 13B, if performing a touch operation to slide on the input detection plane of the input detection section 24 at the standard sliding speed V_0 , after having felt a haptic sense, another "+" directional adjustment frame of the sound volume adjustment bar 29a at the lower part of the image is switched to a hatched frame. The CPU 32 outputs a command D to the speaker 36, to control the speaker 36 so that its sound volume may be increased by one step as compared to that of FIG. 13A.

[0092] Further, according to an example of image display after the sound-volume-adjustment shown in FIG. 13C, if performing a touch operation to slide on the input detection plane of the input detection section 24 at the sliding speed $V_x=V_2$ that is larger than the standard sliding speed V_0 , after having felt a haptic sense, the operator 30 can confirm such a display that a further "+" directional adjustment frame of the sound volume adjustment bar 29a is increased at the lower part of the image by a hatched one than one shown in FIG. 13B. In this case, the CPU 32 outputs the command D to the speaker 36, to control the speaker 36 so that its sound volume may be increased by, for example, three steps as compared to that of FIG. 13A. Thus, by making the sliding speed V_x in sliding on the input detection plane larger than the standard sliding speed V_0 , it is possible to control a sound volume adjustment quantity.

[0093] Next, an example of information processing in the digital camera 100 according to the first embodiment will be described with reference to FIGS. 14A-14D and 15.

[0094] In the present embodiment, it is assumed that information is input by performing a touch operation to slide on the input detection plane. In this embodiment, such a case is assumed that a touched position and a sliding speed of a finger 30a of the operator who performs the touch operation on the input detection plane are detected, to compute a vibration pattern based on these detected touched position and sliding speed of the finger 30a of the operator's finger 30a, thereby to vibrate the input detection plane based on the computed vibration pattern.

[0095] Further, in computation of the vibration pattern, as the finger 30a of the operator goes away from a point where it has touched the input detection plane originally, such a vibration pattern of the input detection plane is computed as to generate vibrations from its low frequency and small amplitude to its high frequency and large amplitude. As operation modes of this digital camera 100, a slide input mode and the other processing mode are prepared, so that based on switchover of these modes, various kinds of information processing are performed. The other mode contains a shutter button operation, an erasure button operation, a power source button operation, a switchover operation between the standard mode and the snap mode, etc.

[0096] In these information processing conditions, a power-on operation is awaited at step R1 of a flowchart of FIG. 14A. For example, the CPU 32 detects power-on information and then activates the system. The power-on information generally occurs when a timer function starts, to turn on a power switch on a portable telephone which has been sleeping.

[0097] The process goes to step R2 where the CPU 32 branches its controls in accordance with whether the system is in the slide input mode or the other processing mode. The slide input mode is referred to as an operation to provide an input by performing a touching input to slide on the input detection plane when making switchover among the playback/fast-forward mode, the zoom-out mode, the zoom-in mode, the sound volume adjustment mode, etc.

[0098] If the slide input mode is set, the process goes to step R3 where it is detected whether an input is provided. Whether an input is provided or not is decided by detecting whether the input detection section 24 is touched. If the input detection section 24 is touched, the process goes to step R4 where the control branches in accordance with whether the input mode is selected (set) to the playback/fast-forward mode or the other mode. It is to be noted that which one of the input modes is selected will be described in the case of, for example, processing the playback/fast-forward mode, the zoom-out mode, the zoom-in mode, and the sound volume adjustment mode in this order.

[0099] In this embodiment, when the operator 30 touches a playback mode region, not shown, of the input detection section 24, touch position information S1 and force information S2 are supplied to the A/D driver 31, so that a playback mode image can be displayed on the display portion 29 of the digital camera 100. Then, the A/D driver 31 converts a position detection signal into a digital signal and detects position information D1 and force information D2 and whether the system is in the cursoring state or the selection state, thus generating cursoring/selection data D3 as a flag.

[0100] If the playback/fast-forward mode is selected, the process goes to step R5 where it is determined how much a sliding speed V_x is given. In this case, the CPU 32 calculates a rate of change V_x , for example, with respect to the time axis in the input positions P1-P5 shown in FIGS. 6A and 6B, which is detected by the input detection section 24, that is, the sliding speed V_x of the operator's finger 30a.

[0101] Then, the process goes to step R6 where the CPU 32 detects operation case I or operation case II based on a discriminant of $T=V_0 \cdot t/V_x$, to provide a control branch. In this embodiment, the sliding speed V_x in the case of going over the input operation face PR at the standard sliding speed V_0 or lower ($V_1 \leq V_0$) is set to be equal to V_1 ($V_x=V_1$). This case is defined to be operation case I. Table 2 shown earlier shows contents of a haptic waveform Wv with respect to the sliding speed V_1 .

[0102] Therefore, if a relationship of $V_0 \cdot t/V_x \geq 1$ is found as a result of the above decision, the process goes to step R7 where the actuator drive circuit 37 is supplied with such control information as to generate a vibration pattern corre-

sponding to operation case I. In this case, according to such an example as shown in FIGS. 7B-7G, at the input detection time point TP2, based on the command D, the actuator drive circuit 37 outputs such the vibration control signals Sa-Sf as to generate the vibration pattern shown in Table 2. The actuator 25a is supplied with the vibration control signal Sa; the actuator 25b is supplied with the vibration control signal Sb; the actuator 25c is supplied with the vibration control signal Sc; the actuator 25d is supplied with the vibration control signal Sd; the actuator 25e is supplied with the vibration control signal Se; and the actuator 25f is supplied with the vibration control signal Sf, respectively.

[0103] The actuators 25a-25f vibrate for about 0.8s based on the vibration control signals Sa-Sd. Specifically, in the vibration waveform shown in FIG. 7B, they vibrate in accordance with a vibration pattern having frequency $f_x=50\text{Hz}$, amplitude $A_x=5\mu\text{m}$, and the number of times $N_x=10$ for about 0.2s at the first stage i thereof. Hereinafter, this pattern is described as [fx Ax Nx]=[50 5 10]. Similarly, they vibrate in accordance with vibration pattern [fx Ax Nx]=[100 10 20] for about 0.2s at the second stage ii thereof too. At the third stage iii thereof too, they vibrate in accordance with vibration pattern [fx Ax Nx]=[200 20 40] for about 0.2s. At the fourth stage iv thereof too, they vibrate in accordance with vibration pattern [fx Ax Nx]=[400 30 80] for about 0.2s.

[0104] Further, according to a haptic image received by the operator's finger 30a in operation case I in FIG. 7G as a result of such propagation of vibration patterns shown in FIGS. 7C, 7D, 7E, and 7F, it is possible to obtain a haptic sense based on the vibration patterns shown in FIGS. 7B-7F in a period of time when moving the input positions P2-P4. At the input position P2, it is possible to obtain a haptic sense based on the vibration pattern [fx Ax Nx]=[50 5 10] for about 0.2s of the first stage i, a haptic sense based on the vibration pattern [fx Ax Nx]=[100 10 20] for about 0.2s of the second stage ii, a haptic sense based on the vibration pattern [fx Ax Nx]=[200 20 40] for about 0.2s of the following third stage iii, and a haptic sense based on the vibration pattern [fx Ax Nx]=[400 30 80] for about 0.2s of the fourth stage iv. Then, the process goes to step R9 where the fast-forward mode is performed based on the sliding speed V_x .

[0105] In this embodiment, the sliding speed V_x at which the input operation face PR is gone over faster than the standard sliding speed V_0 ($V_2 > V_0$) is set equal to V_2 ($V_x = V_2$). This is defined to be operation case II. Table 3 shown earlier shows contents of the haptic waveform W_v with respect to the sliding speed V_2 . Therefore, if a relationship of $V_0 \cdot t / V_x < 1$ is decided at the above-described step R6, the process goes to step R8 where the actuator drive circuit 37 is supplied with such control information as to generate a vibration pattern corresponding to the operation case II.

[0106] In this case, according to such an example as shown in FIGS. 8A-8G, at the input detection time TP2, based on the command D, the actuator drive circuit 37 outputs such vibration control signals Sa-Sf as to generate the vibration pattern shown in Table 3. The actuator 25a is supplied with the vibration control signal Sa; the actuator 25b is supplied with the vibration control signal Sb; the actuator 25c is supplied with the vibration control signal Sc; the actuator 25d is supplied with the vibration control signal Sd; the actuator 25e is supplied with the vibration control signal Se; and the actuator 25f is supplied with the vibration control signal Sf, respectively.

[0107] The actuators 25a-25f vibrate for about 0.4s based on the vibration control signals Sa-Sf. Specifically, in the vibration waveform shown in FIG. 8B, they vibrate in accordance with a vibration pattern having a frequency $f_x=50\text{Hz}$, amplitude $A_x=5\mu\text{m}$, and the number of times $N_x=5$ for about 0.1s at the first stage i thereof. Hereinafter, this pattern is described as [fx Ax Nx]=[50 5 5]. Similarly, they vibrate in accordance with vibration pattern [fx Ax Nx]=[100 10 10] for about 0.1s at the second stage ii thereof too. At the third stage iii thereof too, they vibrate in accordance with vibration pattern [fx Ax Nx]=[200 20 20] for about 0.1s. At the fourth stage iv thereof too, they vibrate in accordance with vibration pattern [fx Ax Nx]=[400 30 40] for about 0.1s.

[0108] Further, according to a haptic image received by the operator's finger 30a in the operation case II in FIG. 8G as a result of such propagation of vibration patterns shown in FIGS. 8C, 8D, 8E, and 8F, it is possible to obtain a haptic sense based on vibration patterns shown in FIGS. 8B-8F in a period of time when moving to the input positions P2-P4. At the input position P2, it is possible to obtain a haptic sense based on the vibration pattern [fx Ax Nx]=[50 5 5] for about 0.1s of the first stage i, a haptic sense based on the vibration pattern [fx Ax Nx]=[100 10 10] for about 0.1s of the second stage ii, a haptic sense based on the vibration pattern [fx Ax Nx]=[200 20 20] for about 0.1s of the third stage iii, and a haptic sense based on the vibration pattern [fx Ax Nx]=[400 30 40] for about 0.1s of the fourth stage iv.

[0109] Accordingly, if the finger 30a moves on the input operation face PR faster than the standard sliding speed V_0 , i, the third and fourth stages iii and iv provide the dead portion 80 on the conventional method, but in the embodiment of the present invention, such a dead portion 80 disappears, so that such a haptic image as shown in FIG. 8G can be obtained. Subsequently, the process goes to step R9 where the fast-forward mode is performed based on the sliding speed V_x . Then, the process returns to the step R3.

[0110] Further, when the input detection section 24 is further touched at the step R3 and if the input mode is the other mode that is any other than the playback/fast-forward mode at step R4, the process goes to step R10 where a control branch is provided in accordance with whether the zoom-out mode or the other mode is set. If the zoom-out mode is selected, the process goes to step R11 in a flowchart shown in FIG. 14B where it is detected how much the sliding speed V_x (see the step R6) is given.

[0111] Then, the process goes to step R12 where the CPU 32 detects operation case I or II based on a discriminant of $T = V_0 \cdot t / V_x$ to provide a control branch. In this embodiment, if a relationship of $V_0 \cdot t / V_x \geq 1$ is established, the process

goes to step R13 where the actuator drive circuit 37 is supplied with such control information as to generate a vibration pattern corresponding to the operation case I (see the step R7).

[0112] Then, the process goes to step R15 where the zoom-out mode is performed. On the other hand, if a relationship of $V_o \cdot t / V_x < 1$ is decided at the above-described step R12, the process goes to step R14 where the actuator drive circuit 37 is supplied with such control information as to generate a vibration pattern corresponding to operation case II (see the step R8). Subsequently, the process goes to the step R15 where the zoom-out mode is performed based on the sliding speed V_x . Then, the process returns to the step R3 of the flowchart shown in FIG. 14A.

[0113] Further, when the input detection section 24 is touched again at the step R3 and if the input mode is the other mode that is any other than the playback/fast-forward mode and the zoom-out mode at the steps R4 and R10, the process goes to step R16 where a control branch is provided in accordance with whether the zoom-in mode or the other mode is set. If the zoom-in mode is set, the process goes to step R17 of a flowchart shown in FIG. 14C, to detect how much the sliding speed V_x (see the step R6) is given.

[0114] Then, the process goes to step R18 where the CPU 32 detects operation case I or II based on a discriminant of $T = V_o \cdot t / V_x$. In this embodiment, if a relationship of $V_o \cdot t / V_x \geq 1$ is established, the process goes to step where the actuator drive circuit 37 is supplied with such control information as to generate a vibration pattern corresponding to the operation case I (see the step R7).

[0115] Then, the process goes to step R21 where the zoom-in mode is performed based on the sliding speed V_x . Simultaneously, the CPU 32 outputs the command D to the display portion 29 to carry out a display control. For example, the CPU 32 calls a subroutine of FIG. 15 to detect a difference between a coordinate value X_1 of an input start point and a coordinate value X_2 of a current point, that is, an input position difference of $X_2 - X_1$ at step ST1 in its flowchart. Then, the process goes to step ST2 where this input position difference $X_2 - X_1$ is compared with a preset control threshold value x . If $X_2 - X_1 > x$ is decided at step ST3, the process goes to step ST4 where the CPU 32 outputs the command D to the display portion 29. Based on the command D, the display portion 29 switches display of a pre-zoom-in image shown in FIG. 12A to that of a post-zoom-in image shown in FIG. 12B at step ST5.

[0116] On the other hand, if a relationship of $V_o \cdot t / V_x < 1$ is decided at the above-described step R18, the process goes to step R20 where the actuator drive circuit 37 is supplied with such control information as to generate a vibration pattern corresponding to operation case II (see the step R8). Then, the process goes to the step R21 where the zoom-in mode is performed based on the sliding speed V_x . Simultaneously, based on the command D, the display portion 29 switches display of the pre-zoom-in image shown in FIG. 12A to that of the post-zoom-in image shown in FIG. 12C. Then the process returns to the step R3 of the flowchart shown in FIG. 14A.

[0117] Further, when the input detection section 24 is further touched at the step R3 and if the input mode is the other mode that is any other than the playback/fast-forward mode, the zoom-in mode, and the zoom-out mode at the steps R4, R10, and R16, to set (select) the sound volume adjustment mode and the process goes to step R22 of a flowchart shown in FIG. 14D where it is detected how much the sliding speed V_x (see the step R6) is given.

[0118] Then, the process goes to step R23 where the CPU 32 detects operation case I or II based on the discriminant of $T = V_o \cdot t / V_x$ to provide a control branch. In this embodiment, if $V_o \cdot t / V_x \geq 1$ is decided, the process goes to step R24 where the actuator drive circuit 37 is supplied with such control information as to generate a vibration pattern corresponding to the operation case I (see the step R7).

[0119] Then, the process goes to step R25 where the sound volume adjustment mode is performed based on the sliding speed V_x . Simultaneously, the CPU 32 outputs the command D to the display portion 29 to carry out a display control. For example, the CPU 32 calls the subroutine of FIG. 15 to detect a difference between a coordinate value X_1 of an input start point and a coordinate value X_2 of a current point, that is, an input position difference of $X_2 - X_1$ at the step ST1 in its flowchart. Then, the process goes to the step ST2 where this input position difference $X_2 - X_1$ is compared with a preset control threshold value x . If $X_2 - X_1 > x$ is decided at the step ST3, the process goes to the step ST4 where the CPU 32 outputs the command D to the display portion 29. Based on the command D, the display portion 29 switches display of a pre-sound-volume-adjustment image shown in FIG. 13A to that of a post-sound-volume-adjustment image shown in FIG. 13B at the step ST5.

[0120] On the other hand, if a relationship of $V_o \cdot t / V_x < 1$ is decided at the above-described step R23, the process goes to step R25 where the actuator drive circuit 37 is supplied with such control information as to generate a vibration pattern corresponding to the operation case II (see the step R8). Then, the process goes to step R26 where the sound volume adjustment mode is performed based on the sliding speed V_x . Simultaneously, based on the command D, the display portion 29 switches display of the pre-sound-volume-adjustment image shown in FIG. 13A to that of the post-sound-volume-adjustment image shown in FIG. 13C. Then, the process returns to the step R3 of the flowchart shown in FIGS. 14A-14D.

[0121] It is to be noted that if the other processing mode is selected at the step R2, the process goes to step R27 where the other processing mode is performed. In the other processing mode, a shutter button operation, an erasure button operation, a power source button operation, an operation to switch between the standard mode and the snap mode, etc. are performed. Then, the process goes to step R28. Further, if the input detection section 24 is not touched

at the step R3, the process goes to step R28 where the CPU 32 decides whether to end the information processing. For example, if having detected any power-off information, the process ends the information processing. If no power-off information is detected, the process returns to the step R2.

5 [0122] In such a manner, according to the embodiments of the digital camera and the information input method related to the present invention, on the assumption that the touch operation is performed to slide on the input detection plane of the input detection section 24, the input detection section 24 detects a touched position and a sliding speed of the operator's finger 30a. The CPU 32 computes the vibration pattern based on the sliding speed of the operator's finger 30a detected by the input detection section 24. Based on the vibration pattern computed by the CPU 32, the actuators 25a-25f etc. vibrate the input detection plane.

10 [0123] Therefore, it is possible to generate plural kinds of vibrations which have different vibration patterns for each operator and which correspond to a sliding speed or a lapse of sliding time of the operator's finger 30a. It is thus possible to improve convenience and certainty of the haptic input function. Besides, a haptic-provided input function can be introduced into more kinds of input forms.

15 [Second Embodiment]

[0124] The following will describe an example of a haptic function-provided input mechanism of a digital camera 200 as the second embodiment. In the second embodiment, input information is controlled variably based on distance information Lx on a distance from a point where the finger 30a of an operator touches an input detection plane PR to a point where its sliding stops.

20 [0125] In contrast to the first embodiment, according to the haptic function-provided input mechanism of the digital camera 200 shown in FIG. 16, below an input detection section 24, actuators A and B are provided. The input detection section 24 is arranged to bridge between the actuators A and B in such a configuration that these actuators A and B serve as bridge girders. As the actuators A and B, the actuators 25e and 25f described with the first embodiment are used.

25 [0126] The input detection section 24, the actuators A and B, etc. are all fixed with an adhesive agent or the like via space members 28a-28f. As the input detection section 24, an electrostatic capacitive sheet (touch panel) and the like are used to detect a position where the operator's finger 30a has touched. An arrow in the figure indicates a touch-and-moving direction of the operator's finger 30a. It is to be noted that for a configuration of a control system, the first embodiment can be referred thereto, so that its explanation will be omitted. This haptic function-provided input mechanism is arranged approximately at an upper part of a body of the camera.

30 [0127] In FIG. 16, on the input detection section 24, six input positions P1-P6 are set. In terms of operation contents, the input position P1 indicates a "start point" of an input operation. The input point P2 indicates a point representing, for example, a zoom quantity "X0.5" as an input operation quantity. With respect to input position P1 as an origin point 0, the input position P2 is set to a position that is distant therefrom by separation distance L1. The input point P3 indicates a point representing a zoom quantity "X1". Similarly, the input point P3 is set to a position distant by separation distance L2.

35 [0128] The input point P4 indicates a point representing a zoom quantity "X2" as an input operation quantity. The input point P4 is set to a position distant by separation distance L3. The input point P5 indicates a point representing a zoom quantity "X4" as an input operation quantity. The input point P5 is set to a position distant by separation distance L4. The input point P6 indicates a point representing an "end position" of the input operation. The input point P6 is set to a position distant by separation distance L5.

40 [0129] The operator goes over the input operation face PR at an arbitrary sliding speed along the touch-and-moving direction indicated by the arrow in the figure. In this case, a CPU 32 described with the first embodiment detects which one of the input positions P2-P6 the operator's finger 30a has reached from the input position P1 detected by the input detection section 24.

45 [0130] Further, according to this haptic function-provided input mechanism, if the operator's finger 30a touches the input detection plane at the input position P1 thereof, the actuator A vibrates this input operation face PR based on a vibration pattern having frequency of $f_x=400\text{Hz}$, amplitude of $A_x=30\mu\text{m}$, and the number of times of $N_x=20$. Further, if the operator's finger 30a is slid from its input position P1 toward the arrow direction, the actuator A once stops vibrating thereof and, when the next input position P2 is reached, vibrates the input operation face PR based on a vibration pattern having $f_x=200\text{Hz}$, $A_x=10\mu\text{m}$, and $N_x=1$.

50 [0131] Further, if the operator's finger 30a is slid from its input position P2 toward the arrow direction, the actuator A once stops vibrating thereof and, when the next input position P3 is reached, vibrates the input operation face PR based on a vibration pattern having $f_x=200\text{Hz}$, $A_x=15\mu\text{m}$, and $N_x=1$. Further, if the operator's finger 30a is slid from its input position P3 toward the arrow direction, the actuator A once stops vibrating thereof and, when the next input position P4 is reached, vibrates the input operation face PR based on a vibration pattern having $f_x=200\text{Hz}$, $A_x=20\mu\text{m}$, and $N_x=1$.

55 [0132] Further, if the operator's finger 30a is slid from its input position P4 toward the arrow direction, the actuator A once stops vibrating thereof and, when the next input position P5 is reached, vibrates the input operation face PR based on a vibration pattern having $f_x=200\text{Hz}$, $A_x=25\mu\text{m}$, and $N_x=1$. Further, if the operator's finger 30a is slid from its input

position P5 toward the arrow direction, the actuator A once stops vibrating thereof and, when the next input position P6 is reached, vibrates the input operation face PR based on a vibration pattern having $f_x=400\text{Hz}$, $A_x=30\mu\text{m}$, and $N_x=20$.
[0133] It is to be noted that while the operator's finger 30a is in contact with the input operation face PR, the actuator B is set to continue to vibrate the input operation face PR based on a vibration pattern having $f_x=200\text{Hz}$ and $A_x=30\mu\text{m}$.
 Table 4 shows relationships between input positions P1-P6 and any one of the vibration patterns of the actuators A and B, their vibration sounds, and the operation contents thereof.

Table 4

Input position	P1	P2		P3		P4		P5		P6	
Vibration of actuator A	400Hz 30 μm 20 times	None	200Hz 10 μm 1 time	None	200Hz 15 μm 1 time	None	200Hz 20 μm 1 time	None	200Hz 25 μm 1 time	None	400Hz 30 μm 20 times
Vibration of actuator B	$f_x=200\text{Hz}$ $A_x=30\mu\text{m}$ $N_x=\text{Continuous}$										
Vibration sound	Peep		Peep		Peep		Peep		Peep		Peep
Operation contents	Start position (dead end)	X0.5		X1		X2		X4		End position (dead end)	

[0134] Next, an example of input operations in the haptic function-provided digital camera 200 will be described.
[0135] For example, if the operator's finger 30a shown in FIG. 16 has touched the input position P1, the input detection section 24 detects that the operator's finger 30a has touched the input position P1 and notifies the CPU 32 of it. When having received this notification, the CPU 32 controls outputs of the actuators A and B. The actuator A vibrates the input operation face PR based on a vibration pattern having $f_x=400\text{Hz}$, $A_x=30\mu\text{m}$, and $N_x=20$. As a result of this vibration, a "peep" vibration sound occurs. The actuator B continuously vibrates the input operation face PR based on a vibration pattern having $f_x=200\text{Hz}$ and $A_x=30\mu\text{m}$. The CPU 32 identifies a "start position" of the input operation.
[0136] Further, if the operator's finger 30a moves from, for example, the input position P1 by the separation distance L1 as the distance information Lx, it reaches the input position P2. In this case, the input detection section 24 detects that the operator's finger 30a has arrived at the input position P2 and notifies the CPU 32 of it. When having received this notification, the CPU 32 controls an output of the actuator A. According to this control, the actuator A, which has once stopped vibrating thereof, vibrates the input operation face PR based on the vibration pattern having $f_x=200\text{Hz}$, $A_x=10\mu\text{m}$, and $N_x=1$ when the operator's finger 30a has arrived at the input position P2. As a result of this vibration, a "peep" vibration sound occurs. The CPU 32 sets a zoom quantity "X0.5" to a zoom drive system etc. as an input operation quantity.
[0137] Further, if the operator's finger 30a moves from the input position P1 by the separation distance L2, it reaches the input position P3. In this case, the input detection section 24 detects that the operator's finger 30a has arrived at the input position P3 and notifies the CPU 32 of it. When having received this notification, the CPU 32 controls an output of the actuator A. According to this control, the actuator A, which has once stopped vibrating thereof, vibrates the input operation face PR based on a vibration pattern having $f_x=200\text{Hz}$, $A_x=15\mu\text{m}$, and $N_x=1$ when the operator's finger 30a has arrived at the input position P3. As a result of this vibration, a "peep" vibration sound occurs. The CPU 32 sets a zoom quantity "X1" to the zoom drive system etc. as an input operation quantity.
[0138] Further, if the operator's finger 30a moves from the input position P1 by the separation distance L3, it reaches the input position P4. In this case, the input detection section 24 detects that the operator's finger 30a has arrived at the input position P4 and notifies the CPU 32 of it. When having received this notification, the CPU 32 controls an output of the actuator A. According to this control, the actuator A, which has once stopped vibrating, vibrates the input operation face PR based on a vibration pattern having $f_x=200\text{Hz}$, $A_x=20\mu\text{m}$, and $N_x=1$ when the operator's finger 30a has arrived at the input position P4. As a result of this vibration, a "peep" vibration sound occurs. The CPU 32 sets a zoom quantity "X2" to the zoom drive system etc. as an input operation quantity.
[0139] Further, if the operator's finger 30a moves from the input position P1 by the separation distance L4, it reaches the input position P5. In this case, the input detection section 24 detects that the operator's finger 30a has arrived at the input position P5 and notifies the CPU 32 of it. When having received this notification, the CPU 32 controls an output of the actuator A. According to this control, the actuator A, which has once stopped vibrating thereof, vibrates the input

operation face PR based on the vibration pattern having $f_x=200\text{Hz}$, $A_x=25\mu\text{m}$, and $N_x=1$ when the operator's finger 30a has arrived at the input position P5. As a result of this vibration, a "peep" vibration sound occurs. The CPU 32 sets a zoom quantity "X4" to the zoom drive system etc. as an input operation quantity.

5 [0140] It is to be noted that if the operator's finger 30a moves from the input position P1 by the separation distance L5, it reaches the input position P6. In this case, the input detection section 24 detects that the operator's finger 30a has arrived at the input position P6 and notifies the CPU 32 of it. When having received this notification, the CPU 32 controls an output of the actuator A. According to this control, the actuator A, which has once stopped vibrating thereof, vibrates the input operation face PR based on the vibration pattern having $f_x=400\text{Hz}$, $A_x=30\mu\text{m}$, and $N_x=20$ when the operator's finger 30a has arrived at input position P6. As a result of this vibration, a "peep" vibration sound occurs. The
10 CPU 32 identifies an "end position" of the input operation.

[0141] In such a manner, according to the digital camera 200 with the haptic function-provided input mechanism related to the second embodiment, input information is controlled variably based on the distance information Lx on a distance from a point where the finger 30a of an operator has touched an input detection plane PR to a point where its sliding stops.

15 [0142] Therefore, it is possible to obtain a haptic sense that matches an input operation to adjust an analog quantity and that corresponds to a sliding position of the operator's finger 30a. It is thus possible to generate a sense of operation that matches an operation image, thereby improving convenience and certainty of the haptic input function.

[0143] Although the above embodiments have described a case of the digital camera in relation to an electronic device, this haptic function-provided input device is applicable to an information processing apparatus such as a notebook-sized
20 personal computer and an information portable terminal unit such as a portable telephone, an electronic notebook, a game device, or an electronic book.

INDUSTRIAL APPLICABILITY

25 [0144] The present invention could be extremely well applied to a digital camera, an information processing apparatus, a portable telephone, an information portable terminal unit, etc. in which information is input by performing the touch operation to slide on an input detection plane.

30 Claims

1. A haptic function-provided input device that performs touch operation to slide on an input detection plane, said device comprising:

35 input detection means, which has the input detection plane, for detecting a touching position of an operation body and a sliding speed of the operation body;
computation means for computing a vibration pattern based on the sliding speed detected by the input detection means; and
40 vibration means for vibrating the input detection plane based on the vibration pattern computed by the computation means.

2. The haptic function-provided input device according to claim 1, wherein the computation means computes a vibration pattern of the input detection plane to generate vibrations from its low frequency and small amplitude to its high
45 frequency and large amplitude, as the operation body goes away from a position where it has touched the input detection plane.

3. The haptic function-provided input device according to claim 1, comprising control means for controlling the input information variably based on the sliding speed.

50 4. The haptic function-provided input device according to claim 1, comprising control means for controlling input information variably based on distance information on a distance from a point where the operation body touches the input detection plane to a point where its sliding then stops.

55 5. An information input method for inputting information by performing touch operation to slide on an input detection plane, said method comprising the steps of:

detecting a touched position and a sliding speed of an operation body that touches the input detection plane;
computing a vibration pattern based on the touched position and the sliding speed that are detected; and

vibrating the input detection plane based on the computed vibration pattern.

- 5
6. The information input method according to claim 5, wherein when computing the vibration pattern, a vibration pattern of the input detection plane to generate vibrations from its low frequency and small amplitude to its high frequency and large amplitude is computed, as the operation body goes away from a position where it has touched the input detection plane.
- 10
7. The information input method according to claim 5, wherein an amount of the input information is adjusted on the basis of the sliding speed.
- 15
8. The information input method according to claim 5, wherein the input information is selected on the basis of distance information on a distance from a point where the operation body touches the input detection plane to a point where its sliding then stops.
- 20
9. An electronic device comprising a haptic function-provided input device that performs touch operation to slide on an input detection plane and display means for displaying a display image based on information input by the input device, wherein said input device includes:
- input detection means, which has the input detection plane, for detecting a touching position of an operation body and a sliding speed of the operation body;
- computation means for computing a vibration pattern based on the sliding speed detected by the input detection means; and
- vibration means for vibrating the input detection plane based on the vibration pattern computed by the computation means.
- 25
10. The electronic device according to claim 9, wherein the computation means computes a vibration pattern of the input detection plane to generate vibrations from its low frequency and small amplitude to its high frequency and large amplitude, as the operation body goes away from a position where it has touched the input detection plane.
- 30
11. The electronic device according to claim 9, comprising control means for controlling the input information variably based on the sliding speed.
- 35
12. The electronic device according to claim 9, comprising control means for controlling the input information variably based on distance information on a distance from a point where the operation body touches the input detection plane to a point where its sliding then stops.

FIG. 1

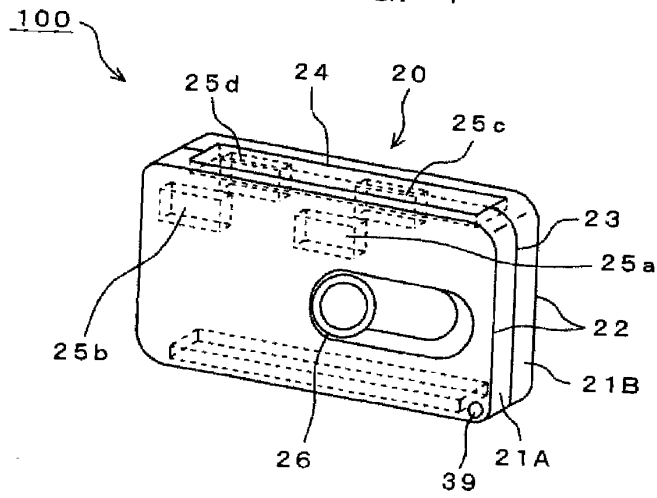
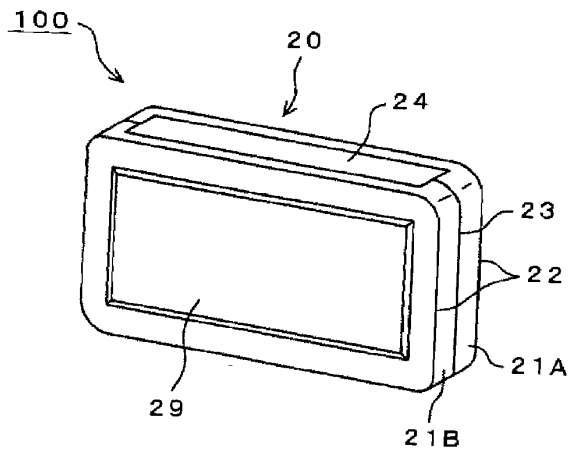
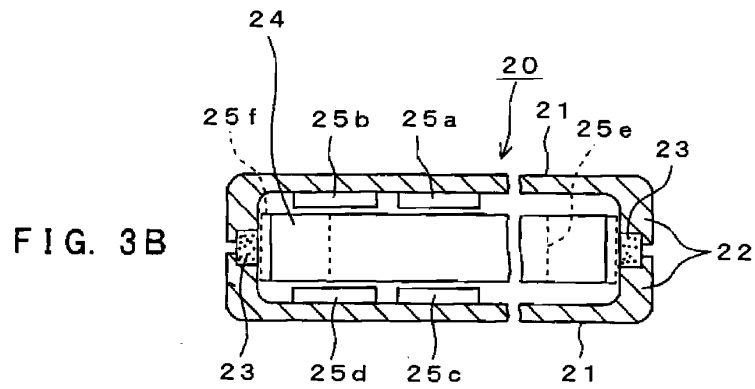
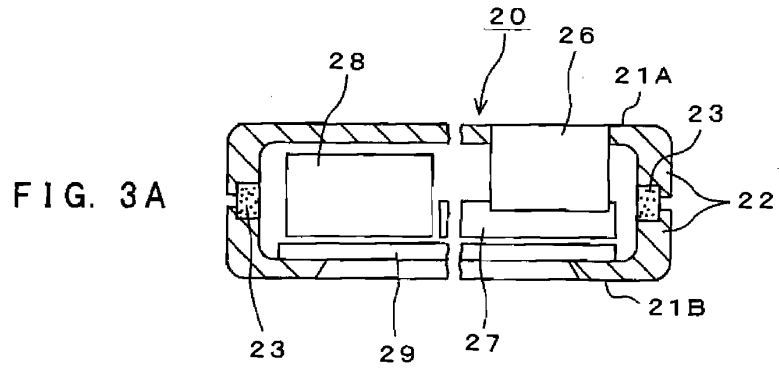
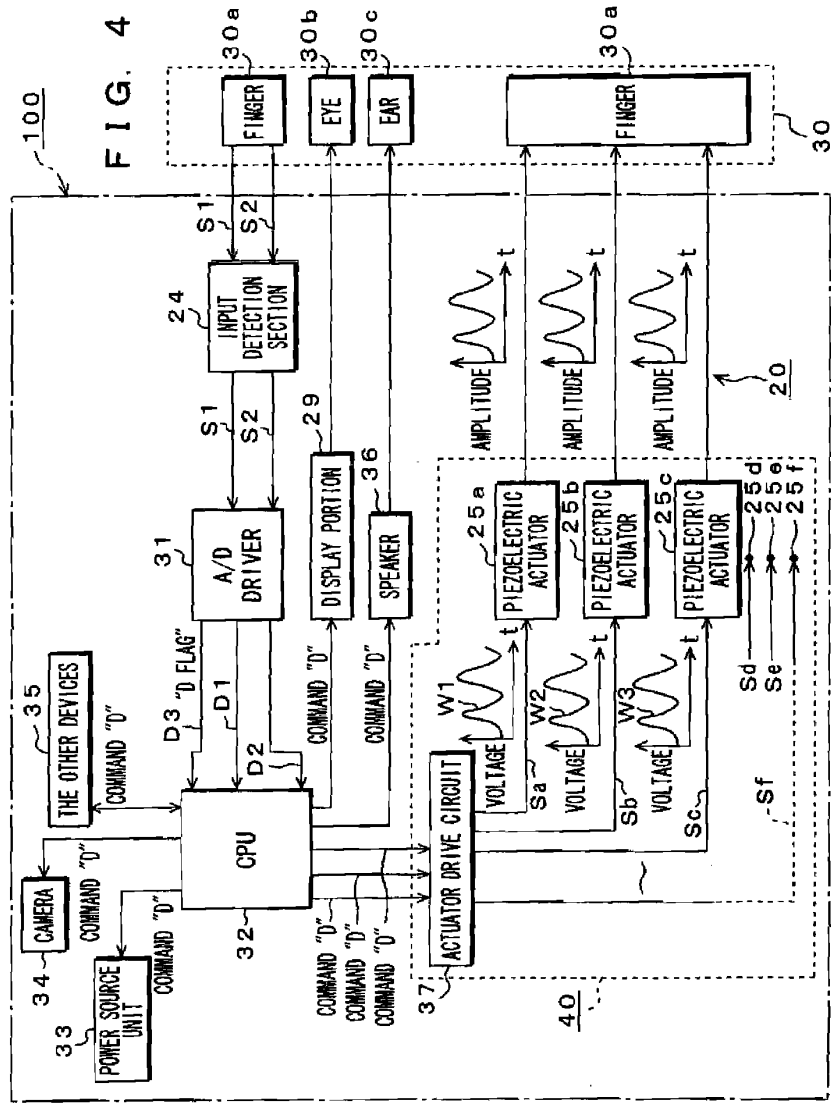
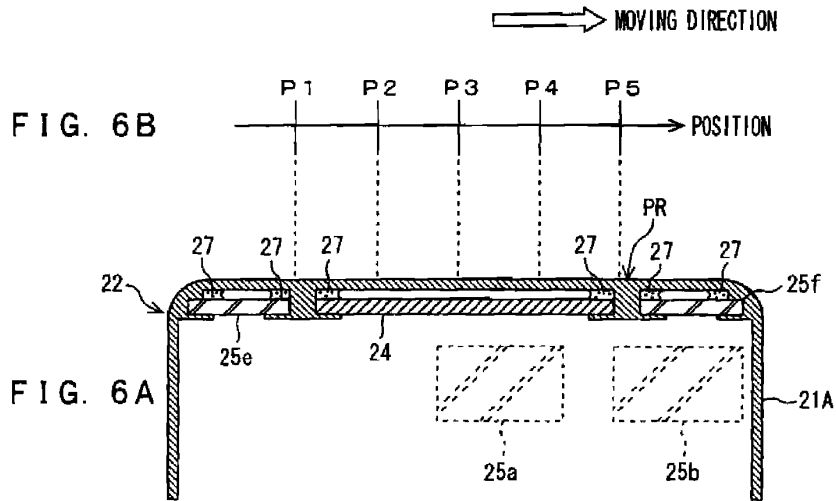
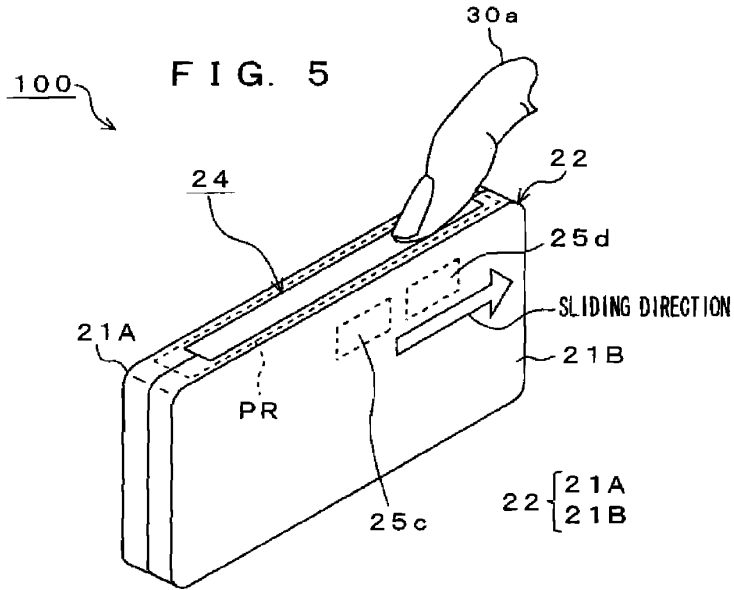


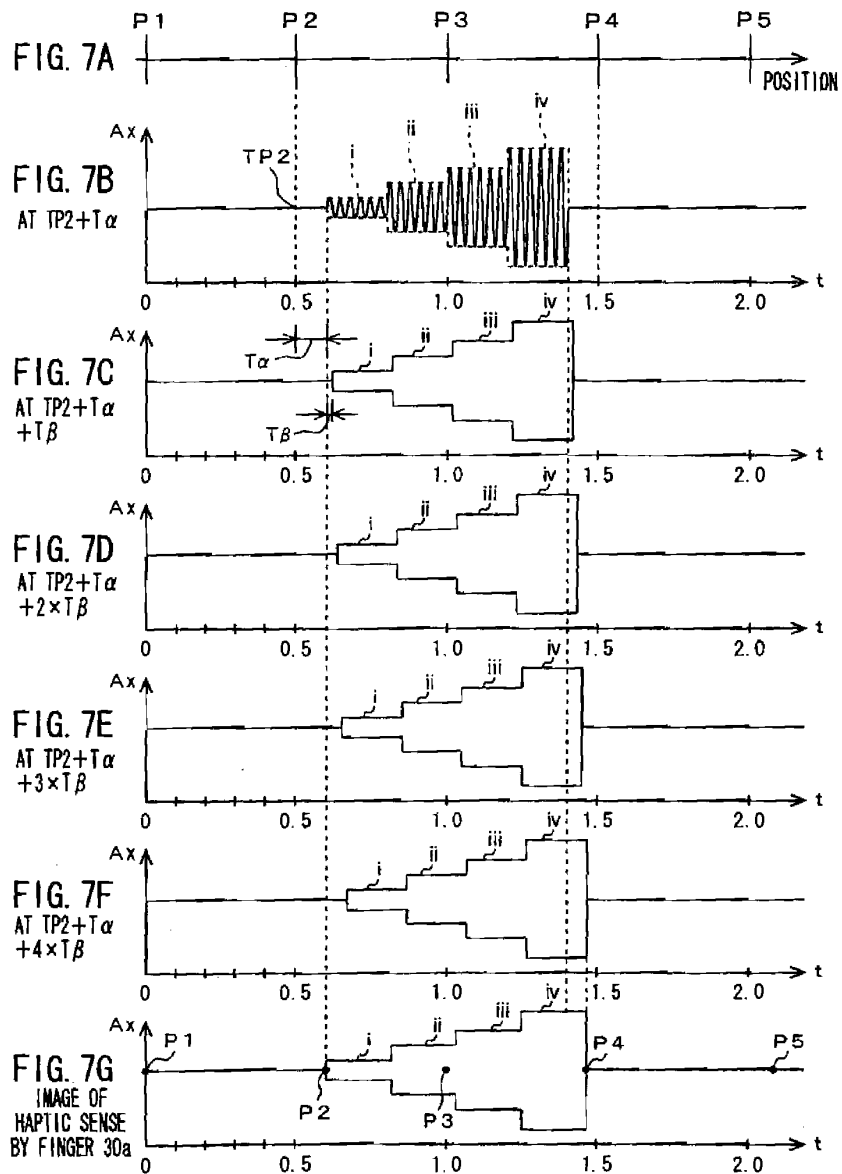
FIG. 2

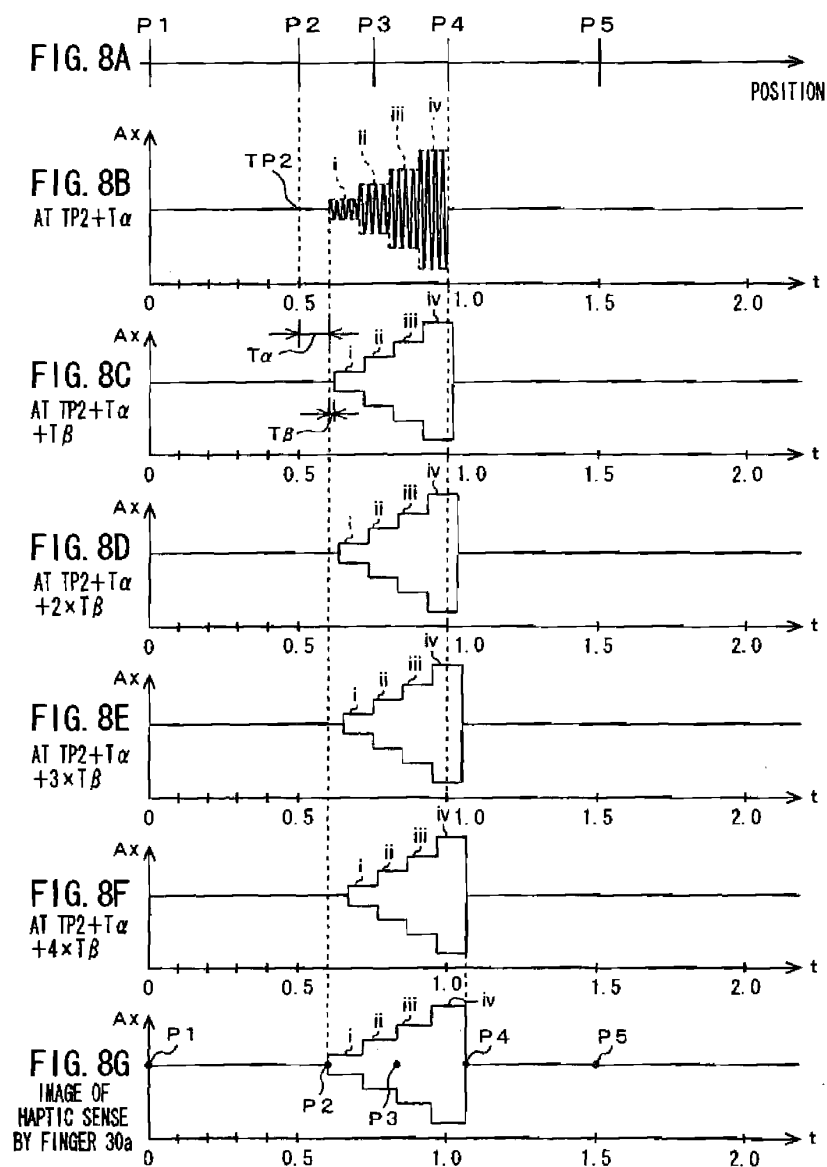


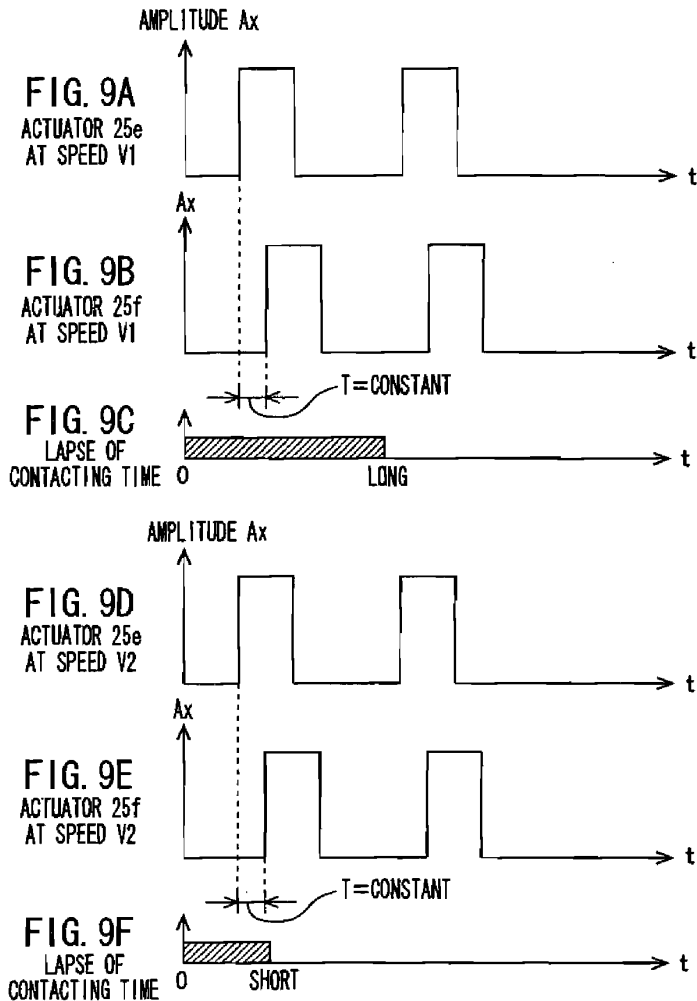


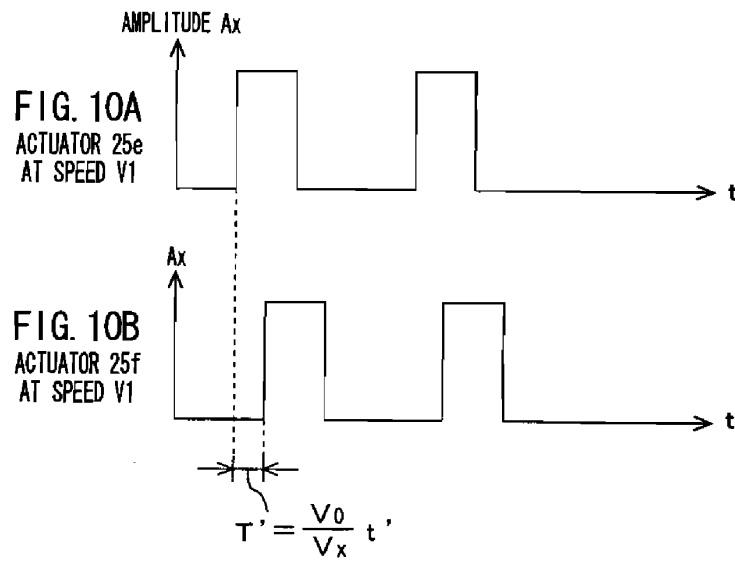












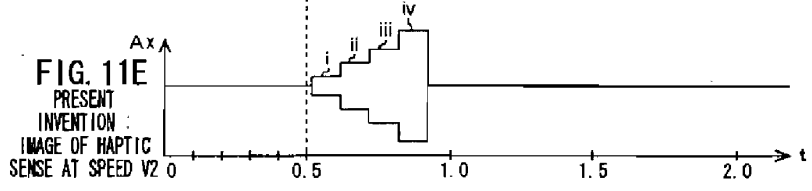
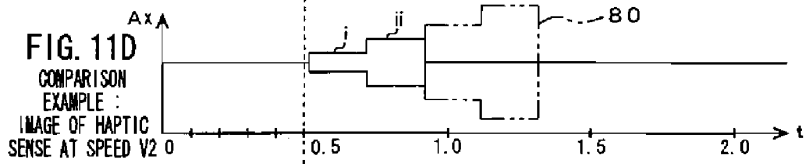
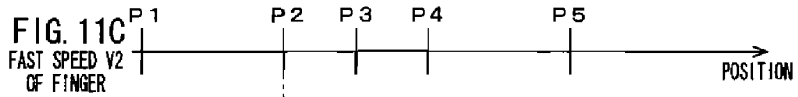
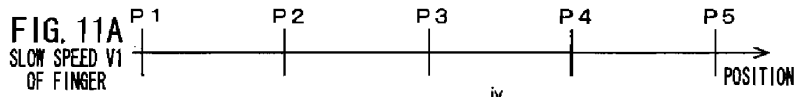


FIG. 12A

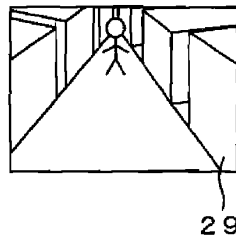


FIG. 12B

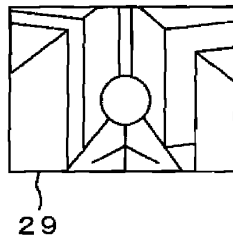


FIG. 12C

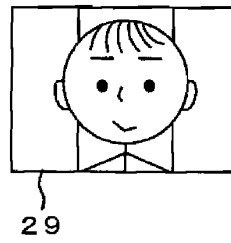


FIG. 13A

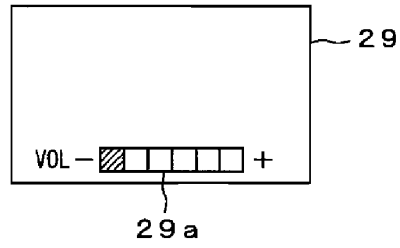


FIG. 13B

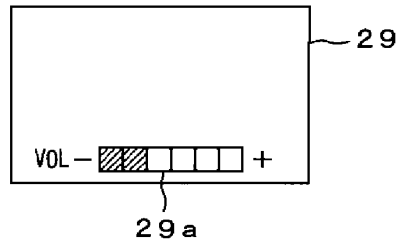


FIG. 13C

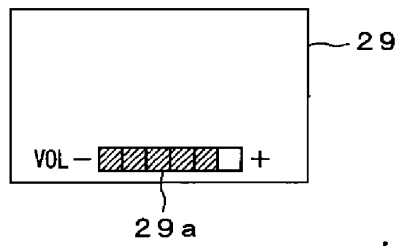
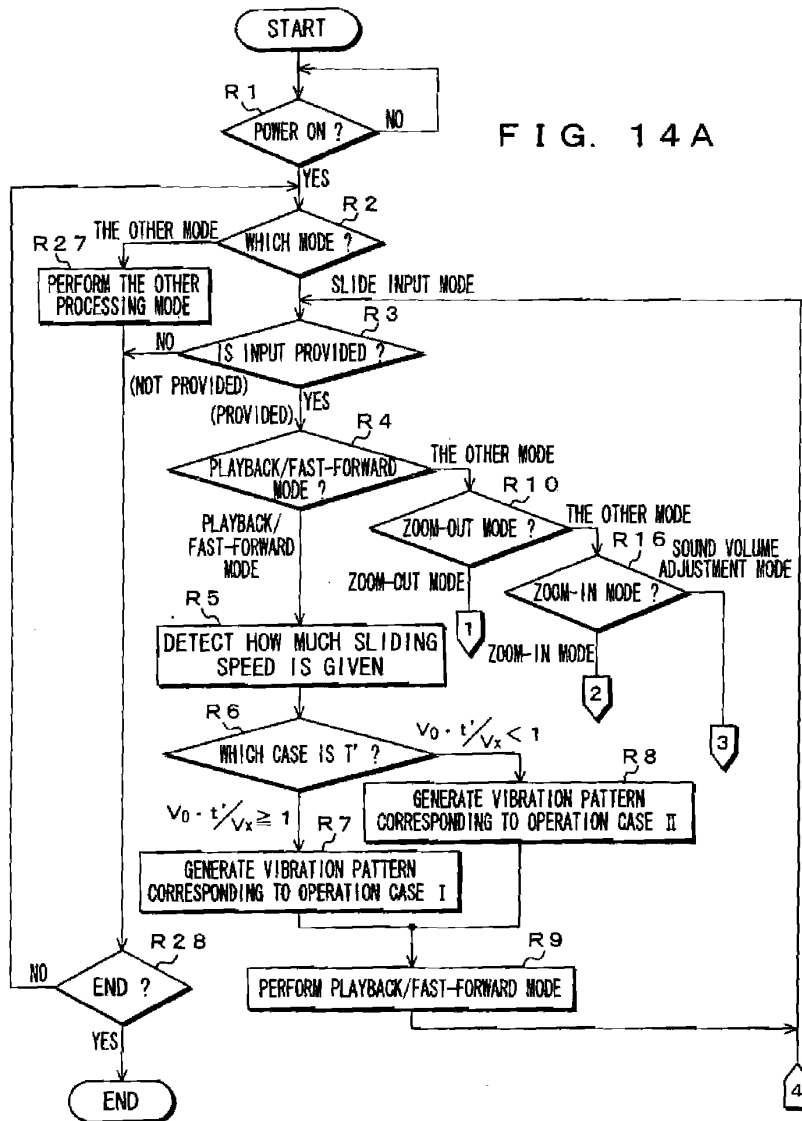


FIG. 14A



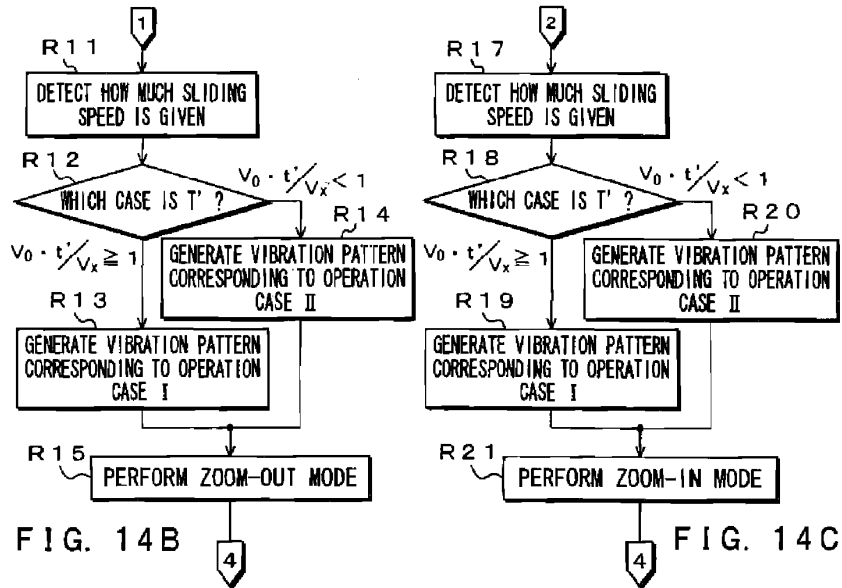


FIG. 14B

FIG. 14C

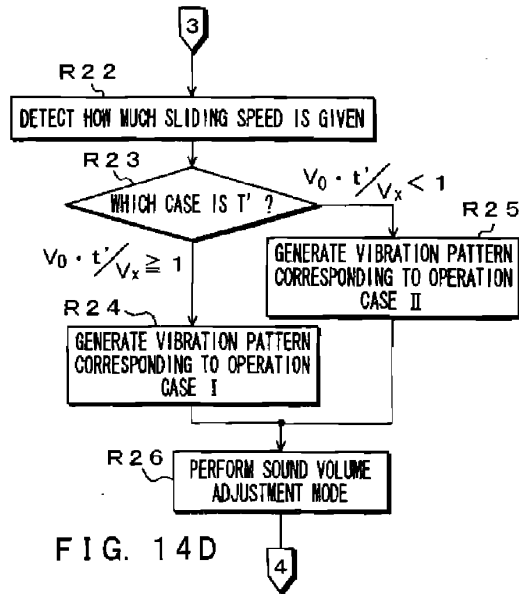


FIG. 14D

FIG. 15

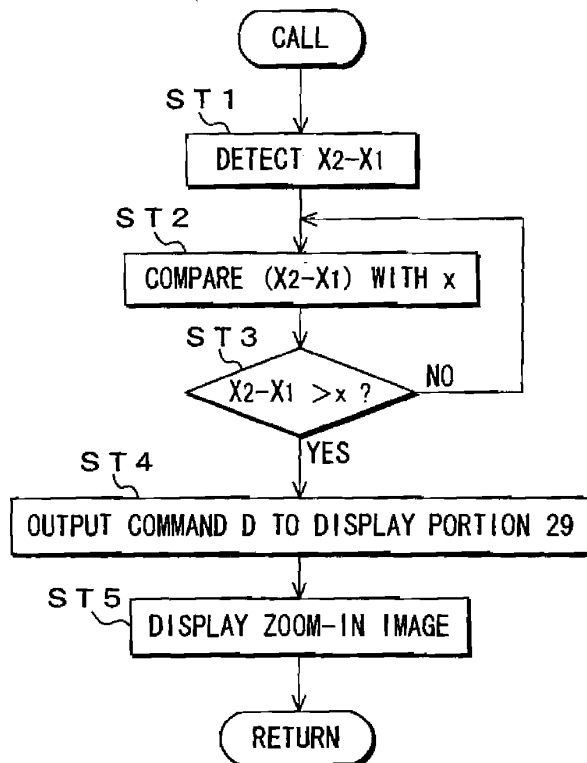
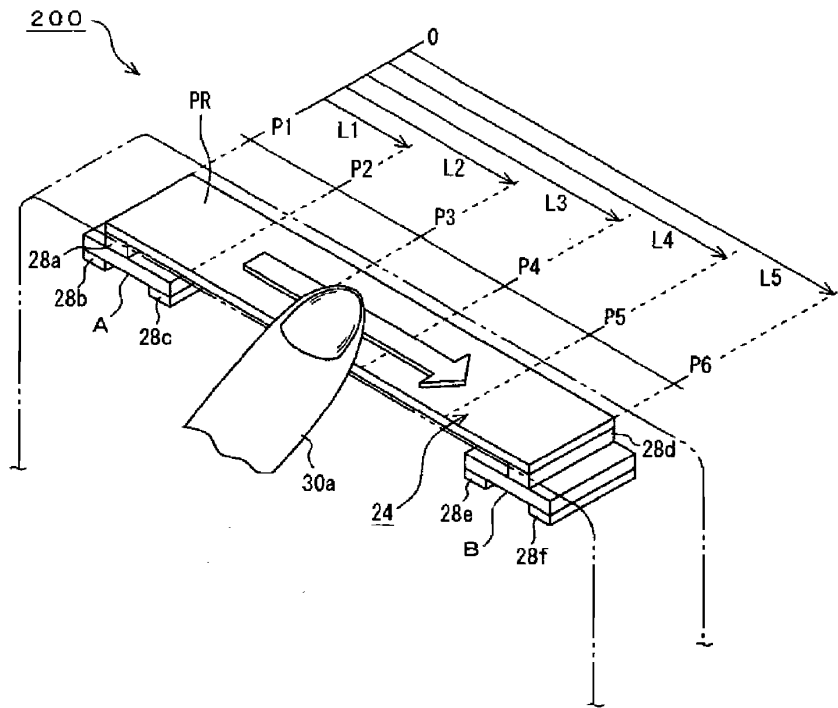


FIG. 16



INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP2005/006196

<p>A. CLASSIFICATION OF SUBJECT MATTER Int. Cl.⁷ G06F3/03, 3/00</p> <p>According to International Patent Classification (IPC) or to both national classification and IPC</p>														
<p>B. FIELDS SEARCHED</p> <p>Minimum documentation searched (classification system followed by classification symbols) Int. Cl.⁷ G06F3/03, 3/00</p> <p>Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched Jitsuyo Shinan Koho 1922-1996 Jitsuyo Shinan Toroku Koho 1996-2005 Kokai Jitsuyo Shinan Koho 1971-2005 Toroku Jitsuyo Shinan Koho 1994-2005</p> <p>Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)</p>														
<p>C. DOCUMENTS CONSIDERED TO BE RELEVANT</p> <table border="1"> <thead> <tr> <th>Category*</th> <th>Citation of document, with indication, where appropriate, of the relevant passages</th> <th>Relevant to claim No.</th> </tr> </thead> <tbody> <tr> <td>X Y</td> <td>JP 2001-255993 A (Japan Science and Technology Corp.), 21 September, 2001 (21.09.01), Full text; all drawings (Family: none)</td> <td>1, 5, 9 2-4, 6-8, 10-12</td> </tr> <tr> <td>Y</td> <td>JP 2004-046792 A (Toshiba Corp.), 12 February, 2004 (12.02.04), Par. Nos. [0155] to [0156], [0218] to [0232]; Figs. 42 to 46b & US 2003/0227441 A1</td> <td>2, 6, 10</td> </tr> <tr> <td>Y</td> <td>JP 2003-296015 A (Casio Computer Co., Ltd.), 17 October, 2003 (17.10.03), Par. Nos. [0101] to [0123]; Figs. 25 to 34 & US 2003/0142081 A1</td> <td>3-4, 7-8, 11-12</td> </tr> </tbody> </table> <p><input type="checkbox"/> Further documents are listed in the continuation of Box C. <input type="checkbox"/> See patent family annex.</p> <p>* Special categories of cited documents: "A" document defining the general state of the art which is not considered to be of particular relevance "E" earlier application or patent but published on or after the international filing date "L" document which may throw doubts on priority claims or which is cited to establish the publication date or another citation or other special reason (as specified) "O" document referring to an oral disclosure, use, exhibition or other means "P" document published prior to the international filing date but later than the priority date claimed "I" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention "X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone "Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art "&" document member of the same patent family</p>			Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.	X Y	JP 2001-255993 A (Japan Science and Technology Corp.), 21 September, 2001 (21.09.01), Full text; all drawings (Family: none)	1, 5, 9 2-4, 6-8, 10-12	Y	JP 2004-046792 A (Toshiba Corp.), 12 February, 2004 (12.02.04), Par. Nos. [0155] to [0156], [0218] to [0232]; Figs. 42 to 46b & US 2003/0227441 A1	2, 6, 10	Y	JP 2003-296015 A (Casio Computer Co., Ltd.), 17 October, 2003 (17.10.03), Par. Nos. [0101] to [0123]; Figs. 25 to 34 & US 2003/0142081 A1	3-4, 7-8, 11-12
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REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- JP 2003256120 A [0003]

Telecommunication system for mutual transmission of emotions, has communication interface provided with access unit accessing trajectory traced by user, and with restitution unit restituting trajectory of user to another user

Publication number: FR2910160 (A1)

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Inventor(s): HOFFMANN CRISTINA; MARQUET BERNARD; JUMPERTZ SYLVIE +

Applicant(s): FRANCE TELECOM [FR] +

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Application number: FR20060055490 20061213

Priority number(s): FR20060055490 20061213

Cited documents:

US2006148527 (A1)

EP0875821 (A2)

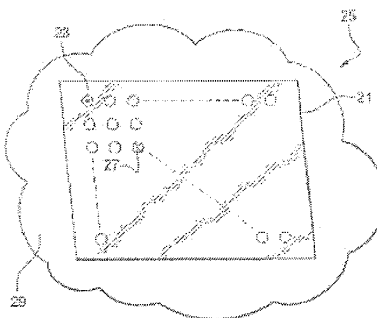
EP0917329 (A1)

FR2743915 (A1)

US2006086896 (A1)

Abstract of FR 2910160 (A1)

The system has a communication interface (25), whose access unit for accessing a trajectory is traced by a user by using a part of a body of the user. A restitution unit of the interface restitutes the trajectory of the user to another user. The interface has a touch screen (21) with two element (23, 27) i.e. points, representing the users. An LED is located in a surface of the interface illuminated under a finger of the former user, when the former user poses the finger on another surface of the interface. independent claims are also included for the following: (1) a method for transmitting information (2) a computer program comprising instructions to perform a method for transmitting information.



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⑫ **DEMANDE DE BREVET D'INVENTION** **A1**

⑲ Date de dépôt : 13.12.06.

⑳ Priorité :

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㉒ Références à d'autres documents nationaux
apparentés :

㉓ Demandeur(s) : *FRANCE TELECOM Société ano-
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㉔ Inventeur(s) : *HOFFMANN CRISTINA, MARQUET
BERNARD et JUMPERTZ SYLVIE.*

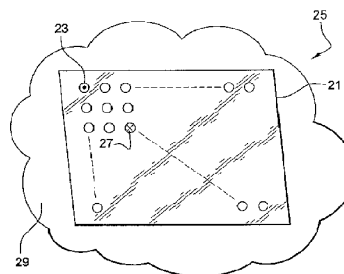
㉕ Titulaire(s) :

㉖ Mandataire(s) : *FRANCE TELECOM.*

㉗ **SYSTEME DE TELECOMMUNICATION TACTILE.**

㉘ L'invention concerne un système de télécommunica-
tion. Le système selon l'invention est caractérisé en ce qu'il
comprend:

- des moyens de saisie d'une trajectoire tracée par au
moins un premier utilisateur au moyen d'une partie du corps
dudit premier utilisateur, et
- des moyens de restitution de ladite trajectoire à au
moins un deuxième utilisateur.



FR 2 910 160 - A1



Système de télécommunication tactile

L'invention concerne un système de télécommunication.

5 Quand deux personnes sont géographiquement séparées, il leur est difficile d'échanger des émotions. Par exemple, dans le cas d'un couple dont un membre se trouve à un endroit différent de l'endroit où se trouve l'autre membre, il peut être difficile pour ces deux membres de se transmettre mutuellement leur émotions.

Ceci présente un inconvénient.

10 L'invention vise à pallier cet inconvénient. L'invention cherche à rendre possible une transmission d'émotions entre au moins deux utilisateurs, qui plus est par un moyen relativement peu coûteux et d'utilisation intuitive.

Le système de télécommunication selon l'invention est caractérisé en ce qu'il comprend:

- des moyens de saisie d'une trajectoire tracée par au moins un premier utilisateur au moyen d'une partie du corps dudit premier utilisateur, et
- 15 - des moyens de restitution de ladite trajectoire à au moins un deuxième utilisateur.

Avantageusement, l'invention permet une transmission d'émotions dont la trajectoire saisie est intuitivement représentative, permettant de mettre par exemple le toucher pour saisir et transmettre des dessins, et/ou de l'écriture.

20 Dans un mode de réalisation, le système de télécommunication est caractérisé en ce qu'il comprend en outre:

- des moyens de saisie d'une trajectoire tracée par ledit deuxième utilisateur au moyen d'une partie du corps dudit deuxième utilisateur, et
- des moyens de restitution de ladite trajectoire audit premier utilisateur.

25 Ceci permet avantageusement, sauf transmission des émotions dans une première direction, c'est-à-dire d'un premier utilisateur vers un deuxième utilisateur en plus la transmission des émotions dans une deuxième direction, c'est-à-dire du deuxième utilisateur vers le premier utilisateur.

L'invention concerne également un procédé de transmission d'informations caractérisé en ce qu'il comprend:

- 30 - une étape de saisie d'une trajectoire tracée par au moins un premier utilisateur au moyen d'une partie du corps dudit premier utilisateur, et
- une étape de restitution de ladite trajectoire à au moins un deuxième utilisateur.

Dans un mode de réalisation, le procédé de transmission d'informations est caractérisé en ce qu'il comprend en outre:

- 35 - une étape de saisi d'une trajectoire tracée par ledit deuxième utilisateur au moyen d'une partie du corps dudit deuxième utilisateur, et
- une étape de restitution de ladite trajectoire audit premier utilisateur.

Les avantages de ces procédés sont comparables aux avantages déjà mentionnés ci-dessus.

L'invention concerne également un programme d'ordinateur, comprenant des instructions de code de programme pour l'exécution d'au moins l'une des étapes d'un procédé décrit ci-dessus, lorsque ledit programme est exécuté sur un ordinateur.

Les étapes seront réalisées par des logiciels séparés, l'un d'entre eux exécutant au moins une
5 étape de saisie, l'autre exécutant au moins une étape de restitution.

L'invention concerne également un interface de communication utilisable dans un système de télécommunication décrit ci-dessus, caractérisé en ce qu'il inclut des moyens de saisie et des moyens de restitution comprenant une deuxième surface, ladite deuxième surface incluant un premier élément symbolisant ledit premier utilisateur et un deuxième élément symbolisant
10 ledit deuxième utilisateur, lesdits éléments mobiles dans ladite deuxième surface et capables de montrer ladite trajectoire dans ladite deuxième surface pendant un déplacement desdits éléments, et lesdits moyens de saisie et lesdits moyens de restitution comprennent en outre une première surface, ladite première surface présentant au moins une propriété apte à varier en fonction d'une interaction entre ladite premier surface et ladite partie du corps dudit
15 premier utilisateur ou ladite partie du corps dudit deuxième utilisateur et en ce que lesdits éléments sont déplaçables en fonction de ladite interaction.

Une telle interface permet avantageusement la possibilité de transmission intuitive et bidirectionnelle des émotions. Le partage d'émotions peut être simultanée ou en temps différé. D'autres interfaces de communication pourront être des moyens de saisie sans
20 contact (vidéo, laser, ou autre) de trajectoires dessinées par exemple dans l'air par un utilisateur.

Dans un mode de réalisation, l'interface de communication est caractérisée en ce que lesdits surfaces ont une dimension par rapport à ladite trajectoire qui est suffisamment fin pour pouvoir écrire un symbole unique mais pas trop fin pour écrire une phrase.

L'avantage d'un tel est qu'il n'a pas l'air d'être technologiquement avancé, ne représente pas un énorme investissement de la part des utilisateurs, qui seront donc plus prêt à l'adopter. En plus, l'interface offre la possibilité à deux personnes, par exemples deux membres d'un couple géographiquement séparés à créer un alphabet de symboles propre avec des connotations uniquement connues par eux et chargées de signifié.

30 Dans un mode de réalisation, l'interface de communication est caractérisée en ce que ladite deuxième surface comprend des diodes électroluminescentes (LED's).

L'utilisation d'une surface à LED's impose une limitation physique. Ceci est un avantage parce que la résolution de la deuxième surface sera ainsi basse par rapport aux écrans actuels. Ceci limite les usages que l'on peut faire de l'interface de communication et le détournement de
35 l'interface de communication vers des usages comme block de notes ou interface d'échange de texte. Cet aspect est avantageux dans la communication d'émotions. En effet, si on peut écrire des grandes frases la fluidité d'utilisation se perd (communiquer à travers de symboles ou quelques lettres est tout d'abord rapide). En plus, les utilisateurs peuvent échangés des

signes et/ou peuvent communiquer en langage codé, sans besoin d'écrire des phrases complètes.

Dans un mode de réalisation, l'interface de communication est caractérisée en ce que ladite propriété comprend une résistance.

- 5 Dans un mode de réalisation, l'interface de communication est caractérisée en ce que ladite propriété comprend une capacitance.

Dans un mode de réalisation, l'interface de communication est caractérisée en ce que ladite interface comprend en outre une couche moelleuse.

- 10 L'aspect "moelleux" de la surface de contact, contribue avantageusement à un aspect confortable, douillet qui colle bien avec un échange chargé en émotion et l'amélioration de l'ergonomie et plaisir d'utilisation de l'interface.

Dans un mode de réalisation, l'interface de communication est caractérisée ladite interface comprend un dispositif d'enregistrement de ladite trajectoire.

- 15 Ceci permet avantageusement d'établir une communication asynchrone, car on peut enregistrer les "passages" d'un utilisateur et ses tentatives de communication, ou symboles laissés pour qu'un autre utilisateur les retrouve. Ainsi, un utilisateur peut en cours de communication (par exemple téléphonique) faire un enregistrement synchronisé entre les deux utilisateurs, qui permet de symboliser et capturer l'instant dans lequel l'échange se produit, le résultat étant fortement chargé d'émotion, ayant un grand pouvoir d'évocation et
20 restant discret et indéchiffrable pour d'autres personnes, c'est-à-dire des personnes autres que ces deux utilisateurs spécifiques.

L'invention sera mieux comprise à l'aide de la description suivante, faite à titre d'exemple non-limitatif et en regard des dessins annexés, dans lesquels:

- la figure 1 montre une interface selon l'invention,
25 - la figure 2 montre le fonctionnement de l'interface selon l'invention, et
- la figure 3 montre la structure de l'écran de l'interface selon l'invention.

- Dans l'état de la technique, il n'existe pas d'interfaces de communication qui permettent la transmission d'émotions entre deux personnes d'une façon simple et intuitive. Certes, on connaît des interfaces comme le téléphone, mais son utilisation est complexe, inconfortable
30 ergonomiquement, et coûteuse en termes de temps et effort pour l'utilisateur. Un utilisateur doit par exemple mémoriser un numéro d'appel d'un correspondant ou chercher le numéro du correspondant dans une liste, décrocher le téléphone, et saisir le numéro. Ce sont donc plusieurs démarches que l'utilisateur doit effectuer pour être capable de transmettre ses émotions vers son correspondant.

- 35 La figure 1 est un schéma qui représente une interface 25 selon l'invention. L'interface 25 comprend un écran 21. L'écran pourrait être intégré dans une couche 29. L'écran pourrait être recouvert d'une couche avec des propriétés tactiles intéressantes, cette couche peut être choisie en fonction d'optimisation de rendu optique et/ou rendu optique et rendu tactile.

L'écran 21 comprend un premier élément 23 qui représente un premier utilisateur de l'interface 25. Ce premier élément 23 peut par exemple être un point. L'écran 21 comprend un deuxième élément 27 symbolisant un deuxième utilisateur de l'interface 25. Ce deuxième élément 27 peut par exemple aussi être un point. L'écran 21 est tactile. Dans un système

5 pour permettre la transmission des émotions entre au moins deux utilisateurs, il y aura au moins deux interfaces 25. Chaque utilisateur peut déplacer et seulement déplacer son point correspondant, c'est-à-dire le point qui lui symbolise en agissant sur l'interface 25 qui lui est propre. Autrement dit, chaque utilisateur n'a accès qu'au point qui le représente, il ne peut pas agir sur celui de l'autre utilisateur. Le déplacement du point se fait par exemple en

10 utilisant un doigt (ou toute autre partie du corps d'un utilisateur) et en appuyant sur le point. Quand les points 23, 27 sont déplacés ils laissent une trajectoire sur l'écran 21 comme montré dans la figure 2. Le déplacement du point peut se faire par un contact direct entre l'utilisateur et son point, dans ce cas, l'utilisateur doit exercer de la pression sur l'écran. Cependant, un déplacement du point sans contact direct est aussi envisageable. Par exemple,

15 quand l'utilisateur approche l'écran avec son doigt, il y aura un changement de température véhiculé par moyen de radiation infrarouge dans l'environnement de l'écran. Ce changement peut être détecté et peut déclencher le déplacement du point symbolisant cet utilisateur. Une autre possibilité est un maillage de rayons infra rouge qui détectent le mouvement. Une autre possibilité est des technologies qui détectent le mouvement à travers un champ

20 électromagnétique d'une fréquence différent de la radiation infra rouge. Il est également possible que l'utilisateur fait un geste sans toucher l'écran qui est filmé et qui résulte en un déplacement du point de l'utilisateur correspondant. Ceci est une technique de détection d'image utilisé dans les installations artistiques, et utilise un mécanisme de captation et traitement d'image.

25 L'utilisateur peut aussi déplacer l'élément qui lui symbolise par moyen des ondes acoustiques ou sonores.

La structure de l'écran 21 sera maintenant expliquée en plus de détail, voir figure 3. L'écran 21 comprend une première surface tactile 41. Cette surface tactile 41 est translucide et située au dessus d'une deuxième surface 43. Cette deuxième surface 43 est lumineuse. Cette

30 deuxième surface 43 pourrait par exemple être constituée par des LED's 47. La première surface 41 est connecte à la deuxième surface 43 par le biais d'un système électronique 45. Lorsqu'un utilisateur pose son doigt sur la première surface 41, la LED 47 située derrière ce point dans la deuxième surface 43 s'illumine sous son doigt.

Deux technologies, connus à l'instant par l'homme du métier peuvent être utilisés pour

35 construire la première surface 41. Une première technologie est connu sous le nom "Quantum". La technologie "Quantum" est basée sur le principe de senseurs capacitifs. Sous le contact du doigt (ou comme dit toute autre partie du corps d'un utilisateur), la capacité de la première surface change localement ce qui peut être détecté par le système électronique

45. Le corps sera à une capacité et la première surface à une autre, donc à travers le contact il y aura un changement de capacité entre les deux.

Un avantage de la technologie Quantum est que la surface tactile peut être constituée de n'importe quel matériel, et avoir n'importe quelle forme, ce qui permettrait d'utiliser des matériels avec des propriétés tactiles intéressantes.

Une autre possibilité pour la première surface 41 est une technologie qui est connue sous le nom "Elotouch" par l'homme du métier. La technologie "Elotouch" est basée sur la construction de dalles résistives.

La technologie Elotouch consiste en construire des dalles tactiles en verre, comme celles qui se trouvent superposées à des moniteurs dans des guichets automatiques. Un panneau en verre est couvert par une couche conductrice. Une deuxième couche en polyester, isolée à l'extérieur et conductrice à l'intérieur, est placée sur le verre, et séparée de celui-ci des micro-points isolants. Ainsi, lorsque la dalle est touchée, un contact entre la couche conductrice du polyester et celle du verre se produit. Le voltage ainsi généré est proportionnel à la position.

Un avantage de la technologie Elotouch est que la dalle est transparente et prête à l'emploi, et il n'y a pas besoin de construire des pièces à la main, ce qui comporte un grand gain en termes de temps. Ainsi elle a une grande résolution, jusqu'à potentiellement 1024 x 496 pixels. La dalle est divisée dans un nombre de cellules égal au nombre de LED's. Les cellules constituent ensemble une grille. Ainsi plus une augmentation du nombre de LED's implique une augmentation du nombre des cellules dans la grille et, si les dimensions de la dalle restent les mêmes, plus petites seront les cellules. Ceci s'appelle quantification de la surface. Ce qui permet de pouvoir varier le nombre de LED's utilisées. Un LED spécifique est lié aux plusieurs pixels de la dalle composant une cellule. Cependant, pour éviter que deux LED's s'allument au même temps, il y a une partie entre deux LED's dont les pixels ne sont liés à aucun LED, comme il sera compris par l'homme du métier.

Au lieu de LED's qui s'illuminent, il est aussi possible que le déplacement du doigt de l'utilisateur a pour résultat un changement dans la structure de la deuxième surface 43, qui pourrait être aperçue à travers de la première surface 41. La deuxième surface 43 pourrait ainsi par exemple comprendre un écran à cristaux liquides (en anglais: "liquid crystal display, LCD").

Aussi, et comme il sera connu par l'homme du métier, les LEDs ne sont pas seulement des émetteurs de lumière, mais aussi des capteurs optiques capacitifs.

Quand le doigt se déplace sur la première surface 41 les LED's se trouvant sous la position du doigt s'illuminent au fur et à mesure. Les LED's qui se sont illuminés restent illuminés pendant un certain temps ce qui permet l'utilisateur de construire une trajectoire ou par exemple un caractère, un chiffre ou un autre symbole. L'écran permet de tracer avec le doigt, des formes autant continues que discontinues. En effet, lorsque le doigt est levé de la surface pour une période supérieure à 1,25 secondes (cette variable temporelle est réglable), la forme tracée

- fera une disparition graduelle (ou en Anglais: "fade-out") pour s'effacer et permettre de tracer une nouvelle forme. Cette variable temporelle est suffisamment longue pour qu'elle permette également la construction des formes où il est nécessaire de lever le doigt, parce qu'un utilisateur dans un tel cas ne lève son doigt que pour des périodes de quelques dizaines
- 5 de millisecondes à peu près. Ceci est plus court que cette variable temporelle.
- Dans un mode de réalisation, l'écran comprend un mécanisme, (par exemple un bouton), que lorsqu'il est activé (on appuie sur le bouton), permet d'enregistrer les trajectoires présentes sur la deuxième surface 43. Par exemple, lorsque un utilisateur appuie sur le bouton et fait des trajectoires au même temps, c'est comme si on enregistrerait une vidéo de ce qui se passe.
- 10 L'utilisateur dessine une forme quelconque des trajectoires, ensuite lève le doigt définitivement et n'appuie plus sur le bouton, la forme (continue ou pas) fait un fade out mais ensuite recommence à être dessinée, en boucle. Pour cela, l'interface de communication comprend par exemple une mémoire.
- Quand les LED's sont arrangés sous forme de matrice, par exemple une matrice de 64 LED's
- 15 (8 files x 8 colonnes), la position du doigt pourrait être représentée par un pair de coordonnées.
- Le nombre de LEDs par unité de surface pourrait être de l'ordre de 1LED chaque 2 cm² (ou bien de 1/2LED/cm²). Chaque LED pourrait avoir deux couleurs différentes, par exemple, rouges et vertes, Alternativement, l'utilisation des LEDs RVB peut être envisagée pour pouvoir
- 20 choisir deux couleurs quelconques. Le champ lumineux créé par une LED pourrait être rond et avoir comme diamètre, par exemple 5mm.
- Comme évoqué ci-dessus le système de deux interfaces selon l'invention peut être utilisé pour la transmission des émotions entre deux utilisateurs qui sont éloignés l'un de l'autre.
- 25 Dans ce cas, les deux interfaces sont connectées à travers d'un réseau de communication, par exemple à travers d'un réseau Wifi et/ou l'Internet. Les deux écrans pourraient être synchronisés, c'est-à-dire, ils affichent toujours la même chose ou asynchrones. Par contre, un utilisateur interagit sur son propre interface.

Revendications

- 1) Système de télécommunication caractérisé en ce qu'il comprend:
- des moyens de saisie d'une trajectoire tracée par au moins un premier utilisateur au moyen
5 d'une partie du corps dudit premier utilisateur, et
- des moyens de restitution de ladite trajectoire à au moins un deuxième utilisateur.
- 2) Système de télécommunication selon la revendication 1 caractérisé en ce qu'il comprend
en outre:
10 - des moyens de saisie d'une trajectoire tracée par ledit deuxième utilisateur au moyen d'une
partie du corps dudit deuxième utilisateur, et
- des moyens de restitution de ladite trajectoire audit premier utilisateur.
- 3) Procédé de transmission d'informations caractérisé en ce qu'il comprend:
15 - une étape de saisie d'une trajectoire tracée par au moins un premier utilisateur au moyen
d'une partie du corps dudit premier utilisateur, et
- une étape de restitution de ladite trajectoire à au moins un deuxième utilisateur.
- 4) Procédé de transmission d'informations selon la revendication 3 caractérisé en ce qu'il
20 comprend en outre:
- une étape de saisi d'une trajectoire tracée par ledit deuxième utilisateur au moyen d'une
partie du corps dudit deuxième utilisateur, et
- une étape de restitution de ladite trajectoire audit premier utilisateur.
- 25 5) Un programme d'ordinateur, comprenant des instructions de code de programme pour
l'exécution d'au moins l'une des étapes d'un procédé conforme aux revendications 3 à 4,
lorsque ledit programme est exécuté sur un ordinateur.
- 6) Interface de communication utilisable dans un système de télécommunication selon l'une
30 quelconque des revendication 1 et 2, caractérisé en ce qu'il inclut des moyens de saisie et des
moyens de restitution comprenant une deuxième surface, ladite deuxième surface incluant un
premier élément symbolisant ledit premier utilisateur et un deuxième élément symbolisant
ledit deuxième utilisateur, lesdits éléments mobiles dans ladite deuxième surface et capables
de montrer ladite trajectoire dans ladite deuxième surface pendant un déplacement desdits
35 éléments, et lesdits moyens de saisie et lesdits moyens de restitution comprennent en outre
une première surface, ladite première surface présentant au moins une propriété apte à
varier en fonction d'une interaction entre ladite premier surface et ladite partie du corps dudit

premier utilisateur ou ladite partie du corps dudit deuxième utilisateur et en ce que lesdits éléments sont déplaçables en fonction de ladite interaction.

- 5 7) Interface de communication selon la revendication 6, caractérisé en ce que lesdites surfaces ont une dimension par rapport à ladite trajectoire qui est suffisamment fin pour pouvoir écrire un symbole unique mais pas trop fin pour écrire une phrase.
- 10 8) Interface de communication selon l'une quelconque des revendications 6 à 7 caractérisé en ce que ladite deuxième surface comprend des diodes électroluminescentes (LED's).
- 9) Interface de communication selon l'une quelconque des revendications 6 à 8 caractérisé en ce que ladite propriété comprend une résistance.
- 15 10) Interface de communication selon l'une quelconque des revendications 6 à 8 caractérisé en ce que ladite propriété comprend une capacitance.
- 11) Interface de communication selon l'une quelconque des revendications 6 à 10 caractérisé en ce que ladite interface comprend en outre une couche moelleuse.
- 20 12) Interface de communication selon l'une quelconque des revendications 6 à 11 caractérisé en ce que ladite interface comprend un dispositif d'enregistrement de ladite trajectoire.

1/1

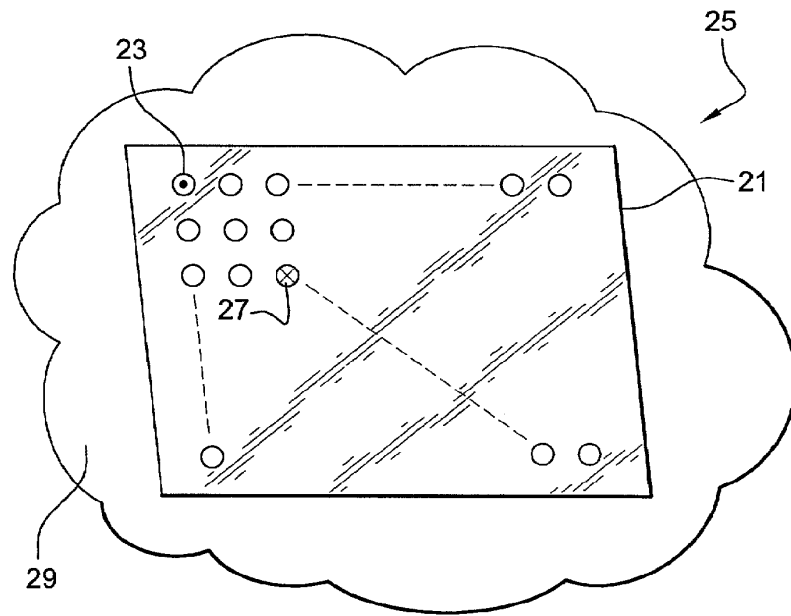


Fig. 1

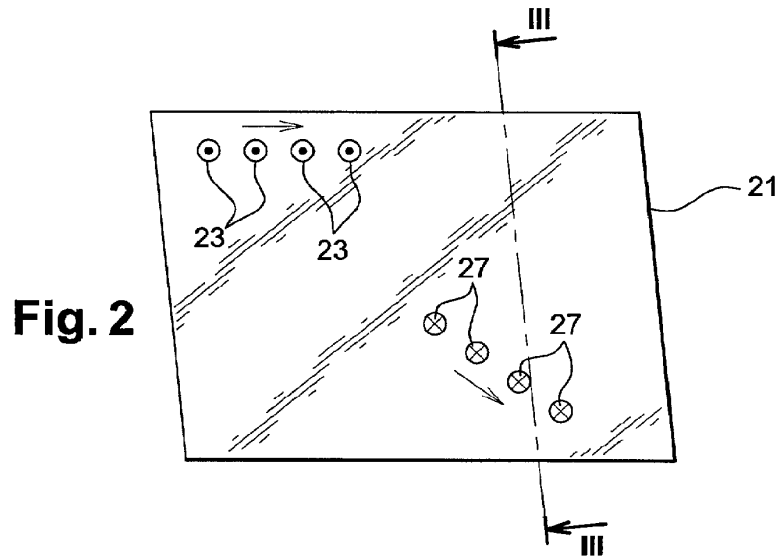


Fig. 2

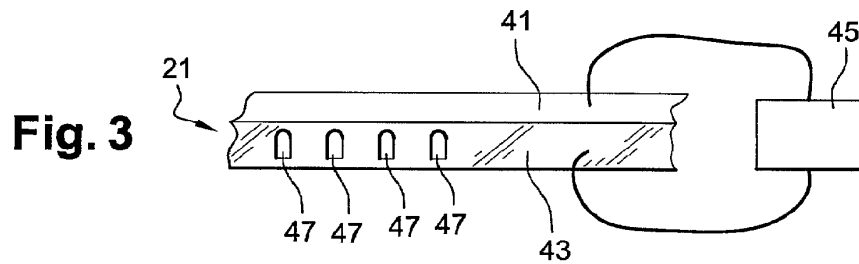


Fig. 3



**RAPPORT DE RECHERCHE
PRÉLIMINAIRE**

N° d'enregistrement
national

établi sur la base des dernières revendications
déposées avant le commencement de la recherche

FA 687300
FR 0655490

DOCUMENTS CONSIDÉRÉS COMME PERTINENTS		Revendication(s) concernée(s)	Classement attribué à l'invention par l'INPI
Catégorie	Citation du document avec indication, en cas de besoin, des parties pertinentes		
X	US 2006/148527 A1 (BLOUNT ALAN W [US]) 6 juillet 2006 (2006-07-06) * abrégé * * alinéa [0004] * * alinéa [0029] * * alinéa [0033] - alinéa [0034] * * alinéa [0056] - alinéa [0060] *	1-5	G08B6/00 G08C19/02 G09G3/14 G06F3/033
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Y	EP 0 875 821 A (MATSUSHITA ELECTRIC IND CO LTD [JP]) 4 novembre 1998 (1998-11-04) * colonne 11, ligne 20 - ligne 40 * * colonne 20, ligne 31 - ligne 56 * * colonne 24, ligne 7 - ligne 56 * * figures 18-21 *	6-12	
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		----- -/--	
		Date d'achèvement de la recherche	Examineur
		26 juillet 2007	Bianchi, Damiano
CATÉGORIE DES DOCUMENTS CITÉS			
X : particulièrement pertinent à lui seul Y : particulièrement pertinent en combinaison avec un autre document de la même catégorie A : arrière-plan technologique O : divulgation non-écrite P : document intercalaire		T : théorie ou principe à la base de l'invention E : document de brevet bénéficiant d'une date antérieure à la date de dépôt et qui n'a été publié qu'à cette date de dépôt ou qu'à une date postérieure. D : cité dans la demande L : cité pour d'autres raisons & : membre de la même famille, document correspondant	

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**RAPPORT DE RECHERCHE
PRÉLIMINAIRE**

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déposées avant le commencement de la recherche

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national

FA 687300
FR 0655490

DOCUMENTS CONSIDÉRÉS COMME PERTINENTS		Revendication(s) concernée(s)	Classement attribué à l'invention par l'INPI
Catégorie	Citation du document avec indication, en cas de besoin, des parties pertinentes		
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			DOMAINES TECHNIQUES RECHERCHÉS (IPC)
		Date d'achèvement de la recherche 26 juillet 2007	Examineur Bianchi, Damiano
CATÉGORIE DES DOCUMENTS CITÉS		T : théorie ou principe à la base de l'invention E : document de brevet bénéficiant d'une date antérieure à la date de dépôt et qui n'a été publié qu'à cette date de dépôt ou qu'à une date postérieure. D : cité dans la demande L : cité pour d'autres raisons & : membre de la même famille, document correspondant	
X : particulièrement pertinent à lui seul Y : particulièrement pertinent en combinaison avec un autre document de la même catégorie A : arrière-plan technologique O : divulgation non-écrite P : document intercalaire			

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**ANNEXE AU RAPPORT DE RECHERCHE PRÉLIMINAIRE
RELATIF A LA DEMANDE DE BREVET FRANÇAIS NO. FR 0655490 FA 687300**

La présente annexe indique les membres de la famille de brevets relatifs aux documents brevets cités dans le rapport de recherche préliminaire visé ci-dessus.
Les dits membres sont contenus au fichier informatique de l'Office européen des brevets à la date du 26-07-2007
Les renseignements fournis sont donnés à titre indicatif et n'engagent pas la responsabilité de l'Office européen des brevets, ni de l'Administration française

Document brevet cité au rapport de recherche		Date de publication	Membre(s) de la famille de brevet(s)	Date de publication
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			TW 229284 B	11-03-2005

EPO FORM P0465

Pour tout renseignement concernant cette annexe : voir Journal Officiel de l'Office européen des brevets, No.12/82

(12) **UK Patent Application** (19) **GB** (11) **2 416 962** (13) **A**

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(71) Applicant(s): Vodafone Group PLC (Incorporated in the United Kingdom) Vodafone House, The Connection, NEWBURY, Berkshire, RG14 2FN, United Kingdom	(56) Documents Cited: GB 2308523 A WO 2004/053670 A2 WO 2003/051062 A2 US 20030064686 A1 US 20020180698 A1 "Mobiles get a sense of touch" BBC News, 21th January 2003 Downloaded from http://news.bbc.co.uk/1/hi/technology/2677813.stm Whole document
(72) Inventor(s): Phil Gosset	(58) Field of Search: INT CL ⁷ A63H, G03F, H04B, H04M, H04Q Other: Online: WPI, EPODOC, JAPIO, INSPEC, WWW
(74) Agent and/or Address for Service: Mathisen Macara & Co The Coach House, 6-8 Swakeleys Road, Ickenham, UXBRIDGE, Middlesex, UB10 8BZ, United Kingdom	

(54) Abstract Title: **Haptic communication in mobile telecommunications networks**

(57) A mobile telecommunications network may be provided with mobile terminals including motion sensors 21 and pressure sensors 23. Movement and/or pressure applied to a mobile terminal can be sensed by these sensors 21,23 and converted into an electrical signal. This electrical signal is encoded and transmitted to the network core. The network core generates a message to a recipient mobile terminal having a movement enabler 25 and/or pressure enabler 26. When the message is received by the receiving mobile terminal, the movement and/or pressure enabler generate an approximation of the touch input generated at the sending mobile terminal. The users of mobile terminals are therefore able to communicate with each other by the sense of touch.

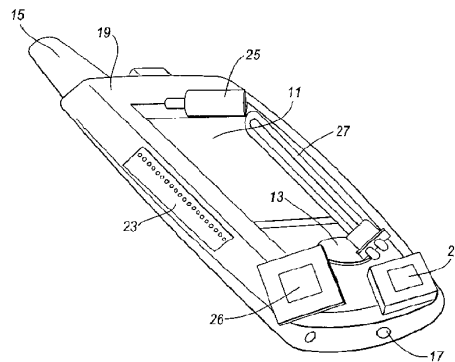


Fig.2

GB 2 416 962 A

At least one drawing originally filed was informal and the print reproduced here is taken from a later filed formal copy.
Original Printed on Recycled Paper

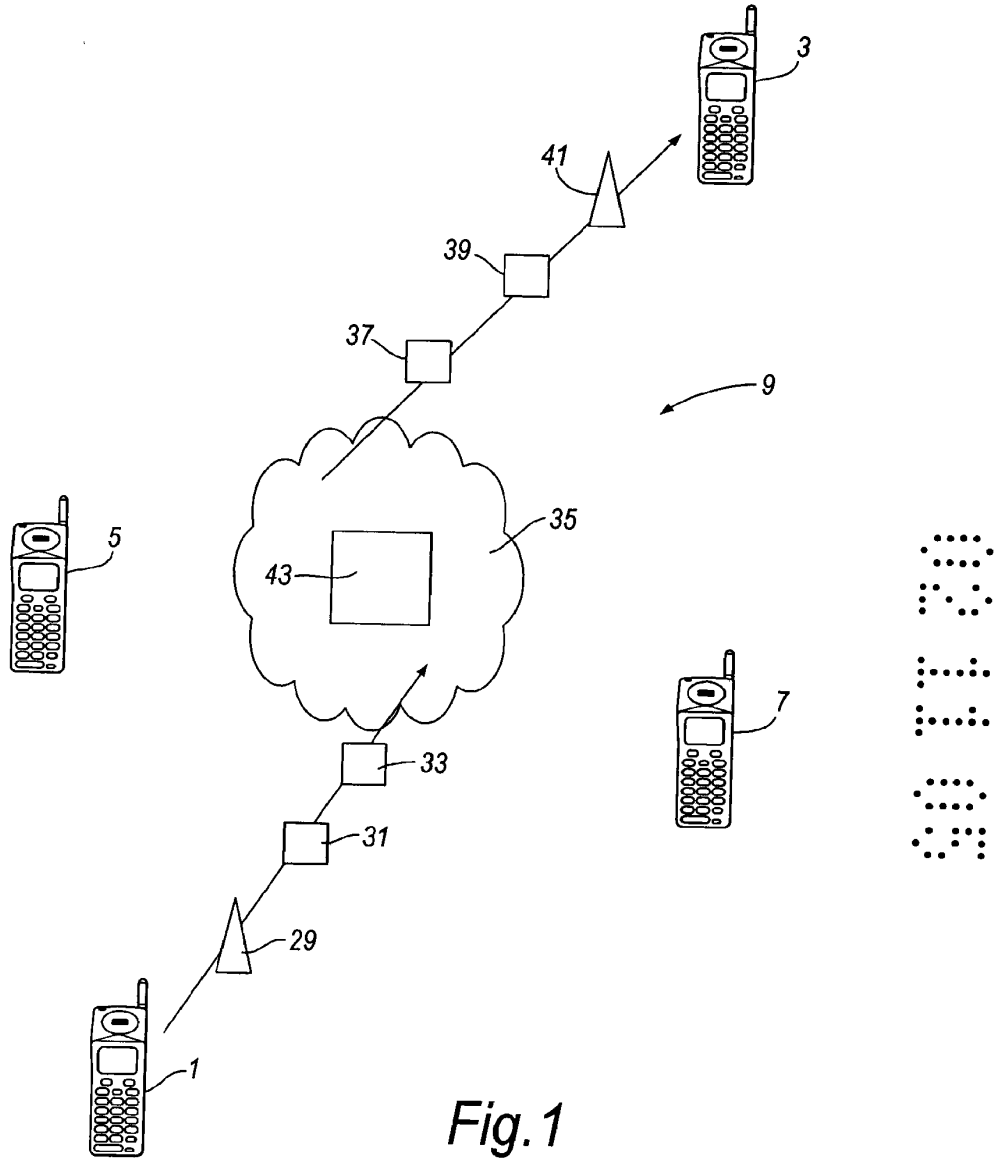


Fig. 1

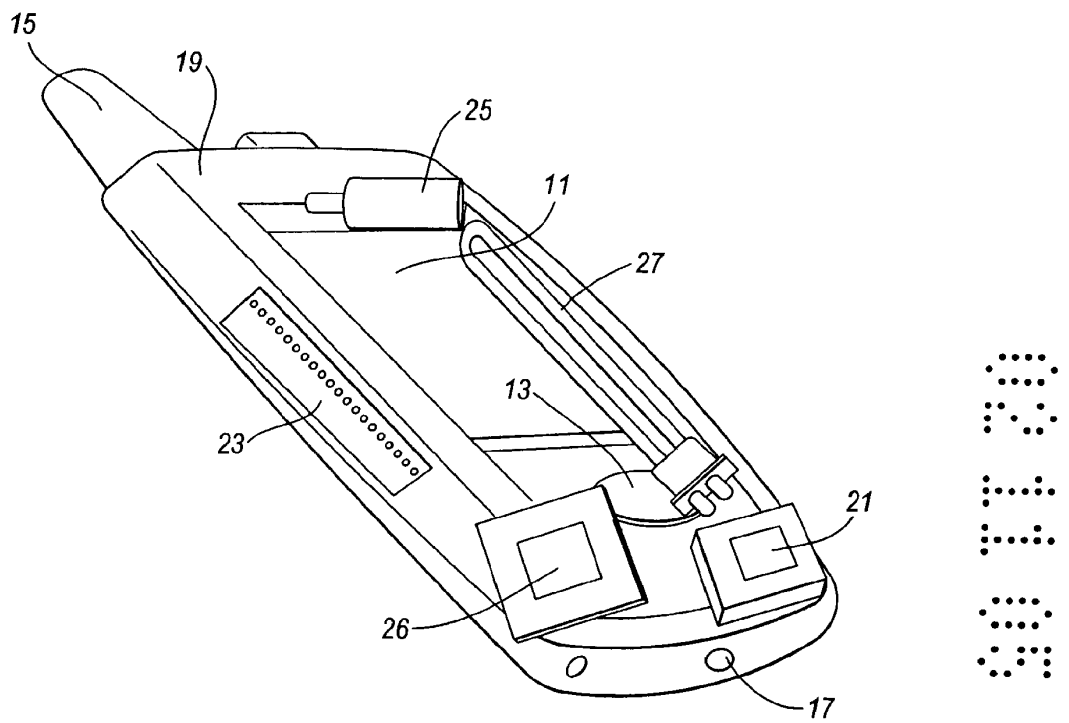


Fig.2

NEW COMMUNICATION TYPE FOR MOBILE
TELECOMMUNICATIONS NETWORKS

5 The present invention relates to a mobile telecommunications network, to terminals for use with a mobile telecommunications network and to a method of operating a mobile telecommunications network, and in particular to an arrangement in which communications can be enhanced by using the sense of touch.

10 In addition to voice calls between mobile terminals registered with a mobile telecommunications network, it is possible to send alphanumeric data in the form of an SMS or text message. Recent developments allow the transmission of multimedia messages (MMS) such as drawings, photographs, music and video clips. The present invention seeks to provide an additional type of
15 communication using a mobile telecommunications network.

According to a first aspect of the present invention, there is provided a mobile telecommunications network including a plurality of terminals registered with the network, wherein a first of said terminals includes means for sensing the
20 variation of a touch input with respect to time and generating a signal representative thereof; and including means for generating a message representative of said signal; and means for transmitting the message to a second of said terminals for generating an output in response to the message that is indicative of the touch input.

25 The message may be generated by the first terminal, the mobile telecommunications network or a separate entity.

The output may be a simulation or approximation of the input - it may
30 stimulate the touch sense of the user of the second terminal to convey the touch

input by the user of the first terminal, allowing the users to communicate by the sense of touch.

Alternatively, the output may be indicative of the touch input but may stimulate
5 a different sense of the user of the second terminal - such as sight or hearing.
This arrangement may be used when the second terminal is not capable of
generating a touch output.

Particular touch inputs generate particular outputs (whether stimulating touch,
10 sight or hearing). Particular inputs may be mapped to particular outputs. For
example, shaking the first terminal may generate a particular audible message
at the second terminal. This mapping may be pre-set and/or may be set by the
users of the terminals or by a third party.

15 According to a second aspect of the present invention, there is provided a
mobile telecommunications network, including means for receiving a message
from a first terminal for delivery to a second terminal and for converting the
message between a first type to a second type, wherein at least the first type of
message includes data enabling the reproduction of an output by a terminal
20 which output is detectable by the sense of touch and varies with respect to time
in dependence upon the content of the message.

The data in the first type of message enabling the reproduction of an output by
a terminal may data input from a terminal (which will subsequently be
25 reproduced in some form) or data for generating an output from a terminal.

According to a third aspect of the present invention, there is provided a
terminal for use with a mobile telecommunications network, the terminal
including means for sensing a variation of a touch input with respect to time
30 and generating a signal representative thereof, a representation of which is for

inclusion in a message for transmission to another terminal for generating an output in response to the message that is indicative of the touch input.

5 According to a fourth aspect of the present invention, there is provided a terminal for use with a mobile telecommunications network, the terminal including means for receiving a message representative of an input signal generated by another terminal, means for generating an output detectable by the sense of touch and which varies with respect to time in dependence upon the content of the message.

10

According to a fifth aspect of the present invention, there is provided a method of operating a mobile telecommunications network having a plurality of terminals, the method including generating at a first of said terminals a signal representative of how a touch input varies with respect to time, generating a message representative of the signal, transmitting the message to a second of said terminals, and generating an output at the said second terminal in response to the message that is indicative of the touch input.

20 According to a sixth aspect of the present invention, there is provided a mobile telecommunication network including means for generating a message containing information for use by the user of a terminal, means for transmitting the message to said mobile terminal, and means for conveying the information to the user of said mobile terminal by stimulating the user's sense of touch.

25 Humans have five senses: sight, hearing, touch, smell and taste.

Known mobile terminals can detect visual and audible stimuli, convert these into a message and transmit this to another terminal via a mobile telecommunications network. For example, a user of a first mobile terminal 30 may record a video clip (comprising sound and moving pictures) of themselves

and transmit this as a message to a second mobile terminal, where it is reproduced, stimulating the sight and hearing sensors of the recipient. The present invention provides an enhancement to communications by allowing a touch input to be sensed by a mobile terminal and/or a touch output to be reproduced on a mobile terminal.

In the specification the term "touch" means anything that is detectable by the human sense of touch, and includes such stimuli as heating and vibration.

Some mobile terminals have the facility to vibrate in order to alert the user of an incoming call or message. However, the vibration is simply triggered by a mobile terminal on receipt of an incoming call or message. The vibration does not convey the content of the message.

Conventional mobile telephones are capable of receiving a touch input in the sense that they have buttons and other controls which are depressed. However, the nature of the touch input is not recorded and conveyed as part of a message. The depression of the key may result in data being recorded in a message (for example a letter in an SMS message), but the nature of the touching of the key (or how it varies with time) is not recorded or conveyed.

According to one aspect of the present invention the variation of a touch input with respect to time is sensed. The intensity of the touch input may be sensed.

The term mobile telecommunications "network" used in this specification does not necessarily refer to a single network operated by a particular (legal) entity. The network might comprise a plurality of separately operated networks, or a part of one of such networks.

For a better understanding of the present invention, an embodiment will now be described by way of example, with reference to the accompanying drawings, in which:-

5 Figure 1 shows schematically principal elements of a mobile telecommunications network; and

Figure 2 shows schematically additional components provided to a mobile telecommunications terminal in accordance with an embodiment of the
10 invention.

As shown in Figure 1, mobile terminals 1,3,5 and 7 are registered with a GSM or UMTS (3G) mobile or cellular telecommunications network 9. The mobile terminals may be hand held mobile telephones, personal digital assistants
15 (PDAs) or laptop computers equipped with a datacard (or, of course, any combination of these). The mobile terminals communicate wirelessly with the mobile telecommunications network 9 via a radio access network comprising base transceiver stations (BTSs) and base station controllers (BSCs). Communications between the mobile terminals and the network 3 are routed
20 from the radio access network via mobile switching centres (MSCs), which may be connected by a fixed (cable) link to the network 9. Of course, in practice, a typical mobile telecommunications network 9 will have many thousands of subscribers, each with one or more terminals.

25 Each of the mobile terminals 1,3,5,7 is provided with a respective subscriber identity module (SIM). During the manufacturing process of each SIM authentication information is stored thereon under control of the network 9. The network 9 itself stores details of each of the SIMs issued under its control. In operation of the network 9, a mobile terminal is authenticated (for example,
30 when the user activates the terminal in the network with a view to making and

receiving calls) by the network sending a challenge to the mobile terminal. The received challenge is passed to the SIM associated with the mobile terminal and the SIM calculates a reply (dependent on predetermined information held on the SIM - typically an authentication algorithm and a unique key K_i) and
5 transmits it back to the network 9. The network receives the reply from the mobile terminal. Using information pre-stored concerning the content of the relevant SIM and the nature of the challenge sent to the mobile terminal, the network calculates the expected value of the reply from the mobile terminal. If the reply received matches the expected calculated reply, the SIM and the
10 associated mobile terminal are considered to be authenticated.

A mobile terminal in accordance with an embodiment of the invention is shown in Figure 2. In a conventional manner the mobile terminal includes a visual display 11, various buttons and keys 13 and an antenna 15 for communication
15 with the radio access network of the mobile telecommunications network 9. The mobile terminal also includes a microphone 17 for sensing audio input such as speech and a loudspeaker 19 for generating an audio output. The visual display 11 may provide a user interface such as a graphical user interface to facilitate access to functions provided by the mobile terminal and may also
20 display messages received by the mobile terminal - such as alphanumeric text and pictures (moving or still). The mobile terminal also of course includes data processing circuitry (not shown) for allowing the user of the mobile terminal to control the terminal and for allowing wireless communications with the mobile telecommunications network 9. The features of the mobile terminal described
25 thus far are conventional.

According to the embodiment the mobile terminal is provided with a motion sensor 21, such as a micro-accelerometer for detecting movement of the mobile terminal. A pressure sensor 23, such as a piezoelectric strip, is also provided
30 for detecting, for example, squeezing, hitting and/or stroking of the mobile

terminal. The sensors 21 and 23 allow the terminal to sense movement and pressure - for example caused by the user of the mobile terminal shaking the terminal or squeezing the terminal. The mobile terminal may be provided with an elastically deformable outer casing and may be configured to allow the outer casing to be resiliently compressed (for example, by squeezing) such that this is sensed by the pressure sensor 23.

Other sensors may also be provided that allow the mobile terminal to sense touch inputs (that is, inputs that would stimulate the human sense of touch). For example, the mobile terminal may also be provided with a temperature sensor.

The sensors 21 and 23 generate electrical signals in response to a touch input. These are detected by processing circuitry of the mobile terminal and may be stored or converted into a format suitable for transmission in the message to the mobile telecommunications network 9 and onwardly to another mobile terminal. The generation and transmission of such messages will be discussed further below.

In addition to providing sensors for receiving and recording a touch input, the mobile terminal also includes devices for generating a touch output (that is, devices that provide a stimulus to the human sense of touch). Motion output is created using a movement enabler 25 such as an electromagnetic device. Heat is generated using a heating element 27. Additionally, a pressure generation mechanism 26 may be provided for flexing (expanding/contracting) the resiliently deformable case of the mobile terminal. These output types all stimulate the human sense of touch.

If the user of mobile terminal 1 wishes to communicate with the user of mobile terminal 3 using the mobile telecommunications network 9, data relating to the

communication is routed wirelessly between mobile terminal 1 and the local BTS 29. From there the communication data is transmitted to the BSC 31 and to MSC 33 via a fixed or cable link. The mobile telecommunications network core 35 then routes the communication to an appropriate MSC 37 with which the mobile terminal 3 is registered. The communication data is transmitted from MSC 37 to the appropriate BSC 39, and from there to BTS 41. The communication data is transmitted from the BTS 41 wirelessly to the mobile terminal 3.

10 The communication data may be data representative of the users' voices in a conventional circuit switched voice call. The communication data may also be transmitted during a (packet switched) communication session between the mobile terminal 1 and the mobile terminal 3.

15 To efficiently facilitate such communication sessions, the third generation partnership project (3GPP) has recently defined a new concept known as IMS (IP-based multimedia subsystem). The aim of IMS is to allow users such as mobile telephone network operators to provide services to their subscribers as efficiently and effectively as possible. For example, the IMS architecture is likely to support the following communication types: voice, video, instant
20 messaging, "presence" (a user's availability for contact), location-based services, email and web. Further communication types are likely to be added in the future. This diverse collection of communication devices requires efficient communication session management due to the number of different
25 applications and services that will be developed to support these communication types. The 3GPP have chosen session initiation protocol (SIP) for managing these sessions.

SIP protocol is a session-based protocol designed to establish IP based
30 communication sessions between two or more points or users. Once the SIP

session has been established, communication between these end points or users can be carried out using a variety of different protocols (for example, those designed for streaming audio and video). These protocols are defined in the SIP session initiation messages.

5

With IMS, users are no longer restricted to a separate voice call or data session. Sessions can be established between mobile terminals that allow a variety of communication types to be used and media to be exchanged. The sessions are dynamic in nature in that they can be adapted to meet the needs of the end users. For example, two users might start a session with an exchange of instant messages and then decide that they wish to change to a voice call, possibly with video. This is all possible within the IMS framework. If a user wishes to send a file to another user and the users already have a session established between each other (for example, a voice session), the session can be redefined to allow data file exchange to take place. This session redefinition is transparent to the end user.

10
15

One application of IMS is push-to-talk over cellular (PoC). PoC allows a communication session to be established between a group of devices such that the user of one of the devices can speak and the users of the or each of the other devices will hear that person speak. During such communication session each device functions like a two-way radio or walkie-talkie in a one-to-one or one-to-many group mode. Full duplex speech communication between the users of the respective devices during the PoC part of the communication is not possible - only one user can speak at a time.

20
25

One feature of PoC is that, when the communication is established, there is an "always on" communication in between the terminals. When a user wishes to talk to the or each of the other terminals associated with the communication session, the user issues an appropriate instruction to their device (typically

30

using a soft key - that is, a key whose function is programmable), and the user's speech is captured by their terminal instantly, or within a relatively short mode of time, is transmitted to the or each of the other terminals and is reproduced on those terminals. There is no requirement for the user inputting the speech data to dial the or each other device, and nor is there any requirement for the users of the devices receiving the speech to take any action to receive the speech data - it is automatically reproduced by the device when it is received (assuming, of course, the device is operating in an appropriate mode for allowing PoC communication).

10

PoC is described in the document "Push-to-talk over Cellular (PoC) - architecture, draft version 1.0 - 13th February 2004" available from the Open Mobile Alliance Limited (OMA).

15 In addition to establishing a PoC communication session using IMS, a PoC communication session could be established over existing GSM/GPRS networks by the exchange of data packets but without IMS.

In the embodiment of the present invention, the touch input of mobile terminal 20 1 is sensed by sensors 21 and/or 23 and a signal representative thereof is generated by the mobile terminal 1. In accordance with a feature of the present embodiment, this touch input is used as a means of communicating with the user of mobile terminal 3. The signal derived from the sensors 21 and/or 23 is encoded and transmitted to the network core 35 via BTS 29, BSC 31 and MSC 25 33. In the network core 35 a translation server 43 is provided which receives the encoded signal and generates a suitable output message representative of the encoded signal. The output message is transmitted to the mobile terminal 3 via MSC 37, BSC 39 and BTS 41.

The data communicated between the mobile terminal 1 and the mobile terminal 3 may be transmitted by any suitable means. The data may be transmitted in the circuit switched domain, but is preferably transmitted in the packet switched domain. The data may be transmitted as GPRS data, as an SMS message or an MMS message. The data may also be transmitted during a IMS communication session (controlled by SIP) between the mobile terminals 1 and 3 (and possibly other mobile terminals). The data may be transmitted as part of a PoC communication session, so that when the message is received by the mobile terminal 3 an appropriate output is generated (preferably immediately) without requiring any action of the user of the mobile terminal 3. In this regard, although PoC relates to push-to-"talk", in fact any type of data can be communicated during such a session.

In a first example, it will be assumed that both mobile terminal 1 and mobile terminal 3 include the features of the mobile terminal shown in Figure 2. In mobile terminal 1 the touch input signals generated as a result of pressure, movement or heating of the mobile terminal 1 have the electrical signals generated thereby recorded and stored by their mobile terminal 1. How the signals received from the sensors vary with respect to time is recorded. For example, the variation in pressure applied to pressure sensor 23 may be recorded for a predetermined period of, for example, one, two, or five seconds (or of any other duration). Simultaneously, or during a different time period, the signals generated by the movement sensor 21 may be recorded and stored. The data processor of the mobile terminal 1 then encodes the signals in a suitable format such that their data content can be extracted by a receiving device. Typically, the data will be encoded as binary data. Suitable methods for encoding such data will be known to those skilled in the art and will not be described further here.

A communication session (for example, a IMS, SIP controlled, communication session) between mobile terminal 1 and mobile terminal 3 is then initiated in a known manner if not already established. The encoded data is transmitted to the network core 35, where it is passed to translation server 43. In this example
5 the translation server 43 need not take any action because the mobile terminals 1 and 3 are the same type of mobile terminal. The translation server 43 then issues a message comprising the encoded data to the mobile terminal 3. On receipt of the message the mobile terminal 3 decodes the message and applies appropriate electrical signals to movement enabler 25, pressure generation
10 mechanism 26 and any other touch output devices provided. The touch output or outputs generated by the mobile terminal 3 will, if the user is in contact with mobile terminal 3, stimulate the touch sense of the user. The touch output is an approximation of the touch input to mobile terminal 1. For example, the squeezing of mobile terminal 1 will temporarily change the shape of its casing.
15 The touch output of the mobile terminal 3 will cause a corresponding temporary change in the shape of the terminal 3. The users of mobile terminals 1 and 3 can therefore communicate with each other using the sense of touch.

If the user of mobile terminal 3 does not have a mobile terminal of the type
20 illustrated in Figure 2, or at least has a mobile terminal of a different type to the mobile terminal 1, the translation server 43 is operative to process the encoded data received from the mobile terminal 1 to convert it into a suitable message for reproduction by the mobile terminal 3. For example, the user of mobile terminal 3 may not have a movement enabler 25. In such an instance, the
25 translation server may generate the message such that the output produced by the mobile terminal 3 is an audible and/or visible output. That is, data encoded from the motion sensor 21 and/or pressure sensor 23 is detected by the translation server 43 and is converted into an encoded signal for generating a different type of output from the sensed input.

30

For example, the encoded signals representing the touch input sensed by the motion sensor 21 and the pressure sensor 23 may be analysed by the translation server 43, where it is determined that these signals are indicative of the user of mobile terminal 1 stroking the mobile terminal. The translation server 43 then
5 accesses a look-up table to determine to which type of output this type of input should be mapped. In this example, it is indicated that the output should be mapped to a simulated voice output generating an "ooh" sound. Similarly, if the translation server determines that the signals input to the movement sensor 21 and pressure sensor 23 are indicative of the mobile terminal 1 being
10 squeezed by the user, the look-up table may indicate that the appropriate output is an audio voice simulation output generating the sound "aaah". Further, if it is determined from the sensors 21,23 that the mobile terminal has been shaken, the look-up table may indicate that the appropriate output is the signal to cause the display 11 of the mobile terminal 3 to have a red colour. Furthermore, if
15 the signals derived from the sensor 21,23 indicate that the mobile terminal has been dropped, the appropriate output message may be a signal to cause the display to flash between red and blue colours.

It should of course be understood that these are merely examples of the
20 translation of types of input to types of output. The output may stimulate more than one sense - for example, the output may produce both an audible and a visual stimulus to the user of mobile terminal 3, or a visual output and a touch output.

25 The mapping of the inputs of mobile terminal 1 to the appropriate output of mobile terminal 3 may be predetermined or preset by the mobile terminal 1, the mobile terminal 3 or the network 9. The mapping may depend upon the functionality of the mobile terminal 1 and/or the mobile terminal 3 - for example, whether the terminal has the facility to detect and/or reproduce
30 movement. The type of message that needs to be generated by the translation

server 43 to cause the receiving mobile terminal 3 to produce the desired output type may depend upon the particular type of mobile terminal 3, and this information may be obtained from the look-up table. If the mobile terminal 3 has a standard operating system, this may not be necessary.


5




As indicated above, the mapping of particular input stimuli to output stimuli may be predetermined or pre-set. The user of mobile terminal and/or the user of mobile terminal 3 may be able to select which input stimuli are mapped to which output stimuli, for example by appropriate data communication with the translation server 43. For example, the users of mobile terminals 1 and 3 may agree a particular form of communication between themselves. For example, the users may agree that the sensed squeezing of the mobile terminal 1 by pressure sensor 23 will cause heat generation by heating element 27 in mobile terminal 3. This allows the user of mobile terminals 1 and 3 to communicate in a manner that will not disturb others around them and which is only understandable to the users. Even if the heat output at the mobile terminal 3 was detected by the person other than the authorised user of mobile terminal 3, that person would not know what the generation of heat signified. If desired, this allows communications between the users of the mobile terminals 1 and 3 that have an element of secrecy.

20

The table below shows the entries of the look-up table stored in the translation server 43 in relation to the mobile terminal 1, indicating the appropriate output to receiving mobile terminals A,B,C and D, depending upon the input from mobile terminal 1.

25

Mobile terminal 1				
Input	Output of Mobile terminal A	Output of Mobile terminal B	Output of Mobile terminal C	Output of Mobile terminal D
Vertical stroke	Simulation of vertical stroke	Audio: "ooh"	Vibration	MMS image: 

Squeeze	Simulation of Squeeze	Audio: "aaah"	Heat generation	MMS image: 
Shake	Simulation of Shake	Display colour to red	Audio: "John is fine"	MMS image: 
Drop	Simulation of Drop	Display flashes red/blue	Audio: "John is cross"	MMS image: 

The mapping of particular input stimuli to output stimuli between any pair of mobile terminals may be set by the users of those terminals, or may be preset in dependence upon the input and output facilities of those terminals.

5

The mapping may also be set or altered by a third party - i.e. not the mobile terminals or the network. For example, mapping data may be obtained from a website and passed to the translation server 43. Such a website may, by way of illustration, be for users interested in massage. Details of the type of mobile terminals 1 and 3 may be provided to the website. The website may then provide for downloading suitable mapping coding that allows the user of mobile terminal 1 to cause the mobile terminal 3 to produce a touch output for performing a particular type of massage. The user of the mobile terminal 1 may do this by providing as an input a particular touch input, alphanumeric character or sound. The website may download a menu for providing a user interface for the user of mobile terminal 1 that provides a convenient mechanism for the desired touch output for mobile terminal 3 to be selected.

As an alternative, or in addition to, the translation server 43 being provided by the network core 35, the mobile terminal 1 may be provided with a data processing function that generates an appropriately formatted message that produces the desired output stimuli on the mobile terminal 3 when transmitted to that mobile terminal 3 without modification. Alternatively, the receiving mobile terminal 3 may receive encoded signals from the sensors 21 and/or 23 of the sending mobile terminal and may include a data processing function for converting those received data to an appropriate message to generate the

desired output stimuli on the mobile terminal 3. These data processing functions may require a considerable amount of processing power, and at present it is preferred that these are performed by the network core 35, rather than the mobile terminals 1 and 3.

5

It should be understood that an output corresponding to the input stimuli of the mobile terminal 1 may be transmitted (possibly simultaneously) to a plurality of receiving terminals. The output stimuli generated by each of the receiving terminals may be different, in dependence upon the data in the relevant part of the look-up table accessed by the translation server 43 in respect of the receiving terminal and/or upon the output facilities of the receiving mobile terminal.

The touch output generated by the receiving mobile terminal may be in addition to conventional forms of visual and/audio output. During a single communication session (such as an IMS SIP controlled communication session), voice data, other audio data, picture data and touch data may be transmitted, providing an enriched communications experience between the users of mobile terminals 1 and 3.

20

CLAIMS

1. A mobile telecommunications network including a plurality of terminals registered with the network, wherein a first of said terminals includes means for
5 sensing the variation of a touch input with respect to time and generating a signal representative thereof; and including means for generating a message representative of said signal; and means for transmitting the message to a second of said terminals for generating an output in response to the message that is indicative of the touch input.
10
2. The network of claim 1, wherein the message is generated by a data processor of the first terminal.
3. The network of claim 1, wherein the message is generated by a data
15 processor of an entity separate from the first terminal.
4. The network of claim 1, wherein the message is generated by a data processor associated with the mobile telecommunications network.
- 20 5. The network of claim 1, wherein the output is generated by a data processor of the second terminal.

6. The network of any one of claims 1 to 5, wherein the output is a simulation or approximation of the touch input.

7. The network of any one of claims 1 to 5, wherein the output is indicative
5 of the touch input but is an audible and/or visible output.

8. The network of any one of claims 1 to 7, including means for mapping selected inputs to generate selected outputs to provide a predetermined relationship therebetween.

10

9. The network of claim 8, wherein said mapping is determined by the first terminal.

10. The network of claim 8, wherein said mapping is determined by the
15 second terminal.

11. The network of claim 8, wherein said mapping is determined by the mobile telecommunications network.

20 12. The network of claim 8, wherein said mapping is determined by a third party entity, separate from said terminals and the mobile telecommunications network.

13. The network of any one of claims 1 to 12, wherein the sensing means includes a motion sensor.
14. The network of claim 13, wherein the motion sensor includes a micro-
5 accelerometer.
15. The network of any one of claims 1 to 14, wherein the sensing means includes a pressure sensor.
- 10 16. The network of claim 15, wherein the pressure sensor includes a piezoelectric device.
17. The network of any one of claims 1 to 16, wherein the network comprises a GSM mobile telecommunications network.
- 15 18. The network of any one of claims 1 to 16, wherein the network comprises a UMTS (3G) mobile telecommunications network.
19. The network of any one of claims 1 to 18, wherein the network
20 comprises a GPRS mobile telecommunications network.
20. The network of any one of claims 1 to 19, wherein the message is transmitted in a push-to-talk over cellular (PoC) communication session.

21. The network of any one of claims 1 to 20, wherein the message is transmitted in a session initiation protocol (SIP) session.

5 22. The network of any one of claims 1 to 19, wherein the message is an SMS message.

23. The network of any one of claims 1 to 19, wherein the message is an MMS message.

10

24. A mobile telecommunications network, including means for receiving a message from a first terminal for delivery to a second terminal and for converting the message between a first type to a second type, wherein at least the first type of message includes data enabling the reproduction of an output
15 by a terminal which output is detectable by the sense of touch and varies with respect to time in dependence upon the content of the message.

25. The network of claim 24 wherein the second type of message includes data enabling the production of an output by a terminal detectable by the sense
20 of touch.

26. The network of claim 24, wherein the second type of message includes data enabling the production of an audible output.

27. The network of claim 24, wherein the second type of message includes data enabling the production of a visible output by a terminal.

5 28. A terminal for use with a mobile telecommunications network, the terminal including means for sensing a variation of a touch input with respect to time and generating a signal representative thereof, a representation of which is for inclusion in a message for transmission to another terminal for generating an output in response to the message that is indicative of the touch input.

10

29. A terminal for use with a mobile telecommunications network, the terminal including means for receiving a message representative of an input signal generated by another terminal, means for generating an output detectable by the sense of touch and which varies with respect to time in dependence upon
15 the content of the message.

30. A method of operating a mobile telecommunications network having a plurality of terminals, the method including generating at a first of said terminals a signal representative of how a touch input varies with respect to
20 time, generating a message representative of the signal, transmitting the message to a second of said terminals, and generating an output at the said second terminal in response to the message that is indicative of the touch input.

31. The method of claim 30, including generating the message at the first terminal.
32. The method of claim 30, including generating the message using a data processor associated with the mobile telecommunications network.
33. The method of claim 30, 31 or 32, wherein the output is a simulation or approximation of the touch input.
34. The method of claim 30, 31,32 or 33, wherein the output is indicative of the touch input but is an audible and/or visible output.
35. The method of any one of claims 30 to 34, including receiving said signal representative of how a touch input varies with respect to time, generating said message such that said output is produced for stimulating a selected human sense.
36. The method of any one of claims 30 to 35, including transmitting the message in a push-to-talk over cellular (PoC) communication session.
37. The method of any one of claims 30 to 35, including transmitting the message in a session initiation protocol (SIP) communication session.

38. The method of any one of claims 30 to 35, including transmitting the message as an SMS message.

39. The method of any one of claims 30 to 35, including transmitting the
5 message as an MMS message.

40. The method of any one of claims 30 to 39, wherein the mobile telecommunications network comprises a GSM, GPRS or UMTS (3G) mobile telecommunications network.

10

41. A mobile telecommunication network including means for generating a message containing information for use by the user of a terminal, means for transmitting the message to said mobile terminal, and means for conveying the information to the user of said mobile terminal by stimulating the user's sense
15 of touch.

42. A mobile telecommunications network substantially as hereinbefore described with reference to and/or substantially as illustrated in any one of or any combination of the accompanying drawings.

20

43. A terminal for use with a mobile telecommunications network, substantially as hereinbefore described with reference to and/or substantially as illustrated in any one of or any combination of the accompanying drawings.

44. A method of operating a mobile telecommunications network, substantially as hereinbefore described with reference to and/or substantially as illustrated in any one of or any combination of the accompanying drawings.

5



INVESTOR IN PEOPLE

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25

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Documents considered to be relevant:

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X	1 & 28 at least	GB 2308523 A (NORTHERN TELECOM LTD) Abstract, figure 3 - 7.
X	28 at least	US 2003/064686 A1 (PHILIPS) see the figures and paragraph 0013
X	28 at least	US 2002/180698 A1 (KAELBLING) see abstract and paragraph 0028
A	-	WO 03/051062 A2 (IMMERSION CORP) Abstract, text e.g. page 3, line 4 - page 4, line 14, page 6, line 17 - page 7, line 14 and page 7, line 29 - page 8, line 33. Figure 1 - 4.
A	-	WO 04/053670 A2 (IMMERSION CORP ET AL.) Abstract, text e.g. page 3, line 24 - page 4, line 34, page 9 line 23 - page 11, line 24. Figure 1 - 6.
A	-	“Mobiles get a sense of touch” BBC News, 21th January 2003. Downloaded from http://news.bbc.co.uk/1/hi/technology/2677813.stm Whole document.

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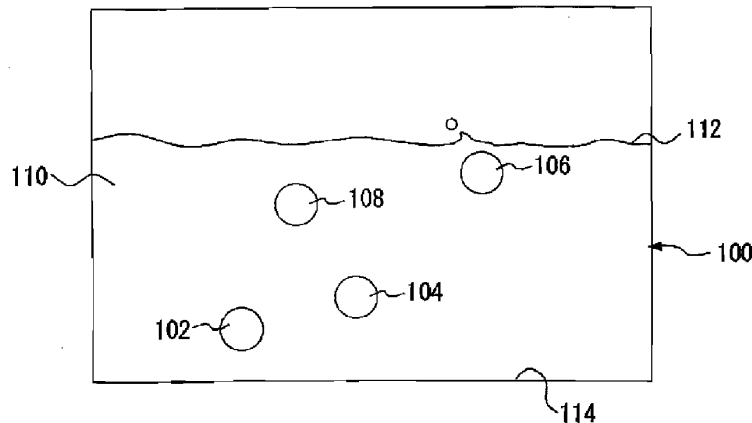
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- (71) Applicant: SONY COMPUTER ENTERTAINMENT
INC. [JP/JP]; 2-6-21, Minami-Aoyama, Minato-ku, Tokyo
107-0062 (JP).
- (72) Inventor: WADA, Shinya; c/o SONY COMPUTER
ENTERTAINMENT INC., 2-6-21, Minami-Aoyama,
Minato-ku, Tokyo 107-0062 (JP).
- (74) Agent: MORISHITA, Sakaki; 2-11-12, Ebisu-Nishi,
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(54) Title: METHOD AND APPARATUS FOR PROCESSING FILES UTILIZING A CONCEPT OF WEIGHT SO AS TO VISUALLY REPRESENT THE FILES IN TERMS OF WHETHER THE WEIGHT THEREOF IS HEAVY OR LIGHT



(57) Abstract: On a screen a file processing apparatus displays values of an attribute related to a plurality of files using a concept of weight. The weight of each file is represented by spherical objects submerged into the water and displayed on the screen. For example, a first spherical object represents a file whose data size is large, and is sunk near bottom. And a second spherical object represents a file whose data size is light and is floating near the water surface.

WO 2004/044728 A2

DESCRIPTION

METHOD AND APPARATUS FOR PROCESSING FILES UTILIZING A
CONCEPT OF WEIGHT SO AS TO VISUALLY REPRESENT THE FILES IN
5 TERMS OF WHETHER THE WEIGHT THEREOF IS HEAVY OR LIGHT

TECHNICAL FIELD

The present invention relates to method and apparatus
for processing files, and it particularly relates to a
10 technology for managing or organizing a plurality of files
on the computer.

BACKGROUND TECHNOLOGY

The rapid spread of personal computers (hereinafter
15 referred to as PCs) has now slowed down, and the current
trend is the marked versatility of functions in hardware
such as PDAs (Personal Digital Assistants), portable
telephones and game machines. For example, PDAs, which are
equipped with wireless communication functions, can now use
20 networks no matter where they are. Moreover, advances in
high-definition display screen and CPU processing capacity
have made it easier for such hardware to carry out high-load
processing, such as moving picture processing which has so
far been only possible on a PC. Similarly, portable
25 telephones are increasingly multi-functional with camera
function, moving picture function, game function and the

like.

The functions of game machines are being extended by the addition of network function, hard disk and the like. And the external connection terminals employed for them are now of the types similar to those on a PC, thus ensuring their newly-added multiple usage and flexibility. This way, the barriers that used to exist between such hardware and PCs are being steadily removed, and such hardware's increasingly high graphic processing capabilities, in particular, are now even threatening the position of PCs.

As a variety of electronic devices grow more and more multi-functional, their increased flexibility is attracting and bringing in more users of their own. Moreover, the concepts of files and folders as seen in the file system, which used to be characteristic of PCs only, are now being introduced to the users of electronic equipment other than PCs as well.

However, some intrinsic limitations of such hardware in the electronic equipment other than PCs still persist. For example, the small size of the screen or the simplicity of control devices can pose visual and operational restrictions. Thus, if the display and control interfaces currently employed for PCs are to be pursued, then it may lead to a reduced accessibility to such hardware. Therefore, it is essential to develop interfaces using their own expression if the potential abilities for a

variety of electronic equipment is to be fully exploited.

DISCLOSURE OF THE INVENTION

5 The present invention has been made in view of the foregoing circumstances and an object thereof is to realize a display that ensures easier visual grasp of the characteristics of data.

 A preferred embodiment according to the present
10 invention relates to a file processing apparatus. This apparatus includes: an attribute input unit which acquires a value of an attribute for at least one file in order to represent a value of a predetermined attribute for an intended file by using a concept of weight; a comparison
15 processing unit which compares the value of an attribute with a reference value; a position determining unit which sets, based on a result obtained from the comparison processing unit, a relative display position of a predetermined object that represents symbolically the
20 weight; and a display processing unit which visually represents the value of the attribute in terms of whether the weight is heavy or light, by displaying the object at the display position on a screen set by the position determining unit.

25 Here a "file" mainly means a program or a collection of data visualized by an icon on a screen. It may also mean

a hierarchy, such as a folder or directory, visualized by an icon in a hierarchical file system or an offshoot document related to the body of a reference target, such as a so-called shortcut or alias visualized by an icon. A file may have a file name which includes an extension at the end. A file may also be a text file containing character data or a binary file containing binary data. An "attribute" may be a characteristic of a file or a parameter used as a reference for comparison with another file, which may include the date of file preparation or updating, the data size, the importance of each file to be set by the user, the type of file to be determined by data format or file usage, the number of files contained in a folder or the number of folders, and the count or frequency of file updating. An "attribute" may also be a parameter showing the level of a character to be controlled by the user in game software. A "values to be used as reference" may be the value of an attribute related to another file or the value showing the unused capacity of the storage area of a storage.

An "object" may symbolize a file or a folder or may collectively stand for a plurality of files or a plurality of folders. An object may be displayed on the screen as an image of a tangible object with a mass in the real world, such as a "sphere", a "particle" or a "weight", or in the form of an icon. For example, a "sphere" may be able to symbolize the weight of a thing because it may fall under

its own weight or the force of gravity and may bounce on the ground or, if thrown into the water, may sink or float up. A scene of measuring the weight of things may be represented by an object like a weight and scale.

5 A file processing apparatus according to the present embodiment may be realized as an electronic equipment, such as a PC, a PDA, a game machine or a portable telephone. Recently, electronic equipment other than PCs can even use file systems primarily designed for PCs. However, PDAs or
10 portable telephones, whose screens are small, or game machines, which are used away from the TV screen, often present much poorer visibility of characters than PCs. Hence, if a file name and the attributes of a file are displayed simply as a character string on the screen, the
15 user may find it difficult to read them when selecting a desired file. This may also develop into some operational difficulties. Moreover, if a large number of files are to be displayed on a small screen, there will be little space left for displaying information on attributes.

20 In this embodiment, visual limitations are reduced by displaying attributes of a file not through the use of characters but in a form that helps the user's intuitive grasp. Further, operational limitations are also reduced by simplifying the contents of display. Moreover, a new
25 operation method may be presented by incorporating a tilt sensor in the whole or a part of this apparatus.

Another preferred embodiment according to the present invention relates to a method of processing files. This method includes: setting a relative display position of a predetermined object that symbolically represents the files
5 in terms of whether the weight thereof is heavy or light, based on a value of a predetermined attribute for an intended file, in order to represent the value of a predetermined attribute therefor by using a concept of weight; and representing visually the weight by displaying
10 the object at the relative display position on a screen.

Still another preferred embodiment according to the present invention relates also to a method of processing files. This method includes: acquiring values of a predetermined attribute for a plurality of intended files in
15 order to represent the values of a predetermined attribute therefor by using a concept of weight; setting, for each of the plurality of files, a relative display position of a predetermined object that represents symbolically the files in terms of whether the weight thereof is heavy or light,
20 based on the values of a predetermined attribute; and displaying the objects of the plurality of files at the respective display positions on a screen, and expressing visually comparison of the weights of the objects via another object that symbolizes weight measurement.

25 "Another object that symbolizes weight measurement" is a character that is used to display on the screen a

comparison of weights between files or a measurement of a total weight of a plurality of files. Such an object used for instance is a weighing device, measuring device, balance, balloon or the like which is used for measurement in the
5 real world.

Still another preferred embodiment according to the present invention relates also to a method of processing files. This method includes: acquiring values of a predetermined attribute for a plurality of files, in order
10 to represent the values of a predetermined attribute for intended files by using a concept of weight; setting a temporary sequence for the plurality of files; determining, based on the temporary sequence, a temporary display position of a predetermined object that symbolically
15 represents the files in terms of whether the weight thereof is heavy or light; displaying an object that corresponds to the plurality of files, at the temporary display position on a screen; comparing the values of a predetermined attribute between adjacent files in the temporary sequence; updating
20 the display position based on a comparison result obtained from the comparing; and representing visually the weight thereof by varying display contents according to the updating.

A "temporary sequence" may be a temporary order of
25 arrangement for convenience' sake, for instance, when displaying on the screen a plurality of files designated by

the user. It may simply be a specified sequence, a random sequence or any other sequence decided irrespective of the sizes of values of an attribute. "Temporary display positions" are temporary positions of display on the screen for instance when the user has designated a plurality of files. A state in which objects are displayed in the specified positions is still an initial display state, and the values of an attribute using the concept of weight are not yet represented.

10 "Adjacent files" are not necessarily strictly adjacent to each other in their sequence. It suffices if the files are located close to each other in an initial display state and the values of their attribute can be compared with each other. As a result of the comparison, the display position of the object for a file whose value is determined larger may be moved downward, or that of the object for file whose value is determined smaller may be moved upward. In this manner, the values of an attribute may be represented for easier visual confirmation by displaying on the screen the process of sorting a plurality of files according to the values of the attribute.

It is to be noted that any arbitrary combination of the above-described structural components and expressions changed between a method, an apparatus, a system, a computer program, a recording medium having stored computer programs therein, a data structure and so forth are all effective as

and encompassed by the present embodiments.

Moreover, this summary of the invention does not necessarily describe all necessary features so that the invention may also be sub-combination of these described
5 features.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 shows a screen representing values of an
10 attribute related to a plurality of files using a concept of weight according to a first embodiment of the present invention.

FIG. 2 is a block diagram showing functions of a file processing apparatus according to the first embodiment.

15 FIG. 3 shows a screen displaying objects corresponding to folders.

FIG. 4 shows how objects move from their initial display position to display positions corresponding to their attribute values.

20 FIG. 5 is a flowchart showing a basic processing flow from folder display to file display in a file processing apparatus.

FIG. 6 illustrates a scene in which the attributes of files to be represented by a concept of weight are switched
25 according to a second embodiment of the present invention.

FIG. 7 is a flowchart showing a process of switching

attributes to be displayed on a screen.

FIG. 8 shows an appearance of a PDA in a third embodiment of the present invention.

FIG. 9A shows a state in which a whole PDA is inclined.

5 FIG. 9B shows a state in which a whole PDA is inclined.

FIG. 10 is a functional block diagram of a file processing apparatus according to a third embodiment of the present invention.

FIG. 11 is a flowchart showing a process of changing 10 display contents according to the inclination of a PDA.

FIG. 12 shows a screen representing attribute values using an object which is a balance, according to a fourth embodiment of the present invention.

FIG. 13 is a flowchart showing a process of comparing 15 the sums of data sizes of a plurality of files or folders between themselves.

FIG. 14 shows a dialogue screen from which a user instructs a check on free capacity.

FIG. 15 shows a screen for using a "balance" object to 20 confirm whether free capacity can hold the downloaded files or not.

FIG. 16 shows a screen using a "balloon" object.

FIG. 17 shows a screen display visually representing attribute values by the appearance and display positions of 25 suspension weigher and spherical objects according to a fifth embodiment of the present invention.

FIG. 18 is a flowchart showing a process of measuring the sum of data sizes of a plurality of files or folders.

FIG. 19 shows a screen display visually representing attribute values by a box and "particle" objects.

5 FIG. 20 shows a display state where a plurality of particles are placed in a box at random positions.

FIG. 21 is a flowchart showing a process of classifying a plurality of files as detailed step of S16 and S30 of FIG. 5.

10 FIG. 22 is a functional block diagram showing a structure of a file processing apparatus according to a seventh embodiment of the present invention.

FIG. 23 is a flowchart showing a process of moving objects, which are a plurality of particles placed in a box,
15 according to attribute values.

FIG. 24 illustrates swaying motions of a PDA in an eighth embodiment of the present invention.

FIG. 25 is a functional block diagram showing a structure of a file processing apparatus according to an
20 eighth embodiment of the present invention.

FIG. 26 is a flowchart showing a process of moving objects, which are a plurality of particles placed in a box, by swaying the whole body of a PDA.

25

BEST MODE FOR CARRYING OUT THE INVENTION

The invention will now be described based on the following embodiments which do not intend to limit the scope of the present invention but exemplify the invention. All of the features and the combinations thereof described in 5 the embodiments are not necessarily essential to the invention.

First embodiment

In a first embodiment of the present invention, a plurality of files or folders to be managed by a file system 10 are represented by such object forms as spheres or cubes and at the same time the values of an attribute attendant on those files or folders are represented by the weights of those objects. In the real world, where gravitational, buoyant and other forces work, things change their positions 15 according to their "weight", which is their mass. In other words, the weight of a thing surfaces in the form of a variation in its position. Utilizing this characteristic, the sizes of values of an attribute related to files or folders are visually represented on the screen. In an 20 actual processing, objects corresponding to the files or folders are displayed in positions corresponding to the values of the attribute. As a result, the values of the attribute can be grasped by the positions where the objects are displayed.

25 FIG. 1 shows a screen representing the values of an attribute related to a plurality of files using a concept of

weight according to the first embodiment. On a screen 100, a plurality of files are displayed as spherical objects. First to fourth spheres 102, 104, 106 and 108 not only represent their respective files but also have the weight
5 corresponding to the data size of their respective files. The first to fourth spheres 102, 104, 106 and 108 are displayed in the water 110.

The first to fourth spheres 102, 104, 106 and 108 are displayed in their relative positions corresponding to their
10 respective weights. For example, the first sphere 102, which is the heaviest, is suspended in the water near the water bottom 114. Conversely, the third sphere 106, which is the lightest, is floating near the water surface 112. The metaphoric relationship of the larger the file size, the
15 heavier the object is conceptually acceptable, and the user can recognize at a glance, without any particular assistance, that a file suspended deeper in the water is of a larger file size.

FIG. 2 is a block diagram showing functions of a file
20 processing apparatus according to the first embodiment. In terms of hardware, the file processing apparatus can be realized by a CPU and other elements of a computer. In terms of software, it can be realized by programs having file managing and display processing functions, but drawn
25 and described in FIG. 2 are function blocks that are realized in cooperation with those. Thus, it is understood

by those skilled in the art that these functional blocks can be realized in a variety of forms by hardware only, software only or the combination thereof.

The file processing apparatus 10 includes a file
5 storage 12 for storing a plurality of files and folders, an attribute input unit 14 for receiving attribute values of files, a comparison processing unit 16 for comparing the attribute values, and an instruction receiving unit 18 for receiving instructions from a user. The file storage 12 may
10 be constituted by an auxiliary storage, such as a hard disk on which a plurality of files or folders are stored under the management of a file system or a memory device, such as a detachable non-volatile memory.

The attribute input unit 14 receives attribute values
15 of files or folders selected by the user from the file storage 12 or a node of a network. In this first embodiment, data sizes of selected files are received. The comparison processing unit 16 compares the data size of the selected file with a reference value. The reference value may be a
20 predetermined numerical value corresponding to the water surface 112 or the bottom 114 of the water shown in FIG. 1. For example, the data size corresponding to the water surface 112 may be set to zero bytes, and the data size corresponding to the water bottom 114 may be set to the
25 maximum data size of the files held in the file storage 12. Suppose that the maximum data size is 10 MB and the data

size of a selected file is 5MB, then the file is displayed in a middle position between the water surface 112 and the bottom 114 of the water. When a plurality of files are to be selected, the data size of any one of them may be set as
5 the reference value.

The file processing apparatus 10 further includes an output processing unit 20 for generating images and audio and an object storage 25 for storing image data or three-dimensional data of each object. To be connected to the
10 file processing apparatus 10 are a monitor 32 for displaying images on the screen and a speaker 34 for outputting audio. The object storage 25 may be formed integrally by a single storage unit that also serves as the file storage 12. The output processing unit 20 includes a position determining
15 unit 22 for setting the display positions of objects, a display processing unit 24 for outputting images to the monitor 32, an audio generator 28 for outputting audio to the speaker 34, and an effect generator 26 for changing images or audio.

20 The position determining unit 22 sets a relative display position of an object for a file selected by the user based on the results of comparison by the comparison processing unit 16. When a plurality of files have been selected, the position determining unit 22 sets relative
25 display positions respectively for them. For example, the position of the heaviest file of the plurality of files is

set to the water bottom 114, the position of the lightest
file of the plurality of files is set to the water surface
112, and the relative positions of the other files are
determined between the water bottom 114 and the water
5 surface 112.

The display processing unit 24 acquires image data or
three-dimensional data necessary for the display of spheres
or cubes from the object storage 25 and displays them in
their relative positions set on the screen 100. The display
10 processing unit 24 displays an image of the water 110 as the
background. When a plurality of files have been selected,
the display processing unit 24 represents a comparison of
their weights by displaying the spheres in their relative
positions. To show how the spheres are adrift in the water,
15 the display processing unit 24 may move the objects up and
down and right and left in the display. In this case, the
objects are moved vertically or horizontally within a range
of a few pixels around their respective display positions
set by the position determining unit 22.

20 The instruction receiving unit 18 may receive
instructions from the user intending to change the display
positions of objects. In such a case, the effect generator
26 causes the position determining unit 22 and the display
processing unit 24 to carry out a processing to effect the
25 change to the position of the object based on the user
instructions. The instruction receiving unit 18 receives

instructions from the user via a control device, such as a mouse or keyboard of a PC or a controller of a game machine. The effect generator 26 determines an object which is to be changed, and calculates the amount of change therefor
5 according to the instructions received by the instruction receiving unit 18 and then sends the results to the position determining unit 22 and the display processing unit 24.

For example, when the user instructs that a motion of a sphere thrown into the water be displayed, the effect
10 generator 26 specifies the sphere for which the display must be changed, and the position determining unit 22 sets a range for the motion of the sphere such that a motion of the sphere dropping into the water and sinking can be displayed. And the display processing unit 24 displays images of a
15 splash, ripples and the like that may accompany such a motion. The motion contents are also conveyed from the effect generator 26 to the audio generator 28, which outputs sounds corresponding to the motion to the speaker 34. The audio generator 28 may produce sounds, using volumes and
20 tones that correspond to the weight of the sphere, namely, the data size of the file.

For example, if the user instructs that the water be stirred or a sphere be flipped, the position determining unit 22 and the display processing unit 24 will perform a
25 necessary processing to display images of the sphere being swayed up and down or right and left and the water surface

112 undulating. In this case, too, the motion contents are conveyed from the effect generator 26 to the audio generator 28, which produces necessary sounds.

FIG. 3 shows a screen displaying objects corresponding to folders. In the present embodiment, folders are represented by cubic objects to be distinguished in appearance from files represented by spheres. Displayed on a screen 100 are how first to fifth cubes 200, 202, 204, 206 and 208 are adrift in the water 110. These cubes are displayed in relative positions between the water surface 112 and the water bottom 114 corresponding to their respective attribute values. The appearances of these cubes are defined by three-dimensional data, and the display processing unit 24 displays the cubes rotating little by little so that the faces thereof change their orientation with time.

When the user selects the third cube 204 via the instruction receiving unit 18, a folder name 212 is displayed on the screen 100. Here, a character string "INBOX" is displayed as the folder name 212. Now the user gives instructions to open the third cube 204 via the instruction receiving unit 18, and the display will show the third cube 204 opening and releasing first to third spheres 102, 104 and 106 from within it. The first to third spheres 102, 104 and 106 represent the files contained in the folder represented by the third cube 204.

FIG. 4 shows how objects move from their initial display position to the display positions corresponding to their attribute values. The first to third spheres 102, 104 and 106, which have been released from the third cube 204 shown in FIG. 3, move to the relative display positions corresponding to their respective data sizes. The trajectories thereof are calculated by the position determining unit 22. When the user selects the second sphere 104 via the instruction receiving unit 18, a file name 213 is displayed on the screen 100. Here, a character string "10/10 RECEIVED MAIL" is displayed as the file name 213.

FIG. 5 is a flowchart showing a basic processing flow from folder display to file display in the file processing apparatus 10. The attribute input unit 14 refers to the whole directory in the file storage 12 (S10) and acquires an attribute value of each folder (S12). According to the present embodiment, the data size of each folder is acquired. The position determining unit 22 sets the display position of a cube for each folder according to the acquired data size (S14). The display processing unit 24 acquires object data, such as image or three-dimensional data on each cube, from the object storage 25 (S16) and displays it in the position set by the position determining unit 22 (S18).

Until the user selects any of the cubes via the instruction receiving unit 18 (S22N), the display processing

unit 24 keeps displaying the cubes while the orientation and position of the faces thereof change little by little (S20). When the user selects one of the cubes and instructs the opening thereof (S22Y), the display processing unit 24
5 displays the process of the cube releasing the spheres (S24). The attribute input unit 14 acquires the attribute value of each file contained in the folder of the opening cube (S26), and the position determining unit 22 sets the display positions of the spheres according to the attribute value of
10 each file (S28).

The display processing unit 24 acquires object data on the spheres from the object storage 25 (S30) and display them near the selected cube, which are their initial positions (S32). The position determining unit 22 generates
15 the trajectories to the set display positions and the display processing unit 24 displays the process of the spheres moving along the trajectories to the set display positions. Until the user selects any of the spheres (S36N), the spheres adrift and swaying in the water is displayed
20 (S34). The user selects one of the spheres (S36Y) and uses it in such a way as opening the file (S38).

By implementing the above structure, data sizes of files or folders are represented using a concept of weight. By presenting files and folders in a display method that
25 appeals to intuitive perception, a graphical file browser is realized.

Second embodiment

A second embodiment of the present invention has a function of switching by user instructions the attributes of files or folders which are to be represented by a concept of weight. Otherwise, the structure and functions thereof are the same as those of the first embodiment.

FIG. 6 illustrates a scene in which the attributes of files to be represented by a concept of weight are switched according to the second embodiment. On a screen 100, the user selects an attribute by pressing one of Size button 120, Date button 122, Type button 124 and Importance button 126. When selecting the data size of files or folders as the attribute as in the first embodiment, click on the Size button 120. When selecting the date and time of data preparation or updating, click on the Date button 122. When selecting the type of files or folders, click on the Type button 124. When selecting the importance of files or folders determined arbitrarily by the user, click on the Importance button 126.

FIG. 6 shows a state in which the Date button 122 has been selected. At this time, a level display 130 corresponding to the type of button selected appears on the left side of the screen 100. The level display 130 shows visually the correspondence of older dates with heavier weights and newer dates with lighter weights, so that an old

or new date of preparation may be grasped at a glance by seeing how far a sphere sinks in the water. Referring to FIG. 6, it can be easily grasped visually that a third sphere 106 is the oldest file and a fourth sphere 108 is the
5 newest file.

Similarly, when the Type button 124 has been selected, the spheres are displayed in depth positions predetermined according to the types of the files. The relationship between the types of files and the weights is indicated by
10 the level display 130. When the Importance button 126 is selected, the spheres for files with greater importance are displayed in positions of deeper submersion.

FIG. 7 is a flowchart showing a process of switching attributes to be displayed on the screen. A basic
15 processing flow in a file processing apparatus 10 according to the second embodiment is as shown in FIG. 5. FIG. 7 represents a flow to be replaced with S20 and S34 of FIG. 5. When user instructions to switch attributes are received via the instruction receiving unit 18 (S50Y), the attributes to
20 be represented by weight are switched according to the instructions (S52). The attribute input unit 14 acquires the attribute values after the switching (S54), and the position determining unit 22 updates the display positions of the objects according to the acquired values (S56).

25

Third embodiment

A file processing apparatus 10 according to a third embodiment of the present invention is a PDA. FIG. 8 shows an appearance of the PDA. On the screen of a PDA 140, too, the values of an attribute concerning files or folders are represented by the weight of spheres thrown into the water. Since the screen of a PDA is relatively small, a display of multiple character strings cannot be grasped at a glance. Thus, it helps intuitive recognition better if the attribute values for the files or folders are represented by the weights of objects rather than by character strings.

This PDA 140 has a built-in tilt sensor, and the positions of the objects change according to the inclination of the body of the PDA 140. Thus, files may be controlled by operating the PDA 140 with one hand. If the screen of the PDA 140 is an x-y plane and an axis vertical to this plane is a z-axis, then the angle between the z-axis and the horizontal plane is the inclination of the PDA 140.

FIG. 9 shows a state in which the whole PDA 140 is inclined. That is, from a state as shown in FIG. 9A, one end of the PDA 140 is inclined downward and the other end thereof upward into a state as shown in FIG. 9B. A sensor detects an angle θ between the z-axis and the horizontal plane as the inclination of the PDA 140, and when the inclination exceeds a predetermined threshold value, the spheres in the water displayed on the screen of the PDA 140 change their positions. When the inclination is in the x-

axis direction, the spheres move in the x-axis direction, and when the inclination is in the y-axis direction, they move in the y-axis direction.

Where the inclination does not exceed the threshold value, buoyancy is assumed to be working in the z-axis direction and the spheres are displayed in such a manner that they are adrift in random directions in the x-y plane. For the first time when the inclination has exceeded the threshold value, the difference in weight is represented by a move in the y-axis direction. When the inclination changes in the x-axis direction, the display may, for instance, be produced in such a way that the screen scrolls to the left or to the right. When not all of a plurality of spheres selected by the user fall within the screen, the area to be displayed may be switched by scrolling the screen rightward or leftward. Through an operation like this, the user can either display or not display on the screen certain spheres from among the plurality of spheres, thus selecting a desired sphere, or a file.

FIG. 10 is a functional block diagram of a file processing apparatus 10 according to the third embodiment. This third embodiment differs from the first embodiment in that the file processing apparatus 10 includes an inclination detector 30 for detecting its inclination and that it has a monitor 32 and a speaker 34 built-in. The inclination detector 30 includes a change detector 33 for

detecting the magnitude of inclination of a PDA 140 as a whole, which is a file processing apparatus 10 operated by the user, and an inclination determining unit 31 for determining the direction of the inclination. The
5 inclination detector 30 may be structured in such a manner that it is detachable from the file processing apparatus 10. When the change detector 33 has detected an inclination surpassing the threshold value, a position determining unit 22 updates the relative display positions for the objects
10 according to the direction of the inclination.

FIG. 11 is a flowchart showing a process of changing display contents according to the inclination of the PDA 140. A basic processing flow in the file processing apparatus 10 according to the third embodiment is as shown in FIG. 5.
15 FIG. 11 represents a flow to replace S20 and S34 of FIG. 5. When the user inclines the PDA 140 (S60Y) and the inclination exceeds a predetermined threshold value (S62Y), the position determining unit 22 updates the display positions along the coordinate axis in the direction of the
20 inclination (S64).

Fourth embodiment

In a fourth embodiment of the present invention, the values of an attribute concerning files or folders are
25 represented in such a manner that a comparison is made using another object besides the objects representing the

attribute values themselves. Another object meant here is a balance for instance, which may change in form or position according to the balance of weight of a plurality of objects to be compared.

5 FIG. 12 shows a screen display representing the attribute values, using another object, namely, a balance. A first sphere 152 and a second sphere 154 are placed on the left-hand scale plate of the balance 150. A third sphere 156 is placed on the right-hand scale plate of the balance
10 150. The first to third spheres 152, 154 and 156 represent their respective files or folders. In this illustration, the left-hand scale plate is hanging lower with heavier objects on, so that it can be seen at a glance that the sum of the files represented by the first and second spheres 152
15 and 154 have a larger data size than the file represented by the third sphere 156.

The user may set a new file or folder to be compared by adding any of fourth to seventh spheres 151, 153, 155 and 157 on the left-hand scale plate or the right-hand scale
20 plate of the balance 150. Thus, in this fourth embodiment, a sum of data sizes of files or folders may be compared with the data size of another file or folder. Moreover, by placing a plurality of spheres on each of the scale plates, the sums of data sizes of files or folders may be compared
25 with each other. Comparison of weights of objects among themselves is processed by the comparison processing unit 16

of FIG. 2. The positions of objects are calculated by the position determining unit 22, and the images to be displayed are processed by the display processing unit 24.

Any of the spheres may be utilized as an object to show the size of free area rather than the data size of a file or folder. For example, the third sphere 156 may be used to represent the size of free area in the total memory capacity of the file storage 12. In such a case, it can be easily seen from FIG. 12 that the files or folders represented by the first and second spheres 152 and 154 cannot be stored in the file storage unit 12 because it can be easily grasped that their data size surpasses the capacity of the file storage unit 12.

FIG. 13 is a flowchart showing a process of comparing the sums of data sizes of a plurality of files or folders between themselves. A basic processing flow in a file processing apparatus 10 according to the fourth embodiment is as shown in FIG. 5. FIG. 13 represents a flow to replace S20 and S34 of FIG. 5.

When the user instructs via the instruction receiving unit 18 that a comparison be made between data sizes of combinations of a plurality of files or folders (S90Y), the sum of data sizes for one of the combinations to be compared is calculated (S92) and the thus calculated sum is compared with the data size of the other combination (S94).

According to the result of this comparison, the position

determining unit 22 sets the display positions for the spheres (S96). The display processing unit 24 acquires object data on the balance from the object storage 25 as measuring objects (S97) and displays the balance and the
5 plurality of spheres on the screen (S98).

FIG. 14 shows a dialogue screen from which the user instructs a check on free capacity. When the user downloads a desired file from a network, the balance object of this fourth embodiment may be used as an interface for confirming
10 whether the data size of the file can be locally stored or not. On this screen, the user who is about to download files named "Game AAA" and "Game BBB" from a network is now being asked to perform a free capacity check. Upon a click on a Check button 159 by the user operating a pointer 210,
15 the screen will switch to a screen as shown in FIG. 15.

FIG. 15 shows a screen for using a "balance" object to confirm whether free capacity can hold the downloaded files or not. On this screen, first and second spheres 152 and 154 representing the files to be downloaded are placed on
20 the left-hand scale plate of the balance, and a third sphere 156 representing the free capacity is placed on the right-hand scale plate of the balance. In this illustration, the left-hand scale plate is hanging lower with heavier objects on, so that it can be seen at a glance that the data size of
25 the files to be downloaded is larger than the free capacity. Further, the names of the files and a character string,

"Free Space", may be displayed near the respective spheres.

FIG. 16 shows a screen using a "balloon" object as an interface with similar functions as the "balance" object in FIG. 15. Another object meant here is a balloon with
5 spheres hanging from it, which changes its position according to the balance of buoyancy and gravity. If gravity is a weight in the positive direction, buoyancy is a weight in the negative direction. The screen in FIG. 16 displays a state in which a plurality of spheres 172
10 representing a plurality of files, respectively, are suspended with a string below a balloon 170. The plurality of spheres 172 show in terms of weight the data size of a file or folder selected by the user. If the user selects a plurality of files or folders, then the total of their data
15 sizes will be shown as the total weight. The plurality of spheres 172 are suspended in the air by the buoyancy produced by the gas inside the balloon 170.

The buoyancy of the balloon 170 indicates the size of free capacity in the file storage 12 in the negative
20 direction. If the data size of a file or folder to be measured is small enough to go into the free capacity, the display thereof will be such that the plurality of spheres 172 are lifted up from the ground by the balloon 170. Conversely, if the data size of a file or folder is larger
25 than the free capacity, then the display will show the plurality of spheres 172 stuck to the ground. In this

manner, a visual representation using a "balance" or "balloon" object is made for the user so that prior to starting downloading, the user can easily see whether or not the free capacity can accommodate the file or folder to be downloaded. Also, this visual simulation for proper selection can be used to easily find which combination of files can be stored before starting to download them.

When the free capacity is confirmed, downloading is started based on user instructions. A user command therefor may be given either by a dialogue screen as shown in FIG. 14 that prompts the start of downloading or a command for action, such as the user's bursting the balloon 170. When the balloon has burst, the position determining unit 22 and the display processing unit 24 carry out such processing as to display the motion of the suspended spheres dropping to the ground. Moreover, the balloon bursting may be displayed for instance when a non-volatile memory is removed from this apparatus to record a file or folder.

20 Fifth embodiment

In a fifth embodiment of the present invention, the values of an attribute concerning files or folders are represented in such a manner that measuring is done using still another object besides the objects representing the attribute values themselves. Still another object meant here is a suspension weigher for instance, which may change

in form or position according to the weight measured of selected objects. Use of a suspension weigher may also allow the user to read the specific value of the weight.

FIG. 17 shows a screen display visually representing the attribute values by the appearance and display positions of the suspension weigher and spherical objects. A plurality of first spheres 162 are placed on the scale plate of a suspension weigher 160. These spheres represent their respective files or folders, and the weight measured by the suspension weigher 160 represents the total of the data sizes of these files or folders. Since a plurality of spheres may be placed on the scale plate, the sum of a plurality of files or folders can be handled in this fifth embodiment.

Changes in the position of the first spheres 162, the scale reading of the suspension weigher 160, and the form or appearance image of the suspension weigher 160 are processed by the position determining unit 22 and the display processing unit 24 of FIG. 2. The user moves a second sphere 163 onto the scale plate by operating a pointer 210 on the screen. The user may also add an object to be measured from among a plurality of third spheres 161. Instructions to increase or decrease the number of spheres are given by moving the pointer 210.

FIG. 18 is a flowchart showing a process of measuring the sum of data sizes of a plurality of files or folders. A

basic processing flow in a file processing apparatus 10 according to the fifth embodiment is as shown in FIG. 5. FIG. 18 represents a flow to replace S20 and S34 of FIG. 5.

When the user instructs a data size measurement (S100),
5 the attribute input unit 14 calculates the sum of data sizes of files or folders represented by the spheres placed on the scale plate (S102). According to the result of this calculation, the position determining unit 22 sets the display positions for the spheres (S104). The display
10 processing unit 24 acquires object data on the suspension weigher from the object storage 25 as measuring objects (S106) and not only displays this data and the spheres in the predetermined positions but also indicates the calculated sum of data sizes on the scale (S108).

15

Sixth embodiment

In a sixth embodiment of the present invention, the values of an attribute concerning files or folders are represented in such a manner that classification is done
20 using still another object besides the objects representing the attribute values themselves. Still another object meant here is a box for instance, which the user can intuitively associate with a folder. Moreover, files or folders to be classified are represented by particles placed in a box. In
25 this sixth embodiment, too, the data size which serves as an attribute value is shown in terms of weight.

FIG. 19 shows a screen display visually representing the attribute values by a box and "particle" objects. A plurality of particles representing files or folders to be classified are placed in a box 180. These particles are
5 divided into three appearance types according to their respective weights. A first particle 182 is a file of relatively large data size, whereas a third particle 186 is a file of relatively small data size. A second particle 184 has a data size in between them. As shown in FIG. 19, the
10 plurality of particles placed in the box 180 are displayed in random arrangement. In this manner, a rough visual classification is made of the files contained in a specific folder. The classification meant here need not be highly accurate but serves its purpose if the user can grasp a
15 rough classification at a glance. The objects in this sixth embodiment are classified into three pattern types, but any colors or patterns or the like may be used so long as they effect a rough classification.

A file processing apparatus 10 according to this sixth
20 embodiment has a structure similar to the one shown in FIG. 2 of the first embodiment. The comparison processing unit 16 in FIG. 2 classifies a plurality of files into a plurality of groups according to their respective sizes of attribute values. The display processing unit 24 acquires
25 "appearance" object data on the groups from the object storage 25 and displays the objects.

FIG. 21 is a flowchart showing a process of classifying a plurality of files as detailed steps of S16 and S30 of FIG. 5. In this sixth embodiment, a plurality of files are roughly classified into three groups, which are then distinguished in appearance by their respective colors and patterns. The classification is made using the following procedure, for instance. First, the comparison processing unit 16 detects a maximum value and a minimum value from each of the attribute values of the files (S150).
5 The range from the maximum value to the minimum value is divided into a plurality of ranges, such as three ranges, and the boundaries of the respective ranges are set as the boundaries for grouping (S152). The division may be into equal parts or any other way under predetermined rules. A
15 plurality of files are thus classified into three groups by comparing an attribute value of each file with the boundary values (which correspond to "a reference value" in WHAT IS CLAIMED of this patent specifications) (S154). After this grouping according to the attribute values, the display
20 processing unit 24 acquires object data on each of the groups from the object storage 25 (S156).

If file types or file creators as attribute values are to be represented by weight, a plurality of files may be grouped by file type or file creator. Moreover, for example,
25 when the attribute values represent dates and times, such as the dates and times of file preparation or updating, the

values of the oldest and the newest dates and times may be detected from the attribute values of the files at S150.

Seventh embodiment

5 In a seventh embodiment of the present invention, the values of an attribute concerning files or folders are represented by particles placed in a box just as in the sixth embodiment. In this seventh embodiment, too, the data size, or an attribute value, is shown in terms of weight and
10 at the same time each particle is displayed in a position corresponding to its weight. Initially, the particles are displayed temporarily in random positions as shown in FIG. 19. Then the positions of accumulation of the particles are changed according to their weights and the particles are
15 visually classified by the position of accumulation as shown in FIG. 21. In FIG. 19 and FIG. 21, the particles are classified in three appearance types, for convenience, just as in the sixth embodiment, but it goes without saying that any other examples with different modes of classification
20 can also be used.

 FIG. 22 is a functional block diagram showing a structure of a file processing apparatus 10 according to the seventh embodiment. An output processing unit 20 in this seventh embodiment differs from the first to sixth
25 embodiments in that it includes a comparison processing unit 16 and an order setting unit 17. The order setting unit 17

sets a temporary order for a plurality of files to be classified. This temporary order, which is determined without regard to the values of an attribute concerning the plurality of files, may be either a random order or an order
5 selected by the user. In the temporary order, the position determining unit 22 determines temporary display positions for the plurality of files and the display processing unit 24 displays the "particle" objects in the temporary display positions.

10 The comparison processing unit 16 compares attribute values for adjacent files in the temporary order. Adjacent files meant here may not have to be strictly adjacent, but may be a plurality of files selected arbitrarily. In effect, a plurality of files are classified into a plurality of
15 small groups, and the attribute values are compared group by group sequentially. Based on the results of the comparison, the order setting unit 17 updates the order of the plurality of files. For example, when the order of a plurality of files is to be updated in an ascending order of the
20 attribute values thereof, the order will be reversed if a file which is behind another file in order has a smaller attribute value than the other.

As the above-described updating of sequence between adjacent files is repeated, the order as a whole is arranged
25 into an ascending order with the results of group-by-group comparison reflected in it gradually. This process of

updating the order, which applies the principle of rearrangement by bubble sort, is displayed progressively on the screen. Thus, the user can visually grasp how a plurality of particles are gradually being classified according to their weights. The visual changes in the display are processed by an effect generator 26, the position determining unit 22 and the display processing unit 24.

FIG. 23 is a flowchart showing a process of moving objects, which are a plurality of particles placed in a box, according to attribute values. A basic processing flow in a file processing apparatus 10 according to this seventh embodiment is as shown in FIG. 5. FIG. 23 represents a flow to replace S20 and S34 of FIG. 5. At S14 and S28 in FIG. 5, the order setting unit 17 determines a temporary order and the position determining unit 22 sets temporary display positions in the temporary order. At S18 and S32, the objects are displayed temporarily. In FIG. 23, when instructions are given to rearrange in an ascending order (S68), the comparison processing unit 16 compares the attribute values between adjacent files in a temporary order and the order setting unit 17 updates the order based on the results of comparison (S70). In the updated order, the position determining unit 22 changes the display position of each object (S72) and the display processing unit 24 displays the particles in their respective positions (S74).

S70 to S74 are repeated until there is no longer order change (S76).

Eighth embodiment

5 A file processing apparatus 10 according to an eighth embodiment of the present invention is realized as a PDA 140. The user can instruct a box 180 to sway by swaying the whole body of the PDA 140. In response to the sway, a plurality of files, represented by particles, are classified into
10 groups.

 FIG. 24 illustrates the swaying motions of a PDA 140. The user can sway the whole PDA 140 up and down or right and left relative to the screen. The PDA 140, which has a built-in vibration sensor, detects the magnitude of sway.
15 Whenever a sway is detected, the display positions for the particles are updated gradually, with the particles moving to the positions of accumulation according to their data sizes.

 FIG. 25 is a functional block diagram showing a
20 structure of a file processing apparatus 10 according to the eighth embodiment. An output processing unit 20 in this eighth embodiment differs from the one in the seventh embodiment in that it further includes a vibration detector
35.

25 The vibration detector 35 detects the sway of a predetermined position of a file processing unit 10 which is

operated by the user. Although the predetermined position of a file processing unit 10 in this eighth embodiment is the whole body of the PDA 140, it may be a controller if the applicable equipment is a game machine. The vibration
5 detector 35 may employ a piezo-electric element to detect the sways, and the sways to be detected may be any of up and down, right and left, and vertical sways relative to the screen. Whenever the vibration detector detects a sway exceeding a predetermined threshold value, the vibration
10 detector 35 causes the comparison processing unit 16 to perform a comparison processing, the order setting unit 17 to perform a rearrangement processing, the position determining unit 22 to perform an update processing of display positions, and the display processing unit 24 to
15 perform a display processing.

FIG. 26 is a flowchart showing a process of moving objects, which are a plurality of particles placed in a box, by swaying the whole body of a PDA. A basic processing flow in a file processing apparatus 10 according to the eighth
20 embodiment is as shown in FIG. 5. FIG. 26 represents a flow to replace S20 and S34 of FIG. 5. At S14 and S28 in FIG. 5, the order setting unit 17 determines a temporary order and the position determining unit 22 sets temporary display positions in this temporary order. At S18 and S32, the
25 objects are displayed temporarily. Referring to FIG. 26, when the vibration detector 35 detects a sway exceeding a

threshold value (S80), the comparison processing unit 16 compares the values of an attribute between adjacent files in a temporary order and the order setting unit 17 updates the order based on the results of comparison (S82). In the
5 updated order, the position determining unit 22 changes the display position of each object (S84) and the display processing unit 24 displays the particles in their respective positions (S86).

Since the processings of S18 to S20 and S32 to S34 in
10 FIG. 5 are repeated, the processings of S80 to S86 in FIG. 26, which belong to those steps, are also repeated, so that the positions of particles are changed whenever a sway of the PDA 140 is detected. It is to be noted that in this eighth embodiment, the rearrangement in an ascending order
15 is accomplished gradually by changing the positions of particles whenever a sway of the PDA 140 is detected, but in other embodiments, the process of rearrangement may be carried out all at once. Namely, when a sway of the PDA 140 is detected for the first time, the processing for
20 rearranging the particles may be carried out until the rearrangement in an ascending order is completed without waiting for the detection of a next sway. In such a case, the rearrangement may be performed by a sort method, such as a simple selection method.

25 The present invention has been described based on the embodiments which are only exemplary. It is understood by

those skilled in the art that there exist other various modifications to the combination of each component and process described above and that such modifications are encompassed by the scope of the present invention. Such
5 modified examples will be described hereinbelow.

In each of the above-described embodiments, the objects to be compared or measured are files or folders stored in a storage in the file processing apparatus 10. As a modified example, the objects may be files or folders
10 stored in a node of a network. In such a case, the file processing apparatus 10 is provided with a communication function for accessing the network. The file processing apparatus 10 may display network files and local files on the same screen without making distinction. As a result,
15 the user can handle files and folders without being conscious of the network.

The third embodiment is structured such that the inclination of a PDA 140 as a whole is detected and the positions of objects are changed according to the
20 inclination. As another modified example, the inclination of a predetermined position of a system, such as the controller of a game machine, may be detected. Such a controller may have a built-in tilt sensor.

In each of the embodiments, the function for changing
25 the positions or forms of objects in response to user instructions has been described. As still another

modification, sound effect may be produced along with these changes in the display. For example, such sound effects may include the sound of a sphere bouncing, the sound of water splashing, or the sound of a balloon bursting. Moreover, 5 such other directing and manipulating effects as vibration of the controller or stronger repulsion of the stick of a game machine may be added to the above sound effect.

In the eighth embodiment, the user can instruct a classification of files by swaying the whole PDA 140. A 10 file processing apparatus 10 according to still another modified example may have a function for instructing a classification not via the vibration detector 35 but via a control device, such as a keyboard, a mouse or a controller of a game machine.

15 In the seventh and eighth embodiments, the rearrangement of files is processed by utilizing the bubble sort method. As still another modified example, another sorting method, such as simple sort, quick sort or shaker sort, may be employed. In the seventh and eighth 20 embodiments, objects are initially displayed in random display positions as the initial display state. As still another modified example, the objects may be displayed in positions corresponding to the values of an attribute from the beginning.

25 In the sixth embodiment, the arrangement is such that objects are roughly classified into appearances

corresponding to their weights, whereas in the seventh and eighth embodiments, the objects are subjected to rearrangements corresponding to their weights. As still another modified example, a structure may be such that the
5 objects are first classified roughly into appearances corresponding to their weights and then further subjected to rearrangements corresponding to their weights.

In the sixth embodiment, a plurality of particles placed in a box 180 are displayed in random positions. As
10 still another modified example, the plurality of particles in the box 180 may, for instance, be divided into three ranges of lower, middle and upper ranges, and the position determining unit 22 as shown in FIG. 2 may set the display position of first particles 182 in the lower range, the
15 display position of second particles 184 in the middle range, and the display position of third particles 186 in the upper range. In a modified example like this, the display positions of particles vary from group to group, so that the user can roughly classify files by the difference in display
20 position.

Although the present invention has been described by way of exemplary embodiments, it should be understood that many changes and substitutions may further be made by those skilled in the art without departing from the scope of the
25 present invention which is defined by the appended claims.

CLAIMS

1. A file processing apparatus, including:

an attribute input unit which acquires a value of an attribute for at least one file in order to represent a value of a predetermined attribute for an intended file by using a concept of weight;

a comparison processing unit which compares the value of an attribute with a reference value;

a position determining unit which sets, based on a result obtained from said comparison processing unit, a relative display position of a predetermined object that represents symbolically the weight; and

a display processing unit which visually represents the value of the attribute in terms of whether the weight is heavy or light, by displaying the object at the display position on a screen set by said position determining unit.

2. A file processing apparatus according to Claim 1, further including an inclination detector which detects inclination of a predetermined region in the file processing apparatus operated by a user, wherein according to the inclination detected by said inclination detector said position determining unit varies the relative display position.

3. A file processing apparatus according to Claim 1, wherein

said attribute input unit acquires values of the attribute for a plurality of files, said comparison processing unit sets a value of an attribute for at least one of the plurality of files to the reference value, said position determining unit sets relative display positions of a plurality of objects corresponding to the plurality of files, respectively, and wherein said display processing unit displays the plurality of files at the respective display positions and visually represents the comparison of weights of the files via another object representative of the measurement of the weights.

4. A file processing apparatus according to Claim 3, wherein said comparison processing unit sets, as the reference value, a size of a storage area that stores at least one file, said position determining unit sets a relative display position of an object indicative of the storage area according to the size of the storage area, and wherein said display processing unit visually expresses the comparison of data size between the at least one file and the storage area via the another object.

5. A file processing apparatus according to Claim 1, wherein said attribute input unit acquires values of an attribute for a plurality of files and said comparison processing unit classifies the plurality of files into a plurality of groups

according to the respective values of the attribute, and wherein said display processing unit displays the object in an appearance corresponding to the respective groups.

6. A file processing apparatus according to Claim 1, wherein said attribute input unit acquires values of an attribute for a plurality of files, said comparison processing unit classifies the plurality of files into a plurality of classes and sequentially compares the values of an attribute for each class, wherein, after relative display positions are temporarily determined respectively as positions that initially display objects for the plurality of files, said position determining unit sequentially updates the relative display positions in a manner such that comparison results for each class are reflected for each class, and wherein said display processing unit varies the display of the objects according to said updating after the plurality of files are displayed at the temporarily determined relative display positions.

7. A file processing apparatus according to Claim 5, further including a vibration detector which detects a swaying motion at a predetermined region of the file processing apparatus operated by a user, wherein said comparison processing unit performs a comparison processing when the motion is detected, and said position determining unit

updates the relative display position according to the result obtained from said comparison processing unit.

8. A file processing apparatus according to Claim 6, further including a vibration detector which detects a swaying motion at a predetermined region of the file processing apparatus operated by a user, wherein said comparison processing unit performs a comparison processing when the motion is detected, and said position determining unit updates the relative display position according to the result obtained from said comparison processing unit.

9. A file processing apparatus according to Claim 1, further including:

an instruction receiving unit which receive an instruction from a user intending to change the display position of the object; and

an effect generator which causes, based on the instruction, said position determining unit and said display processing unit to process a change in any of position, shape and appearance of the object.

10. A method of processing files, including:

setting a relative display position of a predetermined object that symbolically represents the files in terms of whether the weight thereof is heavy or light, based on a

value of a predetermined attribute for an intended file, in order to represent the value of a predetermined attribute therefor by using a concept of weight; and

representing visually the weight by displaying the object at the relative display position on a screen.

11. A method of processing files according to Claim 10, further including:

detecting inclination of a predetermined apparatus operated by a user; and

varying the relative display positions according to the inclination.

12. A method of processing files, including:

acquiring values of a predetermined attribute for a plurality of intended files in order to represent the values of a predetermined attribute therefor by using a concept of weight;

setting, for each of the plurality of files, a relative display position of a predetermined object that represents symbolically the files in terms of whether the weight thereof is heavy or light, based on the values of a predetermined attribute; and

displaying the objects of the plurality of files at the respective display positions on a screen, and expressing visually comparison of the weights of the objects via

another object that symbolizes weight measurement.

13. A method of processing files according to Claim 12, wherein said acquiring further acquires a size of a storage area that stores at least one file, and said setting sets the relative display position of at least one object corresponding to the at least one file, based on a comparison result obtained by comparing a data size between the at least one object and the storage area, and wherein said displaying and expressing represents visually the comparison result via the another object.

14. A method of processing files, including:

acquiring values of a predetermined attribute for a plurality of files, in order to represent the values of a predetermined attribute for intended files by using a concept of weight;

setting a temporary sequence for the plurality of files;

determining, based on the temporary sequence, a temporary display position of a predetermined object that symbolically represents the files in terms of whether the weight thereof is heavy or light;

displaying an object that corresponds to the plurality of files, at the temporary display position on a screen;

comparing the values of a predetermined attribute

between adjacent files in the temporary sequence;
updating the display position based on a comparison result obtained from said comparing; and
representing visually the weight thereof by varying display contents according to said updating.

15. A method of processing files according to Claim 14, further including:

detecting a swaying motion of a predetermined apparatus operated by a user;
performing said comparing when the swaying motion is detected in said detecting;
updating a relative display position of the object according to the comparison result.

16. A method of processing files according to Claim 10, further including:

acquiring an instruction from a user who intends to cause a display position of the object to be changed; and
changing at least one of position, shape and appearance of the object, based on the instruction.

17. A program executable by a computer, the program including the functions of:

setting a relative display position of a predetermined object that symbolically represents the files in terms of

whether the weight thereof is heavy or light, based on a value of a predetermined attribute for an intended file, in order to represent the value of a predetermined attribute therefor by using a concept of weight; and

representing visually the weight by displaying the object at the relative display position on a screen.

18. A program executable by a computer, the program including the functions of:

acquiring values of a predetermined attribute for a plurality of intended files in order to represent the values of a predetermined attribute therefor by using a concept of weight;

setting, for each of the plurality of files, a relative display position of a predetermined object representing symbolically the files in terms of whether the weight thereof is heavy or light, based on the values of a predetermined attribute; and

displaying on a screen the objects of the plurality of files at the respective display positions, and expressing visually comparison of the weights of the objects via another object that symbolizes weight measurement.

19. A program executable by a computer, the program including the functions of:

acquiring values of a predetermined attribute for a

plurality of files, in order to represent the values of a predetermined attribute for intended files by using a concept of weight;

 setting a temporary sequence for the plurality of files;

 determining, based on the temporary sequence, a temporary display position of a predetermined object that symbolically represents the files in terms of whether the weight thereof is heavy or light;

 displaying an object that corresponds to the plurality of files, at the temporary display position on a screen;

 comparing the values of a predetermined attribute between adjacent files in the temporary sequence;

 updating the display position based on a comparison result obtained from said comparing; and

 representing visually the weight thereof by varying display contents according to said updating.

20. A computer-readable recording medium which stores a program executable by a computer, the program including the functions of:

 setting a relative display position of a predetermined object that symbolically represents the files in terms of whether the weight thereof is heavy or light, based on a value of a predetermined attribute for an intended file, in order to represent the value of a predetermined attribute

therefor by using a concept of weight; and
representing visually the weight by displaying the
object at the relative display position on a screen.

21. A computer-readable recording medium which stores a
program executable by a computer, the program including the
functions of:

acquiring values of a predetermined attribute for a
plurality of intended files in order to represent the values
of a predetermined attribute therefor by using a concept of
weight;

setting, for each of the plurality of files, a
relative display position of a predetermined object
representing symbolically the files in terms of whether the
weight thereof is heavy or light, based on the values of a
predetermined attribute; and

displaying on a screen the objects of the plurality of
files at the respective display positions, and expressing
visually comparison of the weights of the objects via
another object that symbolizes weight measurement.

22. A computer-readable recording medium which stores a
program executable by a computer, the program including the
functions of:

acquiring values of a predetermined attribute for a
plurality of files, in order to represent the values of a

predetermined attribute for intended files by using a concept of weight;

setting a temporary sequence for the plurality of files;

determining, based on the temporary sequence, a temporary display position of a predetermined object that symbolically represents the files in terms of whether the weight thereof is heavy or light;

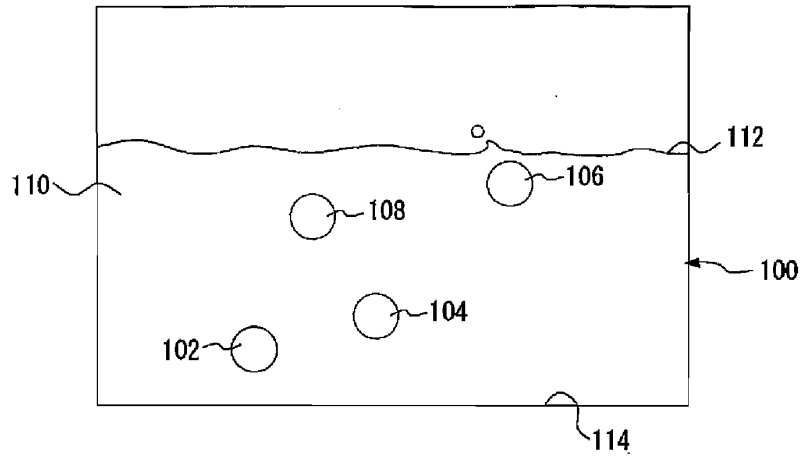
displaying an object that corresponds to the plurality of files, at the temporary display position on a screen;

comparing the values of a predetermined attribute between adjacent files in the temporary sequence;

updating the display position based on a comparison result obtained from said comparing; and

representing visually the weight thereof by varying display contents according to said updating.

FIG. 1



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FIG. 2

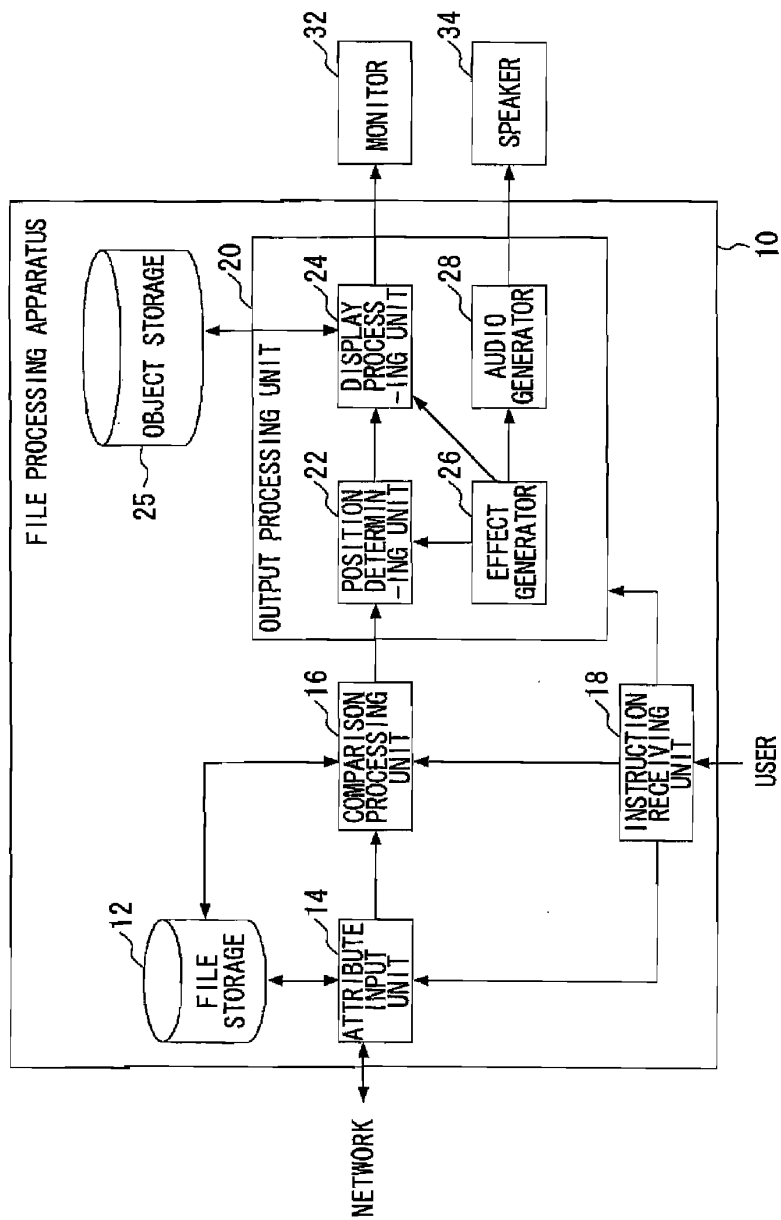


FIG. 3

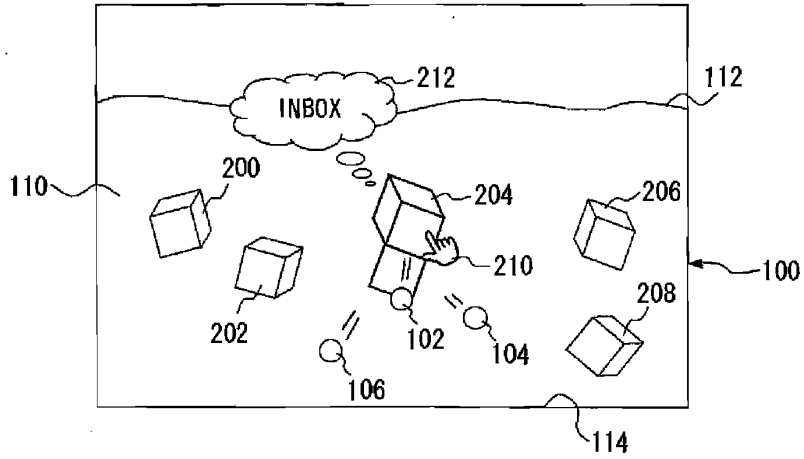


FIG. 4

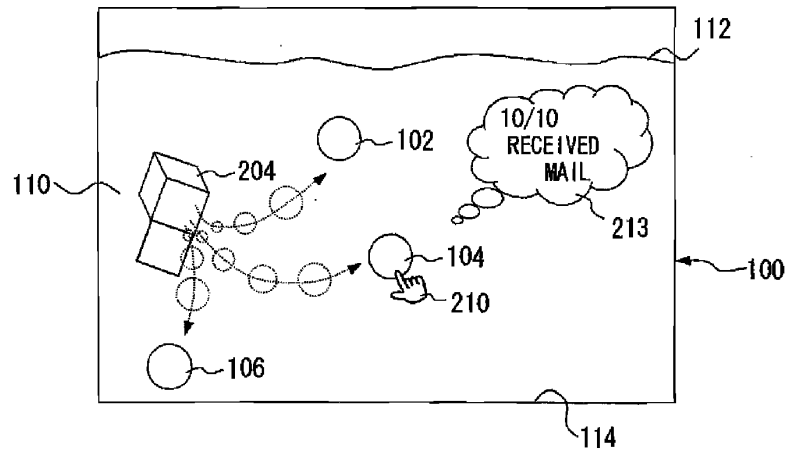
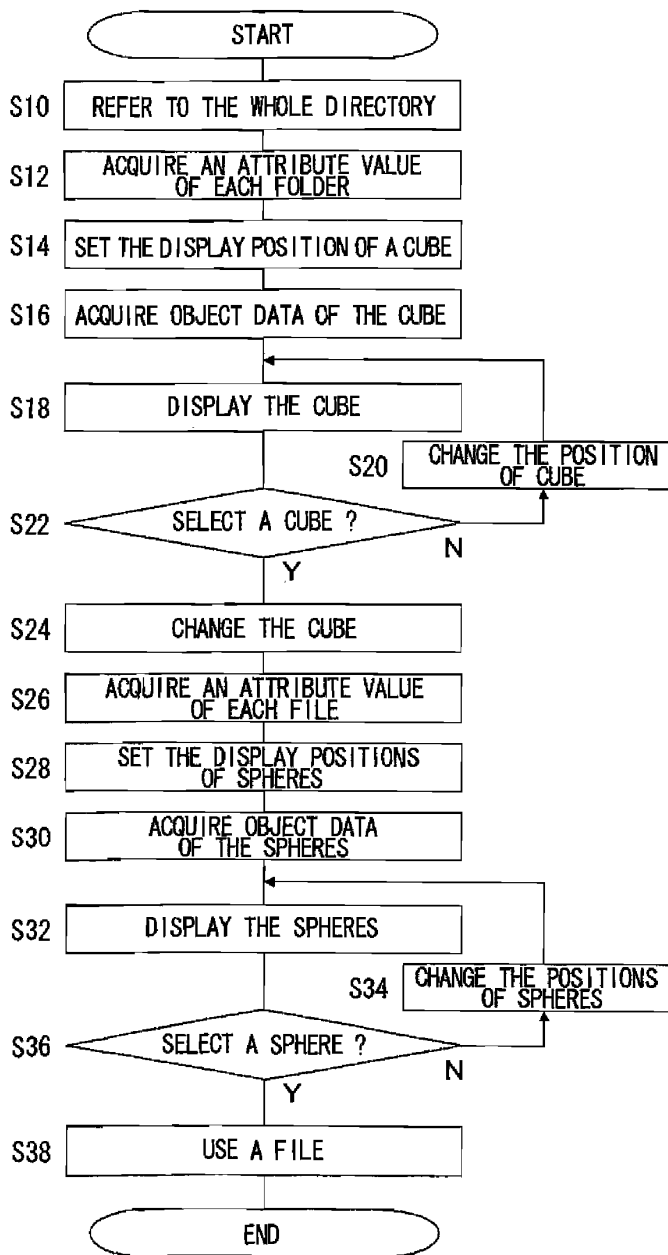


FIG. 5



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FIG. 6

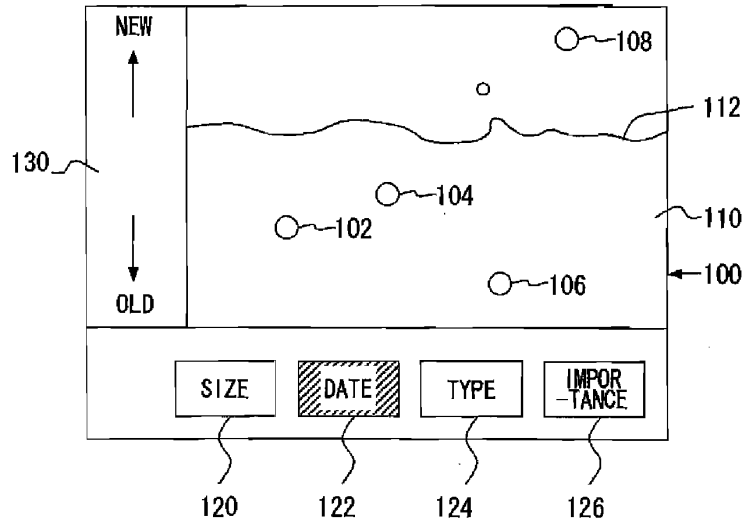
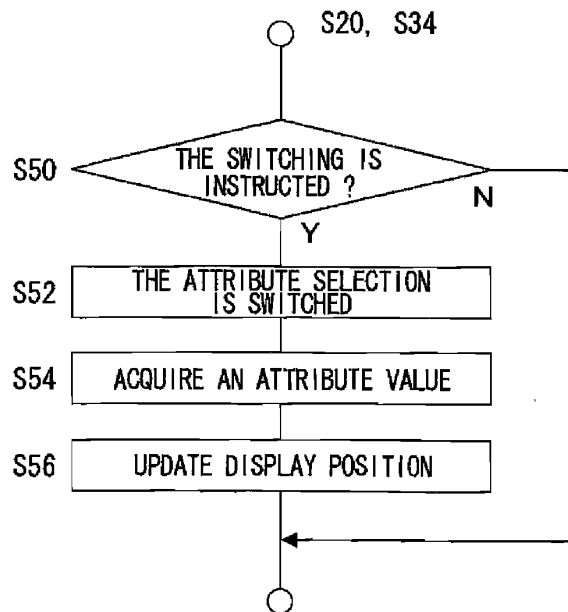


FIG. 7



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FIG. 8

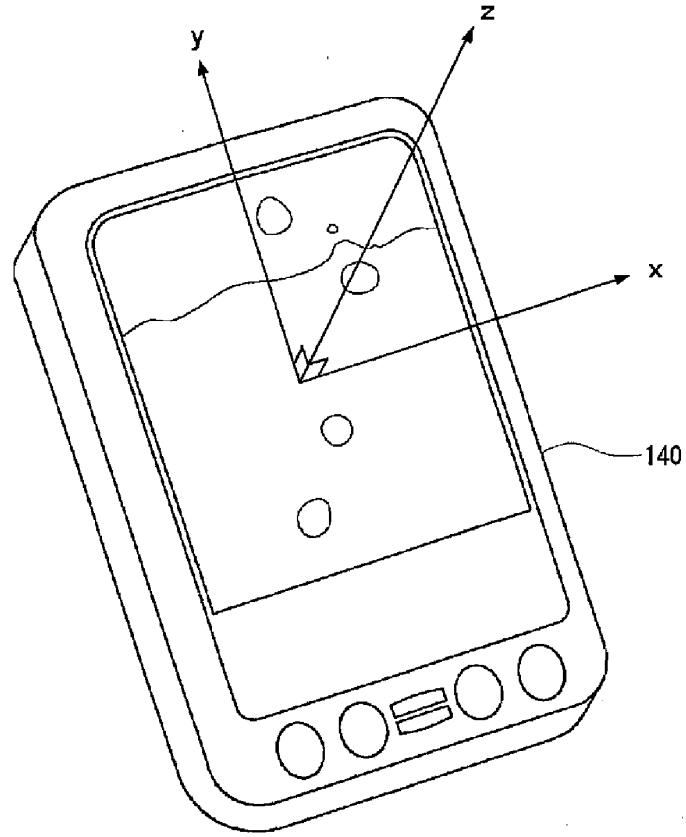


FIG.9B

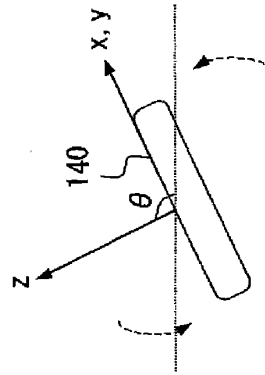
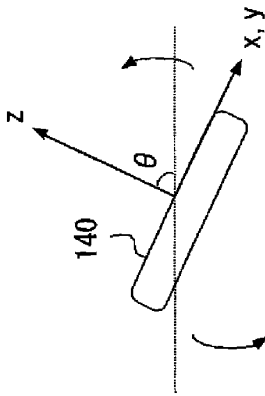
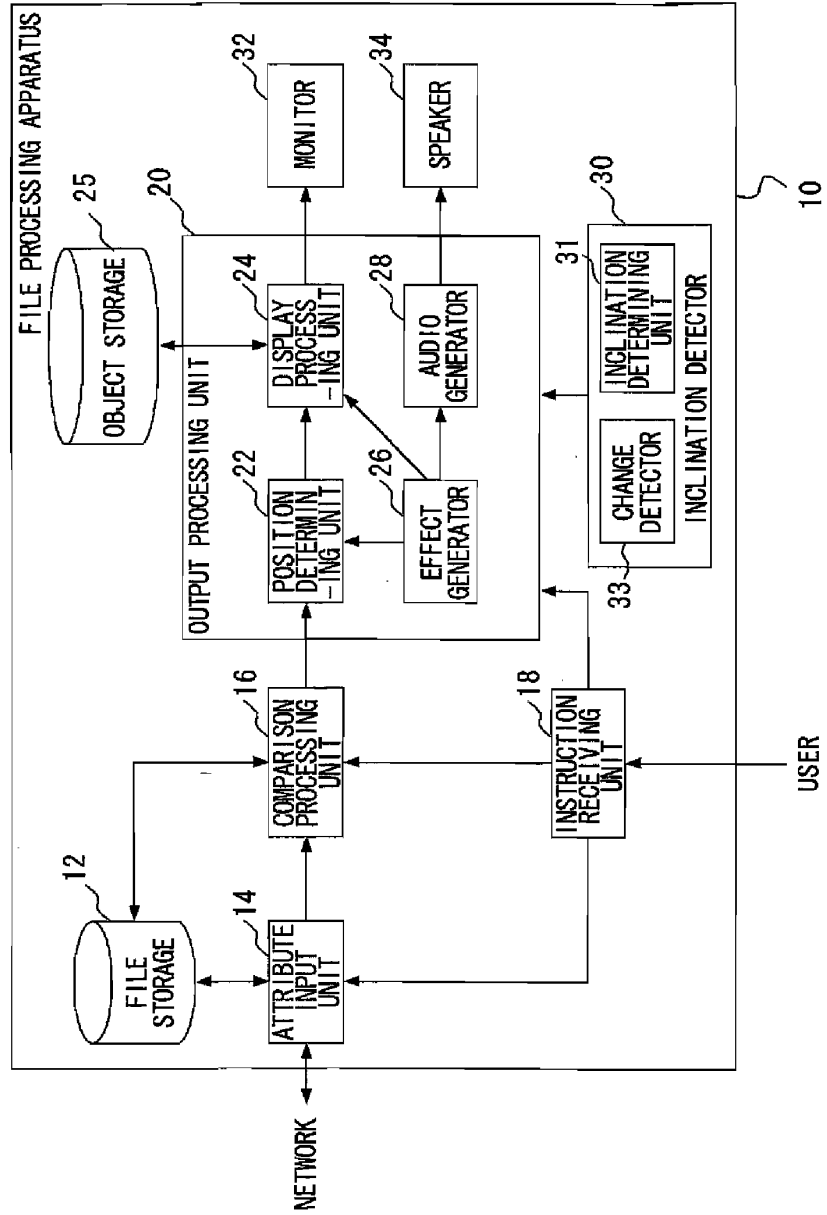


FIG.9A



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FIG. 10



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FIG. 11

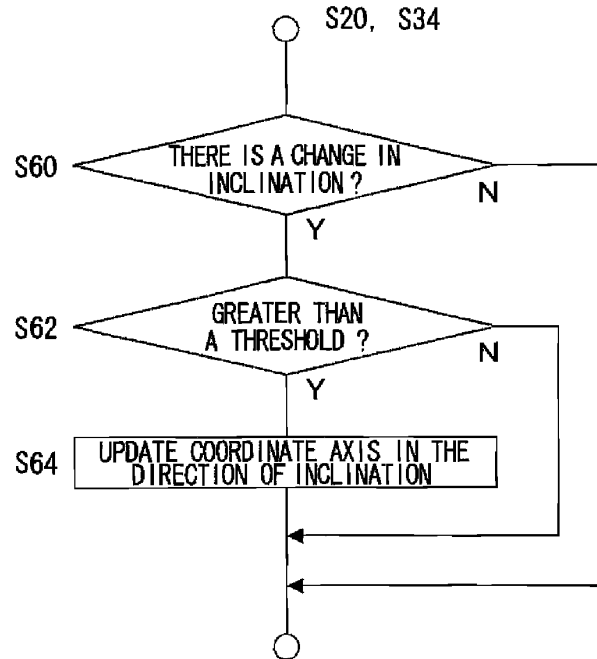
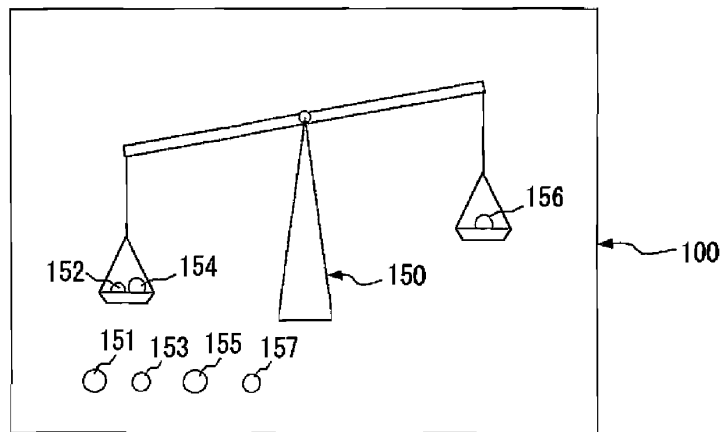


FIG. 12



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FIG. 13

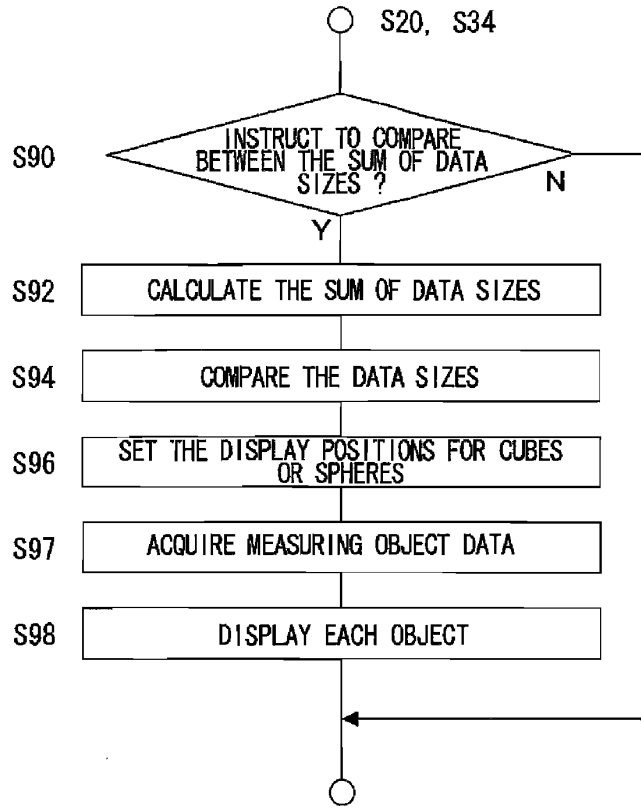


FIG. 14

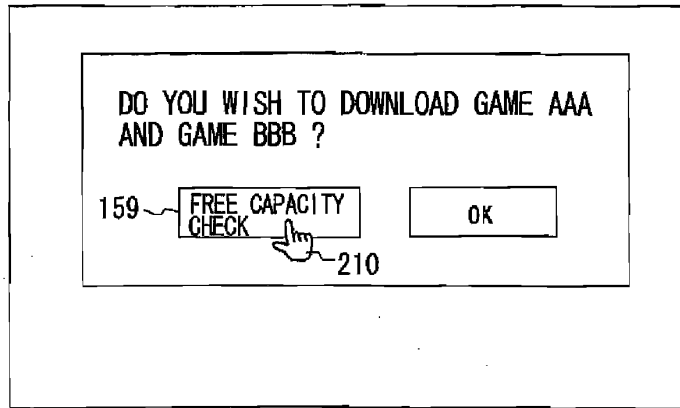


FIG. 15

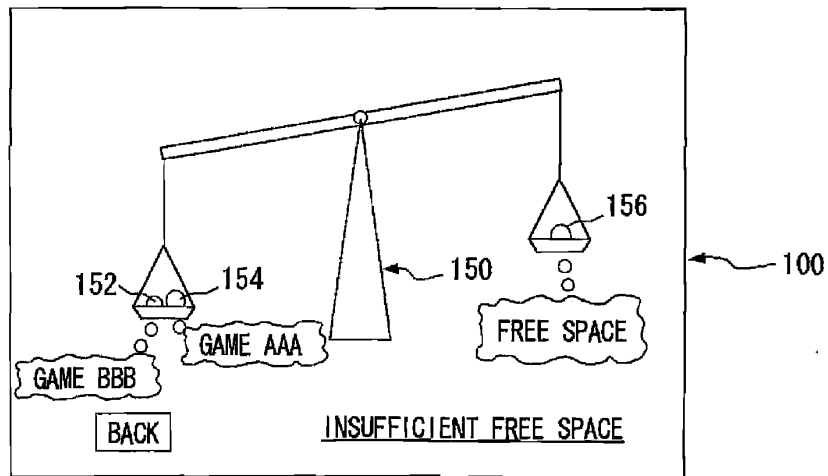


FIG. 16

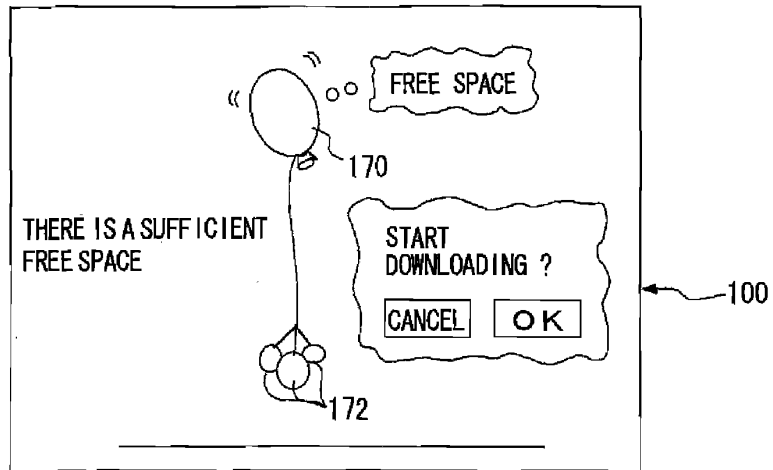


FIG. 17

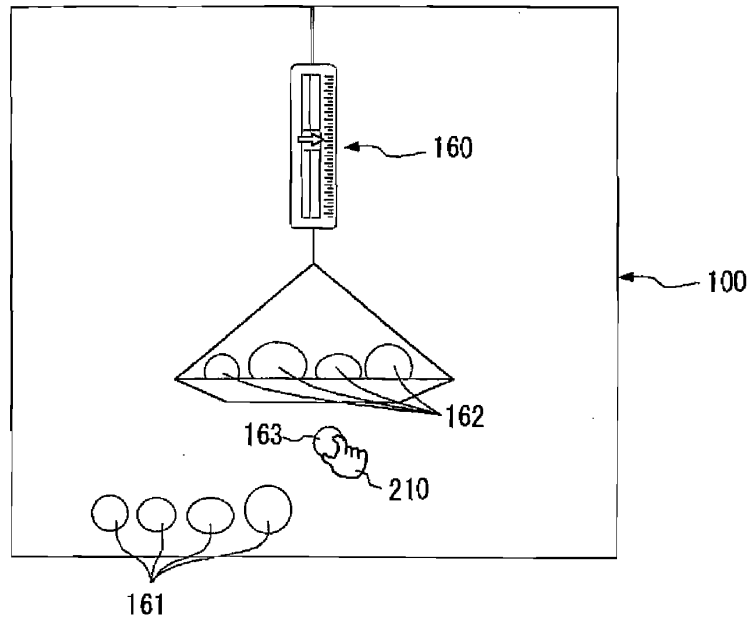
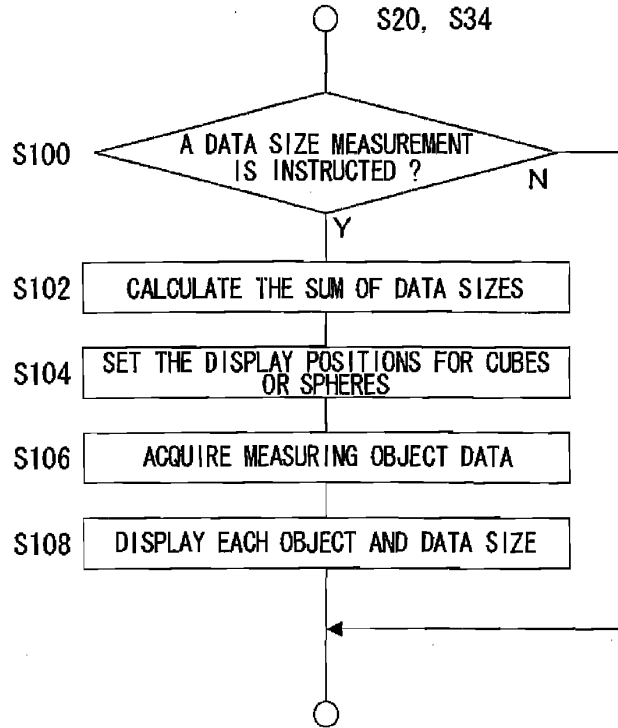


FIG. 18



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FIG. 19

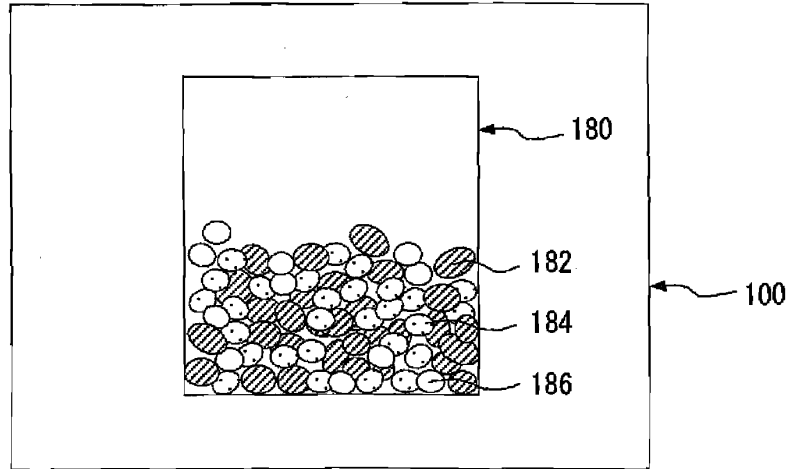


FIG. 20

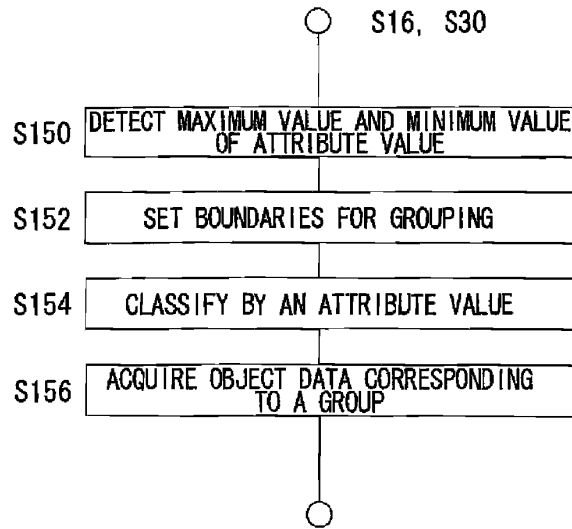


FIG. 21

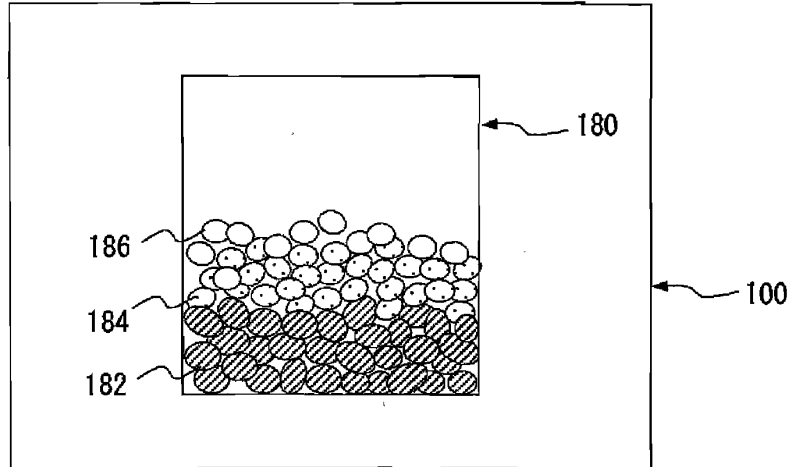


FIG. 22

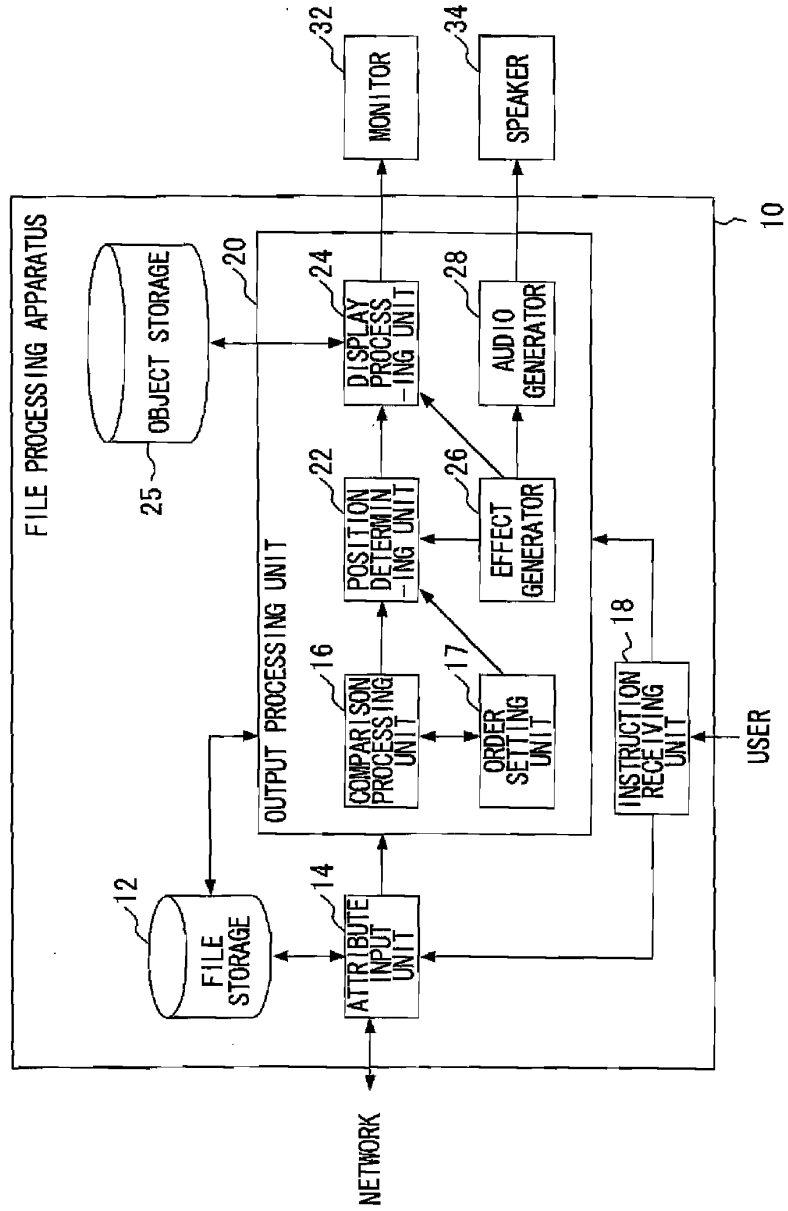


FIG. 23

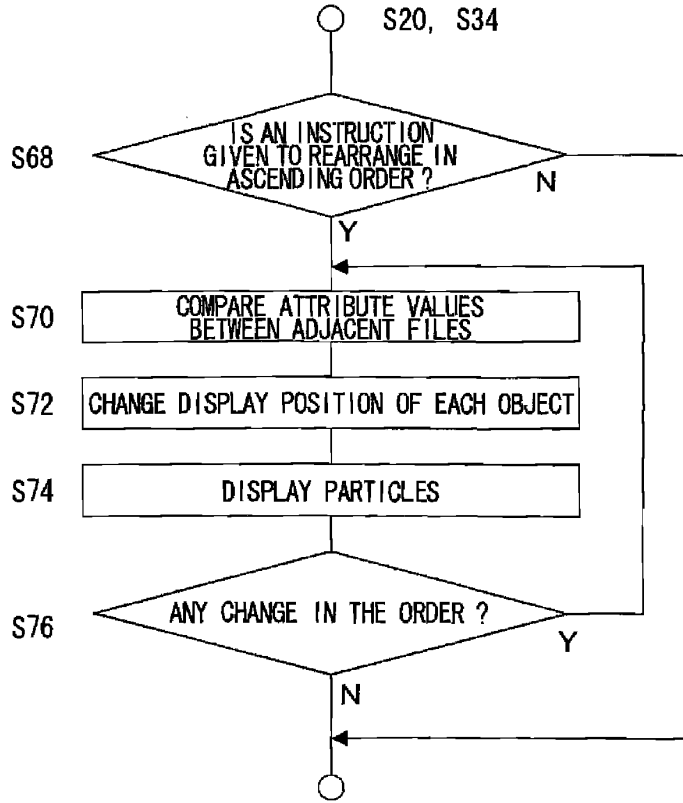
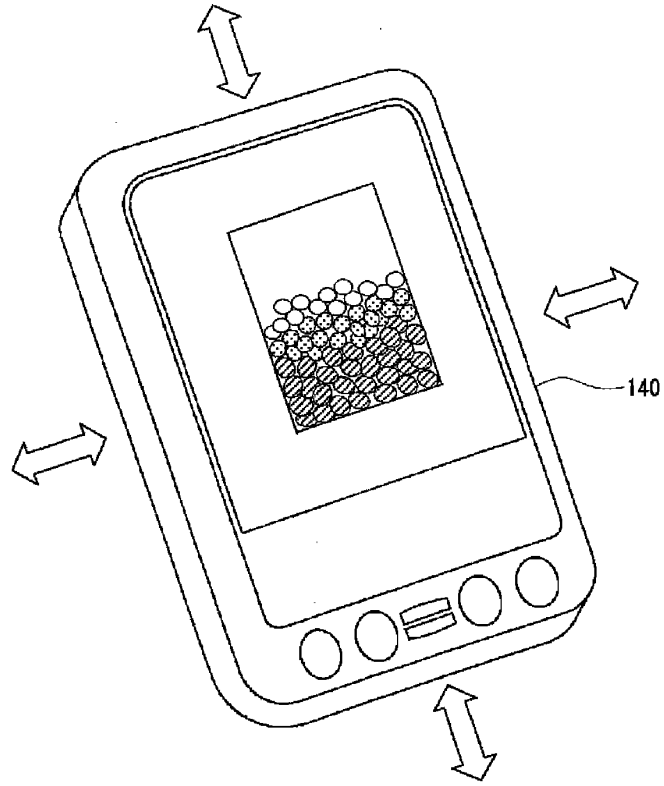


FIG. 24



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FIG. 25

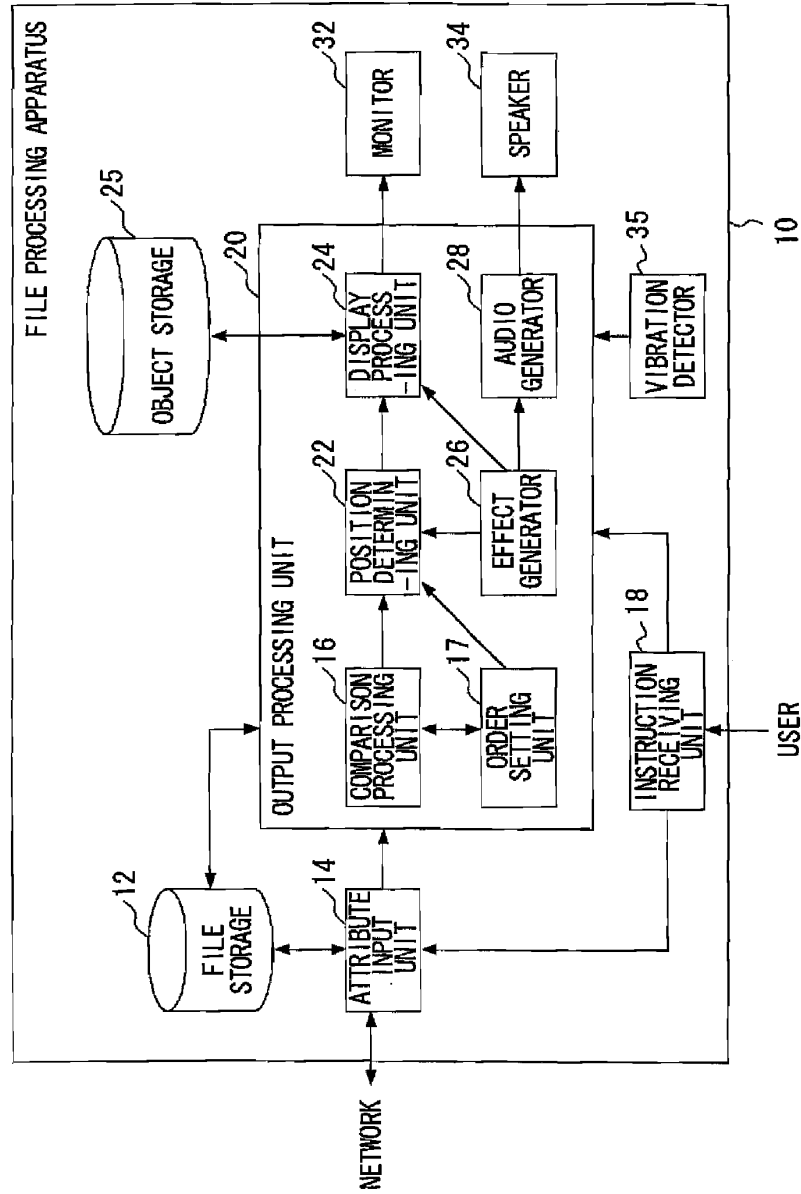
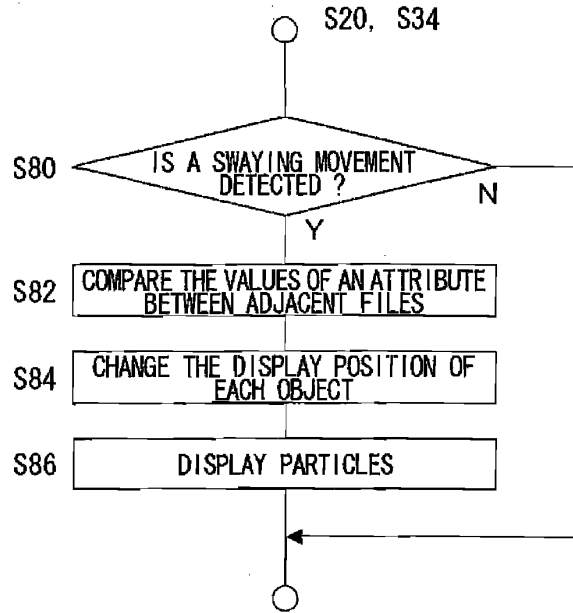


FIG. 26



(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(19) World Intellectual Property
Organization
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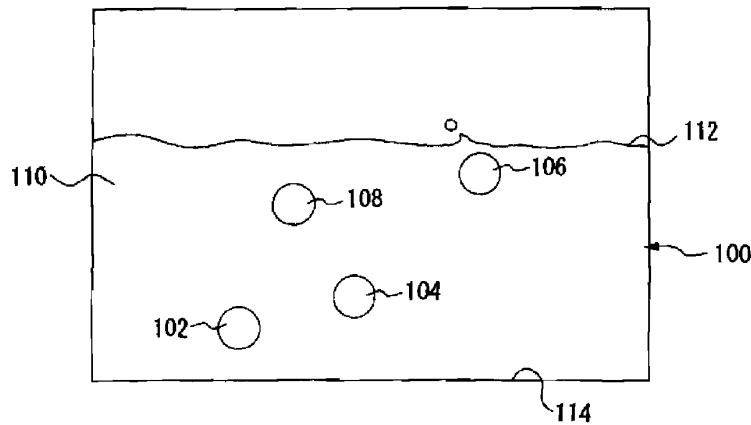
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- (71) Applicant: SONY COMPUTER ENTERTAINMENT INC. [JP/JP]; 2-6-21, Minami-Aoyama, Minato-ku, Tokyo 107-0062 (JP).
- (72) Inventor: WADA, Shinya; c/o SONY COMPUTER ENTERTAINMENT INC., 2-6-21, Minami-Aoyama, Minato-ku, Tokyo 107-0062 (JP).
- (74) Agent: MORISHITA, Sakaki; 2-11-12, Ebisu-Nishi, Shibuya-ku, Tokyo 150-0021 (JP).
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- Published: with international search report
- (88) Date of publication of the international search report: 16 December 2004
- For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.

(54) Title: METHOD AND APPARATUS FOR PROCESSING FILES UTILIZING A CONCEPT OF WEIGHT SO AS TO VISUALLY REPRESENT THE FILES IN TERMS OF WHETHER THE WEIGHT THEREOF IS HEAVY OR LIGHT



(57) Abstract: On a screen a file processing apparatus displays values of an attribute related to a plurality of files using a concept of weight. The weight of each file is represented by spherical objects submerged into the water and displayed on the screen. For example, a first spherical object represents a file whose data size is large, and is sunk near bottom. And a second spherical object represents a file whose data size is light and is floating near the water surface.

INTERNATIONAL SEARCH REPORT

International Application No
PCT/JP 03/14286

A. CLASSIFICATION OF SUBJECT MATTER IPC 7 G06F3/033 According to International Patent Classification (IPC) or to both national classification and IPC		
B. FIELDS SEARCHED Minimum documentation searched (classification system followed by classification symbols) IPC 7 G06F Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched Electronic data base consulted during the international search (name of data base and, where practical, search terms used) EPO-Internal, WPI Data, PAJ		
C. DOCUMENTS CONSIDERED TO BE RELEVANT		
Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 6 253 218 B1 (OBUCHI YASUJI ET AL) 26 June 2001 (2001-06-26) column 26, line 23 - line 67; figures 67,68	1-22
A	WO 98/14863 A (PHILIPS ELECTRONICS NV ; PHILIPS NORDEN AB (SE)) 9 April 1998 (1998-04-09) page 3, line 19 - page 4, line 17; figure 1	2,11
A	EP 0 899 651 A (XEROX CORP) 3 March 1999 (1999-03-03) paragraphs '0057!', '0058!; figure 18	7,8,15
X	US 2002/075322 A1 (PRABHU PRASAD V ET AL) 20 June 2002 (2002-06-20) paragraph '0029! - paragraph '0034!; figures 1,2,6-9	3,12,18,21
<input type="checkbox"/> Further documents are listed in the continuation of box C. <input checked="" type="checkbox"/> Patent family members are listed in annex.		
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Date of the actual completion of the international search		Date of mailing of the international search report
30 August 2004		03/09/2004
Name and mailing address of the ISA European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Tx. 31 651 epo nl, Fax: (+31-70) 340-3016		Authorized officer Mouton, B

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INTERNATIONAL SEARCH REPORT

Information on patent family members

International Application No
PCT/JP 03/14286

Patent document cited in search report	Publication date	Patent family member(s)	Publication date	
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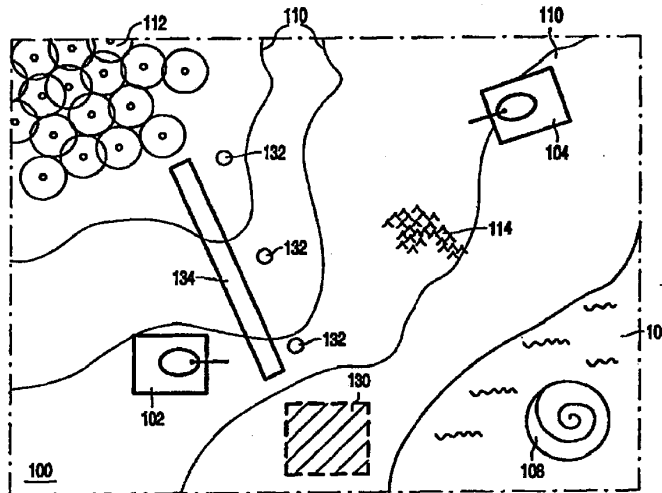
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<p>(21) International Application Number: PCT/IB99/00035 (22) International Filing Date: 14 January 1999 (14.01.99) (30) Priority Data: 98200180.2 23 January 1998 (23.01.98) EP (71) Applicant: KONINKLIJKE PHILIPS ELECTRONICS N.V. [NL/NL]; Groenewoudseweg 1, NL-5621 BA Eindhoven (NL). (71) Applicant (for SE only): PHILIPS AB [SE/SE]; Kottbygatan 7, Kista, S-164 85 Stockholm (SE). (72) Inventor: KEYSON, David, V.; Prof. Holstlaan 6, NL-5656 AA Eindhoven (NL). (74) Agent: GRAVENDEEL, Cornelis; Prof. Holstlaan 6, NL-5656 AA Eindhoven (NL).</p>	<p>(81) Designated States: JP, European patent (AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE). Published <i>Without international search report and to be republished upon receipt of that report.</i></p>	

(54) Title: MULTIPERSON TACTUAL VIRTUAL ENVIRONMENT



(57) Abstract

The invention relates to a method and a terminal for providing a common virtual environment to a plurality of users, for example a game environment. According to the method, each user is provided with an actuator allowing for receiving mechanical input from the user as well as for outputting mechanical feedback to the user. The user controls with the mechanical input a position of a corresponding user object (102) with respect to the virtual environment, and receives tactual cues as originating from tactual environment objects (130, 132, 134) and from distant user objects (104) that are present in the virtual environment. According to the invention, the user can position at least one of the tactual environment objects (130, 132, 134) by appropriate positioning actions.

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Multiperson Tactual Virtual Environment.

The invention relates to a method of providing a common virtual environment to a plurality of users, at least one user being provided with a local actuator for receiving mechanical input from the user and for outputting mechanical feedback to the user, the method comprising the steps of:

- 5 adjusting for the at least one user, in response to the mechanical input, a position of a corresponding user object with respect to the virtual environment comprising tactual environment objects, and
- presenting to the at least one user, through the mechanical feedback, tactual cues as originating from the tactual environment objects and from distant user objects. The
- 10 invention further relates to a terminal for use with such a method.

US Patent 5,405,152 describes a multiplayer game in which each player is represented by a corresponding icon on a screen. The screen further displays a virtual

15 environment through which each player can virtually move by manipulating a corresponding user actuator. Points can be scored by virtually colliding with other players. In the known method, a central processing unit keeps track of the players' virtual positions and sends command signals to the players' actuators in case of particular events such as an icon colliding with another icon or with tactual environment objects in the virtual environment

20 like planets and regions of turbulence. The command signals provoke the relevant user actuator to provide the player with mechanical feedback in conformance with the event, thereby adding realism to the playing of the game.

A disadvantage of the known method is that the virtual environment that is presented has limited attractivity.

25

It is an object of the invention to provide a method as specified in the preamble, which provides a more interesting tactual virtual environment. To this end, the method according to the invention is characterized by the step of positioning at least one of

the tactual environment objects in response to positioning actions by at least one of the users. Besides simple movement of a tactual environment object from one place to another in the virtual environment, positioning also means creation of a tactual environment object into the virtual environment or removal of a tactual environment object from the virtual environment.

5 Thus, the invention enables a user to create, move and remove obstacles that are actually felt by the other users, thereby enabling him to customize the virtual environment to his own wishes and to have a greater influence on the course of events.

An advantage of the measure of Claim 2 is that the users can adjust the tactual properties of individual tactual environment objects, thereby providing the users with
10 a still larger hold on the look and feel of the virtual environment.

An advantage of the measure of Claim 3 is that the tactual properties of the users themselves are dynamic. In a game environment for example, a user just having taken in food provokes a heavier blow when colliding with an other user, indicating that his strength has increased.

15 An advantage of the measure of Claim 4 is that a user can confront an other user with a tactual environment object that is visually but not tactually hidden from him. Preferably, only the user from which such an invisible object originates is presented with a visual representation of the object. This further enriches the virtual environment.

An advantage of the measure of Claim 5 is that more processing can be
20 done locally. Specifically, the tactual feedback resulting from the virtual environment can be initiated locally in contrast with the known method centrally initiating all tactual feedback. In this way, the amount of required communication and central processing is reduced. These demands would otherwise increase to unacceptable levels as a result of the increased hold that users have on the look and feel of the virtual environment as offered by the invention.

25 The library can be part of the application software or be application-independent. In the latter case, the library could be incorporated in the system software of which applications can make use of. In this manner, the library is accessible to a multitude of applications. The library can also be located within the actuator.

30 These and other aspects of the invention will be apparent from and elucidated with reference to the embodiments described hereinafter.

In the drawings:

Figure 1 shows a schematic view of a scene from a video game in which

the invention is applied,

Figure 2 shows a set-up in which the method according to the invention can be applied, and

Figure 3 shows a functional block diagram of a terminal through which a
5 virtual environment can be presented and manipulated according to the invention.

Figure 1 shows a schematic view of a scene from a video game in which the invention is applied. It shows a visual representation of a virtual environment ('theater of
10 war') 100 for a tank battle. Using respective interconnected terminals, a first and a second user move user objects, namely a tank 102 and a tank 104, respectively, through a natural area. Each user is presented with the visual representation of the virtual environment of
Figure 1 on displays that are integrated in the terminals. The users control the movement of their tanks by manipulating respective actuators that are also integrated in the terminals. Here
15 we assume the actuators are trackballs with force feedback, as disclosed for example in EP-A 489 469 (PHN 13,522, US Patent Application serial no. 08/678,115) and EP-A 760 118 (PHN 15,232, US Patent Application serial no. 08/615,559). Such a trackball comprises a rotatable member that is mounted in a housing and motors for transmitting forces to a user via the rotatable member. By means of these forces, the users are enabled to feel the virtual
20 environment 100 while moving their tanks 102, 104. These forces are determined by the tactual properties of tactual environment objects that are present in the virtual environment.

In Figure 1, examples of such tactual environment objects are a river 106 comprising a kind of maelstrom 108, a hilly terrain, the slopes of which being indicated by contours 110, a forest 112 and bumpy surface 114. Each of these tactual environment objects
25 has certain tactual properties that are translated into tactual cues when a user object enters a region of influence of the tactual environment object or actually collides with such an object. For example, when one of the tanks 102, 104 enters the river 106, the corresponding user will actually feel that he can more freely manipulate the actuator, thereby suggesting that he looses grip. When approaching the maelstrom 108, the user will feel a force in a direction
30 tangential to the maelstrom 108. Beyond a certain point, he will enter a violent spin that is felt through the actuator. The user feels a gradient of terrain altitude via the actuator as a force that is proportional to a gradient of terrain altitude in correspondence with the contours 110. When moving through the forest 112, the user will feel a succession of blows opposite to the direction of movement, representing the snapping of trees. The bumpy surface 114 can

be felt via the actuator as a vibration of the member. These objects are hard-programmed, this means that they are not user manipulatable.

According to an aspect of the invention, in addition to the hard-programmed tactual environment objects, users can create, move and remove certain user-manipulatable tactual environment objects. In Figure 1, user-manipulatable tactual environment objects are a pit 130, anti-tank blocks 132 and a wall 134. They are assumed to be part of a defense line that is erected during the game by the first user. When either one of the users moves his corresponding tank 102 or 104 beyond a certain point into the pit 130, his control over the tank diminishes and a force on the member in the direction of movement will establish a virtual pull on the tank, dragging the latter into the pit 130. In this way, the user feels his tank virtually slipping into the pit 130. The pit 130 is assumed to be made invisible to the second user, but it can be seen by the first user, who actually 'dug' it. The anti-tank blocks 132 establish impenetrable obstacles that provoke a rigid force on the actuator member impeding a movement of the member beyond a certain position. The wall 134 has a similar effect, but is assumed to break down when rammed by a tank that has a momentum beyond a certain minimum threshold, thereby allowing the passing through of the tank.

Any one of the tactual environment objects 130, 132 and 134 can be moved or removed by appropriate positioning actions of either user. By dragging and dropping tactual environment objects on top of one another, the user can create new tactual feedback effects, that are composed of a combination of the original effects. Alternatively, either player can adjust the tactual properties of these objects by appropriate adjustment actions. For example, by decreasing the depth of the pit 130, the pull that is felt by the users when moving into the pit 130 is lowered. Furthermore, by appropriate alteration actions the users can alter the tactual properties of the tanks. For example, by moving his tank through a magnet somewhere in the virtual environment, either one of the users can 'magnetize' his tank. Subsequently, the other users will experience an attractive force in the direction of the magnetized tank. The magnetization gradually wears off.

Particularly in a strategy game like this tank battle game, the advantages of the invention are apparent. The user can manipulate the environment as if he were a military engineer. Moreover, the tactual properties of the user objects are not static, as in the known method, but can be altered by the users. This all broadens the hold of the user on the course of events and increases the level of his participation.

The mechanical influence of a tactual environment object, be it a hard-

programmed one or one that is positioned by the users, is in some cases limited to a small area, like with a virtual wall, which upon colliding with a user object provokes the actuator corresponding to that user object to simulate an impact. Alternatively, a tactual environment object's mechanical influence on the users can extend over an arbitrary large part of the virtual environment, e.g. when the tactual environment object virtually incurs some kind of gravitational force.

Besides tactual environment objects, that are environment objects having tactual properties that can be felt by the users, the virtual environment could furthermore contain environment objects that have no tactual properties. An example of such an environment object is a visual mark on the ground or a cloud of gas, etc.

Instead of presenting the users with a plan view, the visual presentation of the virtual environment to the user could simulate the perspective of the user objects, like is usually done in virtual reality. The number of users that can simultaneously move through the virtual environment is not principally limited to two, as in the present embodiment. The method of the invention could be used in combination with an arbitrary number of users.

Figure 2 shows a setup in which the method according to the invention can be applied. A central server 210 is connected to a number of terminals 220 via a network. Each of the terminals 220 is a box in which an actuator 230 being a force feedback trackball, a local processing unit 240, a display and speakers (not shown) are incorporated. Alternatively, the processing unit 240 is incorporated in a settop-box and that the trackball is included in a remote that cooperates with the settop-box. A visual and an auditory representation of the virtual environment is presented via a television set that is a further part of each terminal 220. Alternatively, each terminal includes a personal computer with additional peripherals, such as a stand-alone force feedback trackball, modem, etc.

The central server 210 is responsible for keeping the virtual environment consistent. Hereto, the terminals 220 regularly sent scripts to the central server 210. The scripts contain information about the actions performed by the each user and the position of the corresponding user objects. A script could contain information about positioning actions of users, by which a tactual environment object is positioned or about adjustment actions, by which tactual properties of a tactual environment object are adjusted. Similarly, a script could contain information about an alteration action performed by a user, by which tactual properties of his user object are altered. The central server interprets the scripts and redistributes the information that should be present at the other terminals. During this process, the central server 210 can filter out and manipulate information before the

redistribution step. Other tasks of the central server 210 are managing user accounts, identifying users at login time and recording user profiles. A different distribution of the various tasks over the central server 210 and the terminals 220 can be imagined.

Figure 3 shows a functional block diagram of a terminal through which a
5 virtual environment can be presented and manipulated according to the invention. The terminal has a communication manager 330 for sharing the virtual environment with distant terminals. A local actuator 345 is provided for receiving mechanical input from a local user as well as for outputting mechanical feedback to the local user. An application manager 310 is arranged for adjusting for the local user, in response to the mechanical input, a position of
10 a corresponding local user object with respect to the virtual environment. A virtual environment presentation manager 320 is included for presenting to the local user, through the mechanical feedback, tactual cues as originating from tactual environment objects and from distant user objects that are present in the virtual environment.

A device driver 340 provides a link between the virtual environment
15 presentation manager 320 and the application manager 310 on the one hand, and the tactual feedback actuator 345 on the other hand. Besides a tactual representation, the virtual environment presentation manager 320 also provides the user with a visual and an auditory representation of the virtual environment. Hereto, the virtual environment presentation manager 320 is linked to device drivers 350 and 360, controlling a built-in display 355 and
20 built-in speakers 365, respectively. Main control unit 380 has a scheduling function, it allocates hardware resources within the terminal to the elements 310, 320, 330 so that they can perform their tasks. Alternatively, each one of the elements 310, 320, 330 can be realized with dedicated hardware, in which case the separate control unit 380 is redundant. The various tasks can also be differently organized within the terminal.

25 According to an aspect of the invention, the application manager is arranged for positioning at least one of the tactual environment objects in response to positioning actions by the local user. Upon identifying such a positioning action, the application manager 310 takes care of updating the virtual environment both locally through the virtual environment presentation manager 320 and at the distant terminals through the
30 communication manager 330. The same applies to adjustment actions and alteration actions of the user, by which tactual properties of tactual environment objects and user objects, respectively, are modified.

According to an aspect of the invention, the virtual environment presentation manager is arranged for keeping a topography of the virtual environment and for

obtaining tactual properties of a particular tactual environment object within the topography by referencing a locally present library 370 of generic tactual fields. With both the topography and the library 370 being located within the terminal, all information for generating the tactual feedback is locally present. Thus, extensive communication with the
5 central server is avoided and the generation of the tactual feedback can be performed locally. The library 370 is stored in a memory and can be updated through downloading additional tactual fields or through creation and modification of tactual fields by the local user.

It should be noted that the above-mentioned embodiments illustrate rather than limit the invention and that those skilled in the art will be able to design many
10 alternative embodiments without departing from the scope of the appended claims. In the claims, any reference signs placed between parentheses shall not be construed as limiting the claim. The invention can be implemented by means of hardware comprising several distinct elements, and by means of a suitably programmed computer. In the device claim enumerating several means, several of these means can be embodied by one and the same
15 item of hardware.

CLAIMS:

1. Method of providing a common virtual environment to a plurality of users, at least one user being provided with a local actuator (345) for receiving mechanical input from said at least one user and for outputting mechanical feedback to said at least one user, said method comprising the steps of:
- 5 adjusting for said at least one user, in response to the mechanical input, a position of a corresponding user object (102) with respect to the virtual environment comprising tactual environment objects (130, 132, 134), and
- presenting to said at least one user, through said mechanical feedback, tactual cues as originating from the tactual environment objects (130, 132, 134) and from distant
- 10 user objects (104),
- characterized in that the method comprises the step of positioning at least one of the tactual environment objects (130, 132, 134) in response to positioning actions by at least one of the users.
2. Method as claimed in Claim 1, comprising the step of adjusting tactual
- 15 properties of at least one of the tactual environment objects (130, 132, 134) in response to adjustment actions by at least one of the users.
3. Method as claimed in Claim 1, comprising the step of altering tactual properties of at least one of the user objects (102, 104) in response to alteration actions by at least one of the users.
- 20 4. Method as claimed in Claim 1, comprising the step of visually hiding at least one of the tactual environment objects (130, 132, 134) for at least one of the users.
5. Method as claimed in Claim 1, wherein said at least one user is provided with local processing means, the method comprising the steps of
- keeping a topography of the virtual environment in said local processing means
- 25 and
- obtaining tactual properties of a particular tactual environment object within said topography by referencing a library of generic tactual fields that is kept in said local processing means.
6. Terminal for presenting a virtual environment to a local user, the terminal

comprising

communication means (330) for sharing said virtual environment with distant terminals,

a local actuator (345) for receiving mechanical input from the local user as well
5 as for outputting mechanical feedback to the local user,

an application manager (310) for adjusting for the local user, in response to said mechanical input, a position of a corresponding local user object (102) with respect to the virtual environment comprising tactual environment objects (130, 132, 134), and

a virtual environment presentation manager (320) for presenting to the local
10 user, through said mechanical feedback, tactual cues as originating from said tactual environment objects (130, 132, 134) and from distant user objects (104),

characterized in that the application manager (310) is arranged for positioning at least one of the tactual environment objects (130, 132, 134) in response to positioning actions by the local user.

15 7. Terminal as claimed in Claim 6, wherein the application manager (310) is arranged for adjusting tactual properties of at least one of the tactual environment objects (130, 132, 134) in response to adjustment actions by the local user.

8. Terminal as claimed in Claim 6, wherein the application manager (310) is arranged for altering tactual properties of the local user object (102) in response to alteration
20 actions by the local user.

9. Terminal as claimed in Claim 6, wherein the application manager (310) is arranged for visually hiding at least one of the tactual environment objects (130, 132, 134) for the local user.

10. Terminal as claimed in Claim 6, wherein the virtual environment
25 presentation manager (320) is arranged for keeping a topography of the virtual environment and for obtaining tactual properties of a particular one of the tactual environment objects (130, 132, 134) within said topography by referencing a locally present library (370) of generic tactual fields.

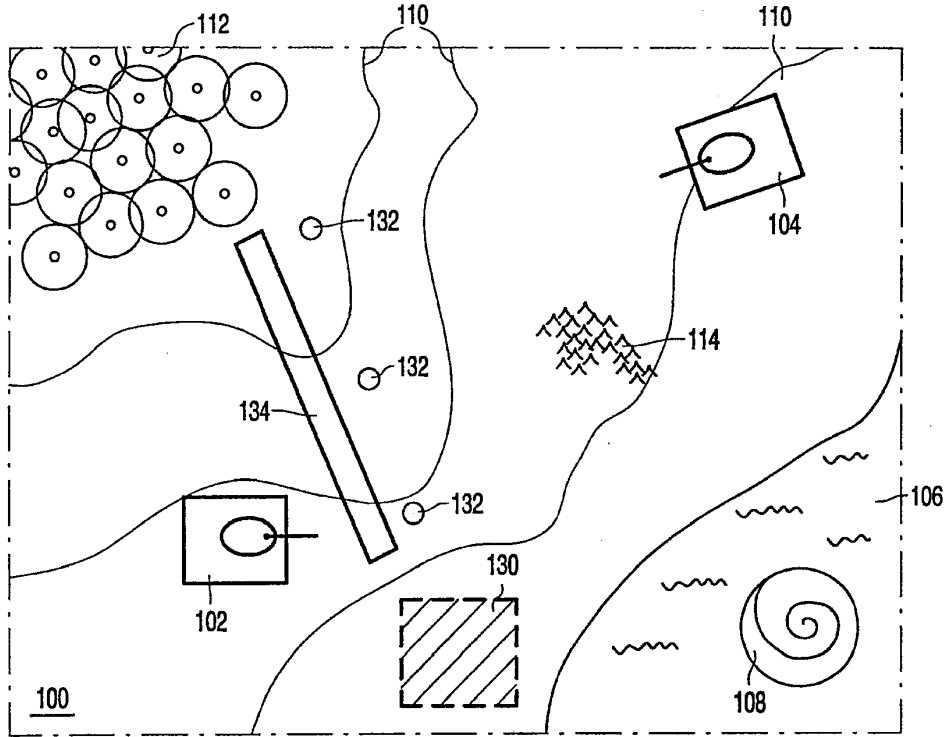


FIG. 1

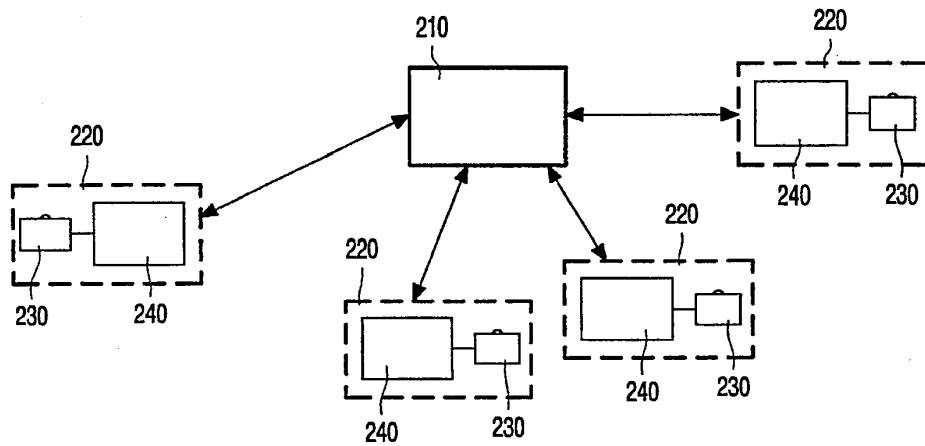


FIG. 2

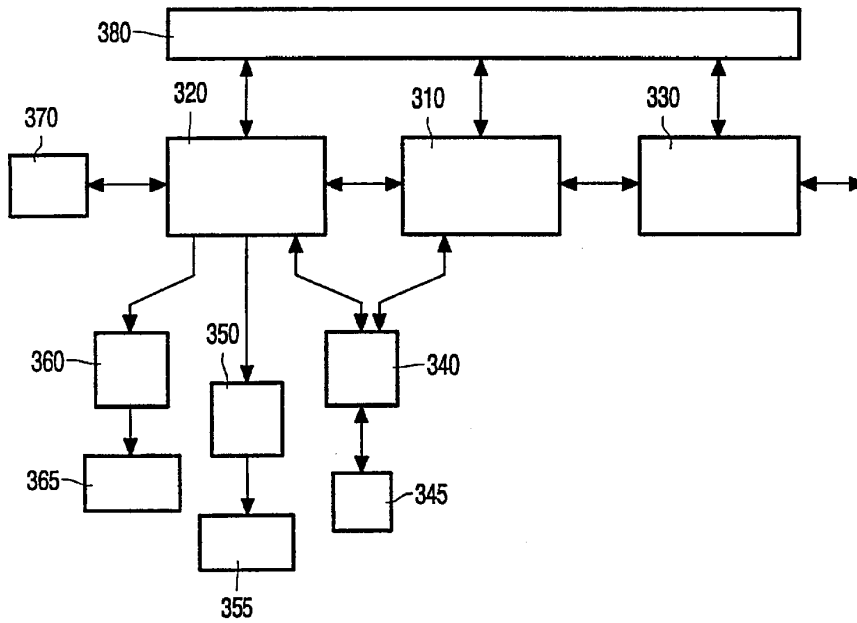


FIG. 3

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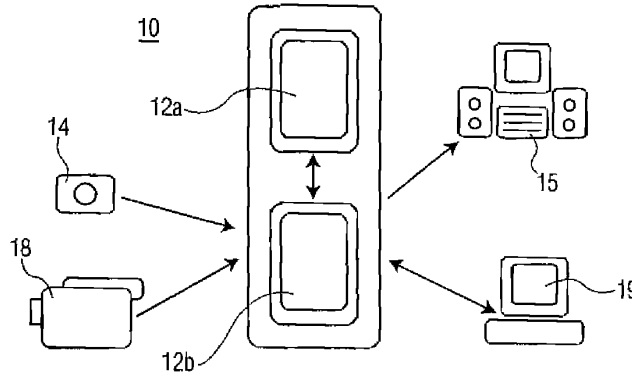
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- (71) Applicant (for all designated States except US): KONINKLIJKE PHILIPS ELECTRONICS, N.V. [NL/NL]; Groenewoudseweg 1, NL-5621 BA Eindhoven (NL).
- (71) Applicant (for AE only): U.S. PHILIPS CORPORATION [US/US]; 1251 Avenue of the Americas, New York, NY 10020 (US).
- (72) Inventors; and
- (75) Inventors/Applicants (for US only): VAN DE SLUIS, Bartel, Marinus [NL/NL]; P.O. Box 220, NL-5600 AE Eindhoven (NL). HOLLEMANS, Gerrit [NL/NL]; P.O. Box 220, NL-5600 AE Eindhoven (NL). SOMMEIJER, Mathijs, Alexander [NL/NL]; P.O. Box 220, NL-5600 AE Eindhoven (NL).
- (74) Common Representative: KONINKLIJKE PHILIPS ELECTRONICS, N.V.; c/o THORNE, Gregory, L., Groenewoudseweg 1, NL-5621 BA Eindhoven (NL).
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[Continued on next page]

(54) Title: SYSTEM FOR AD HOC SHARING OF CONTENT ITEMS BETWEEN PORTABLE DEVICES AND INTERACTION METHODS THEREFOR



(57) Abstract: A user interface concept for wireless ad hoc content sharing between portable devices referred to as portable content containers (PCCs). A user-centered design approach is provided enabling users to share content such as music and photos. A variety of physical ways of establishing a secure connections between the PCC devices is provided. In addition, a clear view on the location of the content stored on the devices, and a drag & drop interface is provided. Use is made of separate spaces, each containing the corresponding content and includes a "shared" space such that all connected users may transfer content to and from to their own personal devices. The use of a drag & drop interface in combination with the subdivision of the screen into several spaces, provided the user with a clear view on the content location. The close proximity of users is assumed and enhances social interaction.

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LU, MC, NL, PT, RO, SE, SI, SK, TR), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG)

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SYSTEM FOR AD HOC SHARING OF CONTENT ITEMS BETWEEN PORTABLE DEVICES AND INTERACTION METHODS THEREFOR

The present invention relates to portable device technology including products that
5 implement storage and wireless connectivity, and particularly to a user interface concept for
a portable multimedia storage device with the focus on content sharing over ad-hoc
networks.

Today's portable "infotainment" (content used for information or entertainment)
players have already a large capacity. One example device is the "iPod" digital music
10 player available from Apple Computer, Inc. However, to exchange music or video files
they have to be connected to a PC or audio equipment with connections now mostly
established with the use of cables (e.g., USB or FireWire) and the user interface of those
products is adapted to that situation.

The Portable Content Container (PCC) is considered to be the next generation
15 portable multimedia player enabled by advances in wireless connectivity, digital data
storage and compression, display and power supply technologies.

For example, with respect to wireless connectivity, the PCC device may implement
the 802.11b standard, also known as Wireless Fidelity (WiFi™) which makes it possible to
create a wireless network. In theory, the bandwidth should be sufficient to transfer a TV
20 signal wirelessly with a range of up to 100 m. Within the WiFi™ connection two modes
are defined: 1) an *infrastructure* mode that makes it possible to set up a Wireless Local
Area Network (WLAN), for examples, in offices and hotels. This is used to create wireless
workspaces. In this mode fixed access points are used to communicate with the portable
devices. Each device communicates with one of these fixed access points. Its device's
25 position can be derived from the distance to at least three of these points; 2) the *ad hoc*
mode is used to make a link between portable devices for a peer-to-peer (p2p) connection.
Operating in this mode, it becomes possible to spot other devices that are within range by
sending out a signal now and then to check their presence. When another device or access
point is discovered, standardization in the field of communication between wireless devices
30 makes that a communication link can be established.

Apart from the described WiFi™ connection, also other wireless applications may
be added such as Global Positioning System (GPS) and Internet connections. By adding
these, worldwide communication and location determination are possible. This way the

PCC concept becomes more an all-purpose device with the functionality of a portable audio player, a PDA and a mobile phone combined.

5 Currently, the present quality of wireless connections is not sufficient to be used in a product like a portable multimedia player. Especially using the ad hoc mode linking devices in a secure way is a problem.

With respect to data storage, the PCC device may implement distributed or local storage. With stored, distributed content, every time a specific item is rendered, the information has to be transferred. Storing the content locally is the only solution for portable devices that are used on the move when no stationary database is nearby to 'stream' data from. Three types of storage are available: optical (for example the Compact Disc), magnetic (Hard Disc) and solid state (Flash memory). Optical discs are easily exchangeable and relatively cheap; however, a drive is needed. Although, the capacity is increasing and the size decreasing, optical discs in portable devices are sensitive to shocks especially during writing the data. Solid-state memory is one of the fastest, smallest storage available. Because it has no moving parts, it is well protected against shocks. Currently the capacity is insufficient and the price too high. At this moment a hard disc is the cheapest form of storage and its capacity does exceed that of the other two forms of storage. It provides a large capacity on portable size. Currently, a small 1.8-inch hard disc can hold up to 200 Gbyte, while its capacity is still rapidly increasing.

20 It is understood that music and video requires vast storage capacity and currently, hard discs are the only form of storage that can satisfy this requirement. Since the PCC device combines wireless connectivity with local storage, the memory itself does not have to be exchangeable. Therefore, a hard disc is a preferred solution, however, solid-state memory will be a viable option as the price and capacity will be competitive to that of hard discs.

25 With respect to the display, the PCC device must implement a color display for rendering photos or videos and to keep the device portable (the size of the present PDA's) a screen size of approximately 4-inch is advantageous. While the screen is illuminated to guarantee good visibility under all conditions, the resolution of present 4-inch screens is 30 240 x 320 pixels, minimum. Apart from viewing photos and videos the display can be used for controlling the device. For example, adding a touch screen it becomes possible to operate the device by an onscreen interface, and operable with a stylus.

Almost all portable devices rely on rechargeable batteries. Rendering photos or videos on an illuminated screen consumes lots of energy. Likewise holds for the wireless connection when checking for other devices and when transferring data. With today's capacity the operating time is limited to only a few hours, however, developments like the polymer battery or fuel cell provides a solution for this problem.

Prior art solutions in the field of connecting and transferring data content focussed on the interactive use of portable displays include: "Kidcom" (Kusano, Kidcom project, Personal Intelligent Communicator for girls aged 7-12 years old, Master's Industrial Design Engineering Project, Philips Research, Eindhoven, The Netherlands, Faculty of Industrial Design Engineering, University of Delft, Delft, The Netherlands 1994), which is a communication device for children that can communicate with other devices using a short-range infrared connection. Text notes, pictures can be created and sent to other users. The sending is initiated by pushing a button on top while aiming at another device. An LED and an audible signal provide feedback whether the transmission was successful. To send messages to another device, the infrared ports have to be aligned.

Sony's Pick-and-Drop system described in U.S. Patent No. 6,470,341 to Rekimoto, is a manipulation technique to copy data from one (computer) screen to another. A more natural way to move things: lifting things up, move and drop is used instead of the well-known drag-and-drop way. To do this, a pen and a touch-screen are used. When the user contacts the screen with a pen and lifts the pen a little, the file is 'floating' above the screen using a shadow. When the user completely lifts the pen, the pen virtually holds the file. It is now possible to tap at another screen and copy to the other computer system. Here the mental model of the user is different from the way the system works. For the user it seems like the data is stored locally in the pen, but the pen does not have storage capacity. The pen contains a unique ID tack, which can be read out when close enough to the screen. The network uses this ID to copy the file wirelessly to the designated place, for example another PDA device.

Thus, the new technologies described above make it possible to exchange content wirelessly with other users on the move. This development has great implications for the user interface (UI) of these devices. Aspects like privacy and 'ad hoc' networking are becoming very important issues and personal content or content protected by digital rights should not be available for anyone. Until now there is no existing user interface that deals

with these aspects.

It would be highly desirable to provide a user interface concept for a portable multimedia storage device such as the PCC with the focus on content sharing using current technology.

5 It is the usability of the PCC device interactions and the development of a user interface that meets the technological constraints, that is the focus of the invention .

According to the principles of the invention, there is provided a system and method for ad hoc sharing of content stored in portable devices, the system comprising: a means for establishing a communications link to connect a single portable device to one or more
10 other portable devices; a means for generating a visualized shared space on a display area of each portable device of a connected user for facilitating content exchange between connected users via established communications links; and a means for enabling each individual connected user to control transfer of content to and from that user's portable device via said communications link in response to manipulation of items representing user
15 content in said shared space.

The objects, features and advantages of the present invention will become apparent to one skilled in the art, in view of the following detailed description taken in combination with the attached drawings, in which:

Figure 1 depicts a generic block diagram depicting the environment 10 of the PCC
20 12 system that includes input devices, PCC, and playback and back-up devices, according to the invention;

Figures 2(a)-2(f) depict example PCC usage scenarios in the "connect-exchange-disconnect" order according to the invention;

Figures 3(a) - 3(e) depict examples of the "Being connected" variant for
25 establishing ad hoc transfer of media content between PCC devices;

Figures 4(a)-4(c) depict in greater detail the 'point & link' concept and the visualization of content transfer between PCC devices according to the invention;

Figures 5(a) - 5(f) depict examples of the "Connect when sending" variant for establishing ad hoc transfer of media content between PCC devices;

30 Figures 6(a)-6(c) depict in greater detail the 'point & link' concept and the visualization of content transfer between PCC devices according to the invention;

Figure 7 depicts the generation of the shared space and another space that includes

the content of the other device added to the PCC display screen 13 after making contact to the other device;

Figure 8 illustrates a PCC device having three spaces and a user icon 89a generated for display within a circle 88a and used for indicating connection with that user;

5 Figures 9(a)-9(b) shows two variations of a border bar that borders a space holding the content stored on a PCC device;

Figures 10(a) and 10(b) depict selected content in a text view metadata format (music) and a thumbnail view format (photos);

10 Figure 11 depicts an exemplary button menu providing buttons enabling functionality for switching between the content type (music and photo) and the presentation mode;

Figure 12 illustrates two example items 95a,b in an example shared space of a user device 75 shown color coded for user identification;

15 Figures 13(a) and 13(b) illustrate an exemplary user interface scenario for navigating through content; and,

Figures 14(a) – 14(l) illustrate an exemplary user interface concept according to a further embodiment of the invention.

20 The Portable Content Container (PCC) is the next step in portable multimedia players having dimensions on the order of the size of current PDAs. Since the concept of an PCC audio / photo player with the added functionality of exchanging items is considered to be one aspect of the PCC, this functionality is illustrated in Figure 1 as now described. Particularly, Figure 1 illustrates the environment 10 of the PCC 12 that includes input devices 14, 18 like digital cameras and A/V playback 15 and back-up devices 19, and additionally, the communication between two portable devices (PCCs) 12a, 12b.

25 Particularly, each PCC 12a, 12b is a lightweight and portable device that easily fits in a user's pocket and implements a stylus for the on-screen drag & drop manipulations, as will be further described. Music, photos and videos are obtained from the Internet, capture devices (such as digital cameras 14 or digital camcorders 18) and other PCC's. This content can be rendered on the device itself, however, may be wired or wirelessly

30 connected to stationary devices that provide better quality, such as TV and/or A/V system 15. Since not all content can be exchanged freely, a solution in the field of digital rights is included.

The PCC 12a, 12b is considered the successor of the portable multimedia player, with added functionality to share content wirelessly. For ad hoc communication, a WiFi™ connection with limited range is preferred, but other short range wireless communication standards may be used. Furthermore, it is assumed that users prefer to communicate before they actually exchange music or photos. Thus, the invention assumes a prior face-to-face communication, i.e., social contact, preceding the exchange of content. Thus, a "connect-exchange-disconnect" order is followed so that a user feels in control by being able to decide to whom he/she connects and when he/she aborts the link.

In a first usage scenario 20, depicted in Figure 2(a), a discussion about the content being exchanged between two users and their respective devices 12a, 12b will precede the actual sharing, so it is assumed people would have close contact. Being in close proximity provides privacy and communication is easy (talking to each other is more effective than other ways of communication). When two users are not in close proximity, the users may not appreciate being detected by others.

Figure 2(b) depicts a remote user connection scenario 30. As shown in Figure 2(b), although the person may be in line of sight, the devices 12a, 12b may still not know the presence of each other. The wireless connection may only detect devices within a range of 50 meters, for example. Thus, letting a first device detect other devices automatically when being nearby, all devices within a range are spotted. This results in a list of present devices or friends nearby, from which the user may choose the right one. Since the users are nearby each other, an action executed by the user, which allows him to connect directly and unambiguously to the person standing in front of him, is preferred. Since this action has to be executed every time a connection is made, it has to require low effort. After this connection is made, the distance can be increased to give the users more freedom of movement. Feedback on the connection is given immediately as the feeling of security for the user is important and this feeling is increased when providing clear feedback.

Figure 2(c) depicts a multi-user scenario 40. Due to privacy reasons a third user (depicted by device 12c) should not be able to connect without the notice of the other two users (devices 12a, 12b). When a third user wants to join the group, it would be consistent to use the same action of connecting. Identifying to both users (or more when multiple users are involved) requires effort. However, when all users are in close proximity they can decide by discussion whether they allow the third user to join or not. Identifying to one

user should therefore be enough to join the group.

Figure 2(d) depicts a content display scenario 50. To provide a clear view to the users about the location of the content, it must be clear which items are owned by the user and which items are not or are being transferred. The interface is easily understood and should not require technical knowledge. The experience of the end user is utilized as much as possible.

Figure 2(e) depicts a content exchange scenario 60. The process of exchanging items requires less effort for the users, and it is possible to easily share multiple items with multiple users. Digital Rights Management issues have been taken into account. A recipient of content is additionally provided with feedback about the status of the exchange process.

Figure 2(f) depicts a disconnection scenario 70. Disconnecting is possible at all times by any user. Combining the action of connecting with disconnecting creates a link / unlink association for the user comparable with an on / off button. When devices are connected and the user walks out of range, then automatically the connection is terminated. This also aborts the exchange of items. It is assumed the disconnecting is also regulated by social interaction.

With respect to exchanging content items, a user must indicate to which device he/she wants to communicate. In the absence of wired connections the problem occurs to indicate the desired device to connect with. As the nature of the content may be personal, the user has to be provided with a secure feeling that his content is available for specific users only which requires linking the devices in a secure way without involving other devices by accident. As mentioned, transferring content wirelessly involves a secure transmission as all devices within range can intercept the transferred data. Encryption technologies are thus used to establish this. By encrypting data before transferring it wirelessly, it cannot be decrypted without having the 'key'. Particularly, a content owner encrypts the content and the information about this process is stored in a key. With this key, the receiver can decrypt the data and transform it back in a readable format. The advantage of using encryption in a multi-user situation is that only the users that possess the key can 'read' the data. The owner can provide the key to the users he selects. This key can be combined with personal information about the owner (e.g., a name or icon).

Within encryption, the PGP (Pretty Good Privacy) standard makes use of two keys:

a public and a private one. The public one is available for everyone and is used to encrypt information. The private one is held by one person and is used to decrypt the information. Content transferred PGP makes it possible to build a friend list and send content to the selected person, no matter the location.

5 Furthermore, Infrared communication is a connection standard can be used to wirelessly 'beam' data from one device to another. It requires facing the transmitter to the receiver and it only works within a short range. Within Infrared connections, there are two modes that may be exploited: A short range, e.g., up to 1.0 meter, connection for sending data called IrDA data. This mode requires the aiming of the infrared port at another
10 infrared port. In this mode, the angle of the beam and the intensity are adjustable. The second mode, called IrDA control functions up to 6 meters, for example, and is used in a wireless mouse and keyboard. It is bi-directional and allows up to eight (8) devices simultaneously.

 Furthermore, sensors may determine the location or orientation of the device. Thus,
15 determining locations in an ad hoc network can be realized with the use of ultrasound transceivers, for example. This technology makes use of sound pulses to determine the relative location of nearby devices. A set of orientation sensors can determine the orientation of a device. Thus, for example, it is possible to determine whether a device is in an upside down position or not.

20 More particularly, as will be described in greater detail, physical contact may also be used in the key exchange. For example, each PCC is equipped with an infrared port. Aligning the infrared ports and pressing a button initiates identification and key exchange between the devices. Once the devices are identified the WiFi™ connection is used to transfer at high speed and wider range. Thus, each device may include a tag that can be
25 read out by other devices when being in very close proximity (centimeters). The tag contains the decryption key and information about the user. To prevent unwanted links, the devices may be held against each other. The action is only performed with the full awareness of both users, like a handshake. The information on the tags can be reprogrammed when the user changes his profile. Furthermore, an infrared beam may be
30 used for the linking. Each device is equipped with an infrared port. Aligning the infrared ports and pressing a button exchange the key and identification between the devices. Once the devices are identified the WiFi™ connection is used to transfer at high speed and wider

range. A stylus exchange may also be performed whereby, after two users meet, they exchange their stylus which includes a tag. The tag is read out when bringing it close to the user's respective touch screen. Information about the ID of the users and the key are stored in here. Giving the stylus to another person calls for trust. Additional hardware in the
5 stylus is needed. The touch screen, in this instance, cannot be operated by finger.

With respect to the graphical user interface, content to be exchanged has to be represented in a way that makes clear to the user on what location the content is stored and what actions can be performed. As will be explained in greater detail, a graphical user interface that follows the desktop metaphor is established. Preferably, all content items are
10 represented by icons and can be moved and handled like real physical objects. Present users are additionally represented by icons. Here the accessibility and the relation between the items and the users are visualized. In a so-called *spaces* concept the different locations on the screen are mapped with physical spaces whereby users and content items are moving around in the virtual space. The spaces concept symbolizes the different storage locations.
15 Each storage location (contacted device) is represented by an onscreen space. Thus, when functioning as a stand-alone player only a single space (user's own space) is visible, for example. As will be explained in greater detail, moving items from space to space by drag & drop initiates copying and transferring between the devices.

The conceptual structures for physically linking described herein combined with the
20 *spaces* interface result in structural concepts that provide solutions for ad hoc linking and exchanging content items.

It should be understood that the connect-exchange portion of the linking includes two actions: connecting to the right user and exchanging the items. In this, two variants appear: 1) a "Being connected" variant whereby a first the device sets up a connection with
25 the other device and, when this connection is established, the exchange of content can be started. During the status of "being connected" content can be transferred until a user disconnects; and 2) a "Connect when sending" variant whereby there is no status of being connected. Every time the user wants to exchange content, he/she makes a new connection, i.e., between the data packages there is no connection.

30 Figures 3(a) - 3(e) depict examples of the "Being connected" variant. In a first embodiment 100 depicted in Figure 3(a) when the devices are brought in close proximity (e.g., less than 10 cm) the link establishes automatically ((Figure 3(a)(1)). In this

embodiment, an infrared transmitter may transmit every few seconds to establish the link automatically with a user in close proximity. Alternately, in a further embodiment 101 depicted in Figure 3(b)(1), both devices 12a, 12b may be aimed at each other and the user pushes a 'link' button 17a, 17b when they are "nearby" (e.g., within 30 cm). In this
5 embodiment, an infrared transmitter is activated by a user to establish the link. Preferably, each device gives feedback about the connection made and once the link is established, the devices do not need to be in those ranges anymore, i.e., the users may keep more distance. As depicted by arrows in Figures 3(a)(2) and 3(b)(2) and as will be described in greater detail, a virtual shared space 75 is used to share content items by dragging them into the
10 space, which makes them visible to the other connected users. This space is updated for all connected users each time a new item appears. Pressing a button, for example, on the screen, performs the disconnecting.

The variants depicted in Figures 3(a)-3(b) represent a 'point & link' concept combining an infrared connection with the high speed WiFi™ connection to initiate the
15 contact. Other variants of the "Being connected" concept include: a "Feel the force" type concept 102 as depicted in Figure 3(c) whereby the devices 12a, 12b implement controllable magnetic forces 80 and an automatic infrared connection such that when users bring their devices closer to each other, they feel (magnetic) resistance getting stronger. When users proceed, suddenly the resistance disappears and a link establishes giving
20 physical feedback. While transfer content items, using the virtual shared space, the range may increase without ending the link. Disconnecting is performed by pressing a soft or hard, button on the device. In a 'Right out of the sky' type concept 103 as depicted in Figure 3(d), one user device 12a is transmitting content items and, all devices, e.g., devices 12b, 12c within range (e.g., less than 1 meter) can pick up this content. No link has to be
25 established and disconnecting is not necessary; the user just walks away. It is understood that this technology however, requires the use of encrypted technology and a 'buddy list'. In a 'Radar' type concept variant 104 as depicted in Figure 3(e), the use of ultrasound sensors that measure the position of the other devices 12a, 12b may be used such that when one device, e.g., 12a is close to another device, e.g., 12b, representations of the other
30 devices, e.g., in the form of icons 85a,b, appear on the user's screen. When the device moves, the icon on the screen also moves. Content items, also represented as icons 90, are dragged to these icons 85b to transfer content to the specific user. When out of range (e.g.,

greater than 3 m) the link is automatically broken as depicted in Figure 3(e).

With further respect to 'point & link' concept depicted in greater detail in Figures 4(a)-4(c), when two users meet, they point their devices 12a, 12b each with an infrared port located thereon, at each other, and both press the 'connect' button 17a, 17b at the same time
5 ((Figure 5(a)). This action has to be performed in close proximity in order to prevent unwanted connecting by pointing at another device by accident. After exchanging the key and user information the WiFi™ connection takes over and the users do not have to point their device anymore at each other as a status of 'being connected' is reached. As depicted in Figure 5(b), while being connected, people can exchange items. In this situation, a
10 'shared space' 75 is created which is a (virtual) space that holds the information both people exchange. This space only has this function during the contact and disappears after the connection is aborted. Translating this to the onscreen interface it means that after making contact the space 75 appears, where people can freely and securely exchange content items represented as icons 90. Items (icons) that are placed in this space are
15 accessible to all connected users. Particularly, in this embodiment, as depicted in Figure 5(c), dragging an item 95 from the transferor's device 12a personal space 25a to the shared space 75, makes it visible on the other transferee's device 12b shared space. The item can now be dragged by the other user to his personal space, e.g., space 25b. The downloaded item 95 is displayed in the shared space as contrasted item 95a in order to distinguish
20 already downloaded items. That is, when an item is placed in the shared space, a copy is made from the original. Since the shared space is continuously updated on all connected devices, a copy in the shared space differs from the original on the device of the device owner to indicate who placed it there. This prevents the owner from downloading items to himself. Thus, it is understood that the content stored on the device is displayed outside the
25 shared space in a so-called personal space. Dragging an item from the shared space 75, into the transferee's device 'personal' space 25b (that includes the items stored on the own device) starts the transfer from the other device. When all connected users, except for the owner have downloaded an item it disappears from the shared space 75. Each of the connected users can disconnect at any time by pushing the button 17a, 17b again. In the
30 case of two connected users the connection is terminated when one of them disconnects. When more than two users are connected one can leave while the others still are connected. The items placed in the shared space by the disconnecting user will disappear.

Figures 5(a) - 5(f) depict examples of the "Connect when sending" variant. In a first embodiment 200, depicted in Figures 5(a)(1) - 5(a)(2) a user transferor device 12a first pre-selects the content items (icons) 95 by dragging them in a separate area 75 (Figure 5(a)(1)), and, then pushes a send button 17a while pointing to start the content transfer to the other (transferee) device 12b (Figure 5(a)(2)). In this scenario, an infrared connection is combined with the WiFi™ connection.

The variants depicted in Figures 5(a)(1) and 5(a)(2) represent a 'select & shoot' concept whereby content is first selected and beamed to another user while pointing at the desired device. Both in the selection of the items and in the transfer, the initiative is with the owner. Other variants of the "Connect when Sending" concept include: a "Kiss" type concept 201 as depicted in Figure 5(b) whereby hard buttons 26a,b are implemented such that content items or media collections represented as icons 95 are placed in a respective space 76a,b relating to a button 26a,b. When pressing the buttons 26a,b of respective two devices 12a, 12b against each other as depicted in Figure 5(b), the transfer of the content files is initiated. No disconnecting is needed. In a 'Fly-by' type concept 202 as depicted in Figure 5(c), tags or magnetic induction technology is implemented such that the user pre-selects the content, e.g., represented as icons 95, and places it in a separate space 76. Two devices 12a, 12b are moved along each other in very close proximity in directions as depicted by arrows 86a,b to initiate the copying. As shown in Figure 5(c) the devices are oriented horizontally and are virtually swiped next to each other lengthwise (without contact) to effect the content transfer. Multiple copies may be made this way and disconnecting is not needed. In a 'Gravity' type concept 203 depicted in Figure 5(d), metal contacts, and infrared eye or magnetic induction are implemented such that the pre-selected content represented by icons 95 are put in a special space 76 for example, in device 12a. By placing the device 12a on top of transferee device 12b, as in a stack, for example in the manner as depicted in Figures 5(d), the content transfer is initiated, as shown by the transferred icon in device 12b. After the content is transferred, connection is terminated. In a 'Shake It' type concept 204 as depicted in Figure 5(e), acceleration sensors and infrared eye technology are implemented such that, transfer of pre-selected content, e.g., represented as icons 95, may be initiated when the devices 12a, 12b are placed together in an abutting fashion as depicted in Figure 5(d) and shaken. After the 'shaking', the content items are transferred, e.g., from device 12a to device 12b. Disconnecting is performed automatically

thereafter. In a 'Liquid Content' type concept 205 as depicted in Figure 5(f), rotation sensors and infrared eye technology may be implemented such that transfer of pre-selected content, represented as icons 95, are first placed in a separate corner 77 of the screen display of a transferor device 12a, for example. The content transfer is then initiated when
5 the transferor device 12a is held vertical and in close proximity to another transferee device 12b. When all content is transferred the connection is stopped.

With further respect to 'Select & shoot' concept depicted in greater detail in Figures 6(a)-6(c), the transferor user pre-selects the content he/she wants to send to another user. Selecting the content items represented as icons 95, is performed by the user himself or
10 after getting an indication from the other (transferee) user which items he/she would like to receive. As shown in Figure 6(a), the user selects the items that will be copied to the other user and drags the items (icons) 95 into a separate send space 78 of the transferor device 12a. It is understood that a copy of each item is made to preserve the original. Until the moment of transfer there is no connection between the devices. When the devices are
15 pointed at each other, a send button, e.g., 17a, is pressed and the transfer starts. In the visualization depicted in Figure 6(b), the send space 78 moves towards the upper edge of the screen- collapsing in size as depicted by arrows and effectively pushing the items 95 to the transferee device 12b. It is understood that the key and identification is exchanged before starting with the actual transfer. As shown in Figure 6(c), after the transfer, the
20 user's send space 78 lowers again as depicted by the arrows, however, items 95 may still remain in the 'send space' 78 for a second transfer to another user. The owner may add or remove some items before sending them to another user. It is also possible to permanently place popular items in the 'send space' 78. After transferring the items to the transferee device 12b, the devices do not have to be pointed at each other anymore. The transfer is
25 carried out by the WiFi™ connection with a range up to 100 m. As further shown in Figure 6(c), the items 95a transferred to the transferee's device 12b are placed in the user's personal space 25b between other possessed items. That is, incoming items 95a appear on the screen outside that devices 'send space' 78b. Feedback about new items may be given by an audible signal and the blinking of the items. Since the users are generally in close
30 proximity, social interaction may be used to get feedback about whether the transfer was successful or not.

It is a feature of the invention to make content accessible for other users with

decreased effort, e.g., a single action. Thus, adding a third space to the embodiments described with respect to Figures 4(a)-4(c) and 6(a)-6(c) that enables visualization of the items stored on other devices may reduce the effort needed for the owner when distributing items. With the permission of the owner, users can browse the items themselves instead of
5 asking to place them in the shared space.

Thus, as shown in Figure 7, after making contact to another device (not shown) the shared space 75 and a space 79 that includes the content of the other device (other space) is added to the PCC display screen 13 of the user device 12a. During contact, the spaces can be resized to maximize the work area. The presence of the three spaces 25a, 75, 79
10 adjacent each other creates a model in which the content items can be dragged, e.g., vertically, from space to space. The minimizing of spaces when not needed or the absence of them (when not connected), does not affect this model. Inaccessible spaces have minimal dimensions and are not resizable in order to maintain the spaces model. To keep the effective working space maximal, horizontal lines separate the spaces. Preferably, to give
15 the user the control the spaces may be resized manually. The user can determine the size of the spaces to make the drag & drop actions easier to accomplish.

It should be further understood that as the stored content has a private nature it must therefore not be accessible to everyone. It is understood that, while this solution minimizes the combined effort for all users, privacy and security is still maintained.

As mentioned herein, when contact is made with another device, feedback is
20 provided as to whether the connection was successful and with whom the connection has been made. This is realized by representing the connected user on the screen. Representing the connected user(s) may be done by displaying their names in a list or, preferably, as shown in Figure 8, indicating their presence with an icon 88 which will
25 enable the user more space to personalize on the screen 13. A picture or a character 89 may be used to identify the user which is sufficient when a small number of users are connected at the same time. Thus, just as the *spaces* concept relates the content to the storage locations, the same holds for the use of user icons. That is, the icon of the connected user is related to the space that represents his content. To keep consistency the own space will
30 also display an icon. The user can see how he/she is visualized on the other connected device. In one embodiment, the icons are placed in the border of the spaces to show their relation with the space. That is, when a connection is made, the user icon of the other user

appears on the screen, preferably at the border of a space, e.g., a space dividing line. In a two-user situation both users see the icon of the other user on their screen.

When more users are connected, more icons appear on the screen. Giving each connected user his own space would make the screen overcrowded. The shared space shown in Figure 8 still has the same meaning: the space 75 including all shared content. The upper space 79 however now gets the meaning of space 'that holds the content of the other users'. The content displayed here belongs to the user that is selected at that moment. The icons are used for switching: tapping one of the user-icons makes that the upper space shows the content of that user, if accessible. Figure 8 illustrates a PCC device 12a having three spaces 25a, 75, 79 and a user icon 89a generated for display on the border 99 of the upper space 79 within a circle 88a for example, and used for indicating connection with that user. In one embodiment, the spaces may be rendered in a different color to make them better distinguishable. In the embodiment shown in Figure 8, two users are shown connected and one user represented by icon 89 within circle 88 has opened his/her space and the other user, indicated by icon in circle 91 shows a connected user that has closed his/her space. Preferably, each user 89, 91 can 'flip' his personal icon from the left to the right to 'open' his/her space for the other users. On the screen of the connected users his icon then changes from 'closed' to 'open'.

When two devices are connected items can be shared using the shared space. This provides the user total control about the content that is accessible for other users. As mentioned herein, when an item is dragged to the shared space, a copy is made. When the other user is looking for a specific item or just wants to browse through the items of another user, permission from the latter is needed. In most cases, this will be done simply by asking. When two users are familiar with each other, the permission can also be given without asking. Since no distinction is made in access level concerned the shared space, the same will be done with the 'browsing' mode. When a user gives permission, all users can browse his personal content. Apart from indicating the presence of other users, their access level ('open' or 'closed') is also visualized by the user icons.

Figures 9(a)-9(b) show two example variations of a lower border bar 29 that borders the lower space holding the content stored on the own device. The width of both lower bar 29a,b depicted match the device screen size. Since opening the user's personal space means giving access to other users and permitting them to drag items from this space to

their own, it was chosen to visualize this by creating an opening in the closed border. Opening the own space (Figure 9(b)) swaps the user icon 89 to the right creating a passage in the normally closed border. The little toggle button 82 allows the user to switch at any moment he wants. When at least one of the connected users has opened his space, the
5 upper space is accessible and thus resizable. A handle 83 in the middle of the border allows the user to resize the space manually. Preferably, when none of the connected users have opened their spaces the handle is not available. The user's own space is always accessible and therefore always resizable. Each user can at any time 'open' or 'close' his space by creating or closing a passage in the border. This provides the two ways of sharing content:
10 *sharing* with a maximum of privacy and security and *browsing*, providing access to content stored on other devices, making it possible to quickly locate an item without effort needed from the owner. Spaces can only be resized when access is granted.

The huge collection of content, e.g., music and photos has to be organized in such a way that the user can easily and quickly navigate through all his content. Two ways of
15 content organization can be distinguished: A hierarchical structure including organizing all content by placing it in folders that may include several related items. The same can be done with folders. Such an organization with multiple levels arises related to the way people store their content in the real world. Network structures only have one level. To find the way in this large pile of items smart search engines and filtering systems are put on
20 top. The user can use keywords or indicate a direction and the system automatically generates a set of items that meets the criteria. To accomplish, this metadata is needed. Often a combination is used since people have the need to store related items in albums (photo books, CD's). The combination of a flexible structure and albums on the lowest level is proven.

The metadata available is often limited to song title and artist regarding downloaded
25 MP3 songs. In the case of photos, the user often transfers them from his digital camera without renaming them or adding extra information (such as the location the photo was taken). In most cases only date information is included. Although technologies that generate or extract metadata automatically such as integrated GPS systems and photo
30 analyzing software are gaining ground, with the expected usage scenarios not much metadata will be available. The lack of metadata makes the classic hierarchical structure more suitable. As little levels as needed were added to minimize the effort for the user.

Photos, as well as music songs, are considered to be stored in albums.

The photos and music songs are stored in albums, which when opened, its contents are made visible. Preferably, music and photos are stored separately, for example, and the content of an album may be displayed in the same level, e.g., opening a folder in left
5 column of a Windows Explorer type folder structure. Preferably, a one level structure is provided in order to avoid buttons to switch between the levels. Tapping it once can open an album and the album's metadata content may be displayed below the album icon that now indicates it has been opened as shown in Figure 10(a) with an example text view
(music) and in Figure 10(b) with an example thumbnail view (photos). Closing an album
10 may be performed by tapping it again or opening one of the other albums that are lined up under the opened album.

To perform a drag & drop operation (e.g., by tapping & dragging an item with the stylus) possible between all spaces, only one content type at the time is displayed in all spaces. This is to avoid a situation of dragging a photo into a space where music songs are
15 displayed. A switch button allows the user to switch between the content types when he/she wants. Items can be represented by thumbnails 95a (e.g., for Figure 10(b) photos) or by text 95b (e.g., for Figure 10(a)), or both. Text specifies the picture in the case two photos look the same. With music albums, thumbnails can help identify an album when the user knows what it looks like. Separate songs often do not have a picture. For quick
20 browsing, a text presentation is more effective while thumbnails are more fun to use. For these reasons two modes were created between which the user can switch. Since the items can be dragged, they may look like objects, e.g., by adding a little shadow. As shown in Figures 10(a) and 10(b), to browse through the content, standard scrollbars or like scroll mechanisms 66 may be used. To indicate their relation with the space, the scrollbar
25 preferably has the same color of the space it is in.

As shown in Figure 11, the lower part of the screen 13 includes a button menu 115 providing buttons enabling functionality for switching between the content type (music and photo) buttons 116, 117, and the presentation mode, e.g., thumbnail and text, 118, 119. These text and thumbnail buttons may also appear on the side of the content type that is
30 selected to indicate their relation. Feedback is given to change the color of the selected button and the type of content that is played on the screen. Thus, to indicate the origin of a content item, the items have the same color as the background color of the space they

originate from.

Figure 12 illustrates two example items 95a,b in the shared space 75 of a user device 12a. One item 95a is of a first color (e.g., blue) indicating that it was transferred from the blue space and thus provided by the owner of this device 12a. Assigning the personal colors to the items in the shared space makes it easy to distinguish items from the various owners. When an item is retracted to the personal space again, it is removed from the space. Dragging a second item, e.g., a yellow colored item 95b, owned by a connected user, into the personal space starts the copying. The yellow item changes slowly into blue when placed in the personal blue space. This color change provides two kinds of information at the same time. It indicates the other user now also owns the item. Transfer feedback is given by using the text bar as a progress bar (not shown). Dragging items indicating actions that cannot be performed (like dragging an item into the personal space of the other user) are cancelled accompanied by a sound signal.

Since the users can always disconnect, it is only allowed to transfer one item at the time. This avoids situations where multiple items are being downloaded. While the owner disconnects and all downloads are lost. Dragging items to the personal space and releasing them places them between the albums. Releasing items on an album, places them into this album so as to avoid an 'inbox' where items are stored temporarily.

A first exemplary embodiment illustrating the user interface concept according to the present invention is now described. As described herein, pointing two PCC devices at each other and pressing the link buttons, for example, will establish a connection between the devices. Keeping the buttons pressed for a short time, establishes a link. Feedback about the successful connection may be given by a sound signal.

In operation, a start screen on a device provides an upper border (not shown) that is dynamically lowered to indicate a second border to expose the presence of the shared space region. The user icons are placed in the circles as described herein with respect to Figure 8. The content type switch buttons as well as the content view buttons (Figure 11) are placed on the bottom. When a third user joins by connecting and linking with one of the devices, all three users see each other as shown in the screen display (Figure 8) which shows the presence of two connected users, for example, one 'open' and the other one 'closed'. The owner has also closed his space here (Figure 9(a)).

With respect to navigating through content, as now depicted as a scenario 300 in

Figure 13(a), a screen 300 is generated depicting that the owner of the PCC device 12a and all connected (second and third) users have opened their personal spaces as represented by respective icons 301, 302 and 303. The personal space 25a is maximized by dragging the handle 83 upwards as depicted by arrow 84. This action automatically minimizes the other spaces. Albums 95 may then be opened by tapping on them so that the content is displayed underneath. Scrollbars 66 depicted in Figure 13(a) may then be used to browse through all items in a space. Although not shown, selecting the 'text view' button 119 for instance, will generate for display all items without thumbnails and a larger name (e.g., metadata description).

10 With respect to exchanging items, an item may be placed in the shared space 75 and initially hold the color of the space they originate from. Upon dragging an item 95a to the personal space as shown in Figure 13(b), a transfer starts with feedback given by changing color of the copied item. The same holds for downloading items from the personal space of other users. Items can be retracted from the shared space 75, simply by dragging them back
15 to the personal space.

 With respect to rendering of items in the display screen, only items that are located in the personal space can be rendered. When tapping items in other spaces, a sound gives feedback this is not possible. Photos may be displayed full screen; and music can be listened through a speaker or headphones. To view landscape photos, the device has be
20 rotated 90 degrees. Disconnecting is performed by pressing the same button that is pressed for connecting. Pointing at the other device is not necessary as the action may be performed without the cooperation of another user.

 It should be understood that items may be placed in the 'shared space' 75 without being connected. The items placed here are immediately accessible for others after
25 connecting. The space is opened by dragging down the border, and, just like sharing when connected, a copy is initiated. Since the shared space holds the items shared by all users, after disconnecting the space empties. However, in a not connected state it still remained possible to copy items to the shared space. Pre-placed items (by others) appear in the shared space upon connecting with them. The temporary character of the items in this
30 space interferes with the possibility to use it also in the stand-alone mode. Dragging an item to the shared space is obvious making a copy, leaving the personal collection untouched.

Thus, after disconnecting, the shared space disappears completely to emphasize its temporary character, i.e., there is no shared space in the stand-alone mode. Thus, as shown in a further embodiment for the user interface 400 depicted in Figure 14(a), only the user's personal space 410 is provided in a stand-alone mode. In the view depicted in Figure 14(a),
5 three collections 405a-405c are available in a top level navigation view. The border 401 has moved automatically to the top of the screen, and an audio/video player 415 appears below the screen. As shown in Figure 14(a), the personal icon is hidden to save screen space in the stand-alone mode. Although not shown, in this second embodiment, a multi
10 level structure is supported for content navigation. Tabs appearing on the left side of the screen provide feedback about the present location. Clicking an underlying tab shows a level more on top.

The temporary character of the shared space implies that items disappear after the owner disconnects. This might necessitate quick grabbing of the items. The small screen does not offer enough space to visualize both spaces completely. In order to copy the items
15 into the right location, actions like scrolling and navigating between different levels in the hierarchy are needed. Since these actions take time, an option to place the downloaded items on the temporary location is preferable, and subsequent thereto, organization of the content can be performed. Preferably, this 'temporary location' does not interfere with the concept of the spaces and, thus, a temporary space is located within the user's personal
20 space, since the items are already downloaded and does not increase the complexity of the user interface.

A temporary place to park items (i.e., shared space) is opened when sliding over with an item and closes again when it includes no items anymore. Dragging an item to this area makes a *copy*, dragging an item from the area involves a *move* action. To minimize the
25 number of items in the shared space, items are deleted from the space when every connected user has downloaded them. On the other hand, items that are still not downloaded by everyone should be accessible as long as possible. When the original owner disconnects, the item also disappears. However, when at least one of the others users has already downloaded the item, he/she could replace this item. This action can also
30 be performed by the system. The item simply changes color in the shared space, indicating another user is now controlling it.

Functionality for enabling users to preview items before downloading them is

provided. This can be useful since the screen space only offers a minimal amount of information of the items. Thus, to be sure to download the right item or when just browsing, the option of previewing is provided. The rendering of items from the shared space is aborted when the owner disconnects. The user should therefore be informed when
5 viewing or listening to items he does not own. This may be indicated to a user by changing the color of the audio and video player 415, for example by enabling the player to take the color of the user to which the item belongs.

As mentioned, the personal space in the stand-alone mode is illustrated in Figure 14(a). Here, the top level shows three collections 405a-405c. After connecting with
10 another user, the border 401 lowers, the owner's icon 408 is generated for display as is the user icon 409 of the other connected user, and the shared space 475 is generated as shown in Figure 14(b). The audio player is minimized to provide more screen space. In Figure 14(c), the 'music albums' collection 405b is opened. A tab 412 on the left appears, indicating the current location. By tapping a portion of the tap, the user is returned to the
15 top level. As shown in Figure 14(d), dragging an item 415 to the shared space 475 makes a copy. The item now becomes visible on all connected devices. The transparency indicates the user already possesses the item, to clear the view on the 'new' content.

As shown in Figure 14(e), the connected user shares his photo collection indicated by icon 416 with the original user as indicated by its addition to the shared space 475. As
20 shown in Figure 14(e), the collection 415 on top level is dragged into the shared space 475. Tapping the collection via a touch screen interface shows the albums it contains, such as album 425 indicated in Figure 14(f). The tab 422 on the left side of the screen provides an indication of the navigation and preferably, is rendered the same color of the other user. Opening the album 425 shows the picture contents 435 as shown in Figure 14(g). As
25 shown in Figure 14(g), a scrollbar 430 is displayed to provide a scrolling function when the amount of items 435 can not fit in the screen display area. The tab 432 shows the third level and gives metadata information about the opened album 425. As shown in Figure 14(h), two photos 435a,b are dragged to the user's (temporary) personal space 485. By sliding over the border, the 'temporary space' 485 opens and copies are made. The item
30 can be placed here or can be stored in an album at once. Feedback about the transfer progress is given by the changing color. As depicted in Figure 14(i), after minimizing the shared space 475, the downloaded items 435a,b can be organized, for example, by moving

them to an album or collection. When the temporary area 485 is empty, it closes automatically.

After pointing and linking to another user in the manner as described herein, the icon 407 of that new user appears on all connected devices as shown in Figure 14(j). When maximizing the shared space 475, the user's temporary space 485 automatically becomes visible to enable quick downloading (organizing may be performed later). As shown in Figures 14(k)-14(l), the third user's content items 490 have been placed in shared space 475. Figure 14(l) particularly depicts content items 495 rendered in the color identifying the third user's content.

10 When a hard button is pushed again, the device disconnects from the group. After disconnecting, the shared space disappears. When a photo is rendered in the shared space, the player gets the color of the user that owns the item. This emphasizes a preview is being made which can be aborted when the owner disconnects.

15 While there has been shown and described what is considered to be preferred embodiments of the invention, it will, of course, be understood that various modifications and changes in form or detail could readily be made without departing from the spirit of the invention. It is therefore intended that the invention be not limited to the exact forms described and illustrated, but should be constructed to cover all modifications that may fall within the scope of the appended claims.

CLAIMS:

1. A system for ad hoc sharing of content stored in portable devices, said system comprising:
 - a) a means for establishing a communications link to connect a single portable device to one or more other portable devices;
 - b) means for generating a visualized shared space on a display area of each portable device of a connected user for facilitating content exchange between connected users via established communications links; and
 - c) means for enabling each individual connected user to control transfer of content to and from that user's portable device via said communications link in response to manipulation of items representing user content in said shared space.
2. The system as claimed in Claim 1, wherein said display area comprises a user space for displaying items representing content stored in said portable device, wherein a copy of said content is available for transfer to a connected user by moving an item representing said content from said user space to said shared space, said moved item being displayed in a shared space on each connected user's device.
3. The system as claimed in Claim 2, wherein a copy of said content is transferred from a transferor device to a transferee device via an established communications link in response to moving an item representing said content from said shared space to said user space of a transferee device.
4. The system as claimed in Claim 1, further comprising means for indicating to a user a status of being connected during which time content items can be freely exchanged between portable devices of all connected users.
5. The system as claimed in Claim 4, whereby said means for establishing a communications link further includes means for enabling secure encrypted communications.
6. The system as claimed in Claim 5, whereby said means for establishing a communications link with a connecting user is by wireless RF communications.

7. The system as claimed in Claim 5, whereby said means for establishing a communications link with a connecting user is by Infrared communications.
8. The system as claimed in Claim 5, whereby a communications link connecting a single portable device to one or more other devices is established when said devices are in close distance range to each another.
9. The system as claimed in Claim 8, whereby a communications link becomes automatically disconnected when said devices are out of communication range from each another.
10. The system as claimed in Claim 5, whereby a communications link connecting a single portable device to another device is established when said devices contact each other, wherein content may be transferred between devices while in said contact.
11. The system as claimed in Claim 5, whereby a communications link connecting a single portable device to another device is established when said devices are positioned one on top of another, wherein content may be transferred between devices while in said on top position.
12. The system as claimed in Claim 5, whereby a communications link connecting a single portable device to another device is established when said devices are first in close proximity and in motion relative to one another, wherein content may be transferred between devices while in said motion.
13. The system as claimed in Claim 5, further including means for generating a space in said display area on a transferee portable device indicating content included in a transferor portable device, said transferee user being enabled to transfer content from said transferor portable device to said shared space via said transferee device.
14. The system as claimed in Claim 4, wherein said means indicating status of a user includes means for generating a graphic for display to indicate the presence and identity of a connected user and providing indication of whether content is or is not provided by said connected user in said shared space.
15. The system as claimed in Claim 12, further including means for providing visual indication for identifying content in said shared space owned by a particular connected user.

16. The system as claimed in Claim 15, wherein said visual indication is a color indication.

17. The system as claimed in Claim 12, further including means enabling switching display of content items in said portable device according to graphic or textual views.

18. The system as claimed in Claim 14, further including means providing metadata information associated with content items displayed in said display area.

19. The system as claimed in Claim 14, wherein said shared space of a user's device is populated with items already in said shared space as placed by other users upon connection.

20. The system as claimed in Claim 14, wherein said content items associated with a first user are removed from the shared area of a connected user's portable device when the first user's communications link is disconnected.

21. A method for ad hoc sharing of content stored in portable devices, said method comprising steps of:

- a) establishing a communications link to connect a single portable device to one or more other portable devices;
- b) generating a visualized shared space on a display area of each portable device of a connected user for facilitating content exchange between connected users via established communications links; and
- c) enabling each individual connected user to control transfer of content to and from that user's portable device via said communications link in response to manipulation of items representing user content in said shared space.

22. The method as claimed in Claim 21, wherein said display area comprises a user space for displaying items representing content stored in said portable device, said step c) of controlling transfer comprising: moving an item representing said content from said user space to said shared space for making a copy of said content available for transfer to a connected user, said moved item being displayed in a shared space on each connected user's device.

23. The method as claimed in Claim 22, wherein said step c) of controlling transfer comprises: moving an item representing said content from said shared space to said user space of a transferee device and initiating transfer of a copy of said content from

a transferor device to a transferee device via an established communications link in response to.

24. The method as claimed in Claim 21, further comprising the step of indicating to a user a status of being connected during which time content items can be freely exchanged between portable devices of all connected users.

25. The method as claimed in Claim 24, whereby step of establishing a communications link further includes communicating first information enabling secure encrypted communications between connected devices.

26. The method as claimed in Claim 25, whereby said step of establishing a communications link with a connecting user includes implementing wireless RF communications.

27. The method as claimed in Claim 25, whereby said step of establishing a communications link with a connecting user includes implementing Infrared communications.

28. The method as claimed in Claim 25, wherein said step of establishing a communications link occurs between a single portable device and one or more other devices according to distance range of said devices with respect to each other.

29. The method as claimed in Claim 25, further including the step of automatically disconnecting a communications link when said devices are out of communication range from each another.

30. The method as claimed in Claim 25, wherein said step of establishing a communications link to connect a single portable device to another device includes touching said devices with each other, and transferring content between said devices while in said contact.

31. The method as claimed in Claim 25, wherein said step of establishing a communications link to connect a single portable device to another device includes positioning a portable device on top of another device, and transferring content between said devices while in said on top position.

32. The method as claimed in Claim 25, wherein said step of establishing a communications link to connect a single portable device to another device includes moving

said devices in close proximity relative to one another, and transferring content between said devices while moving.

33. The method as claimed in Claim 25, further including the step of generating a space in said display area on a transferee portable device indicating content included in a transferor portable device, said method including enabling a transferee user to transfer content from said transferor portable device to said shared space via said transferee device.

34. The method as claimed in Claim 24, further including the step of: generating a graphic for display to indicate the presence and identity of a connected user and providing indication of whether content is or is not provided by said connected user in said shared space.

35. The method as claimed in Claim 35, further including the step of: providing visual indication for identifying content in said shared space owned by a particular connected user.

36. The method as claimed in Claim 35, wherein said visual indication is a color indication.

37. The method as claimed in Claim 32, further including the step of switching display of content items in said portable device according to graphic or textual views.

38. The method as claimed in Claim 32, further including the step of providing metadata information associated with content items displayed in said display area.

39. The method as claimed in Claim 24, further including the step of populating said shared space of a user's device with items already in said shared space as placed by other users upon connection.

40. The method as claimed in Claim 24, further including the step of removing content items associated with a first user in said shared space of a connected user's portable device when the first user's communications link is disconnected.

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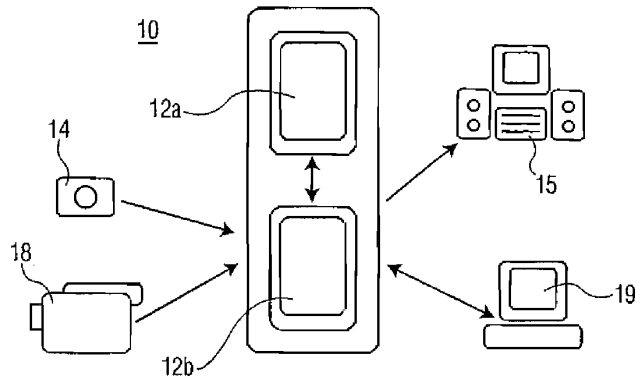


FIG. 1

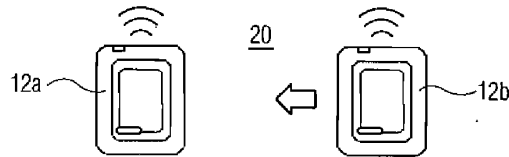


FIG. 2A

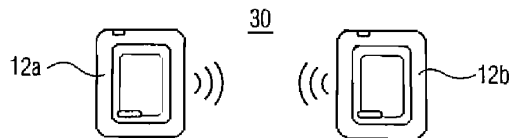
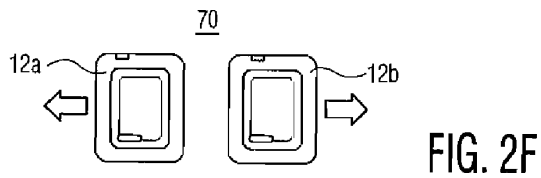
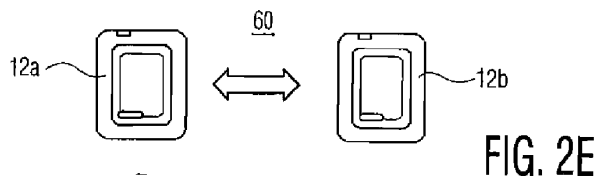
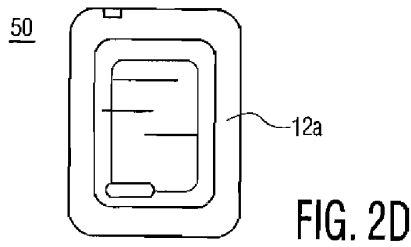
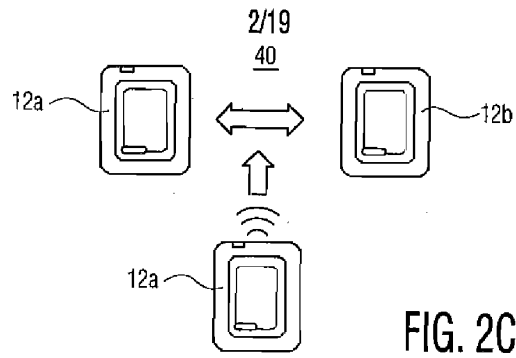


FIG. 2B



3/19

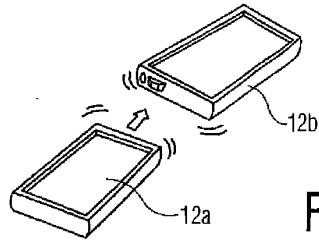


FIG. 3A1

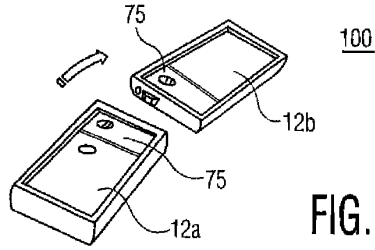


FIG. 3A2

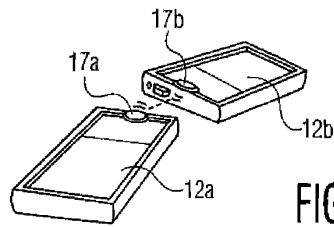


FIG. 3B1

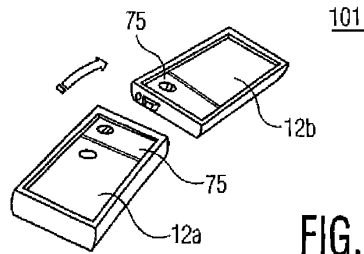


FIG. 3B2

BNSDOCID <WO ____2004075169A2.1.>

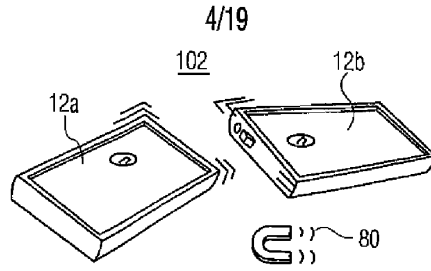


FIG. 3C

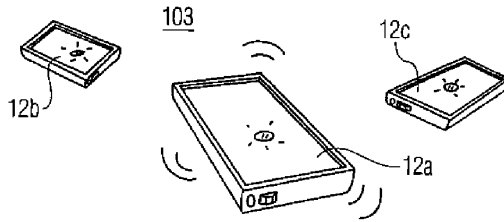


FIG. 3D

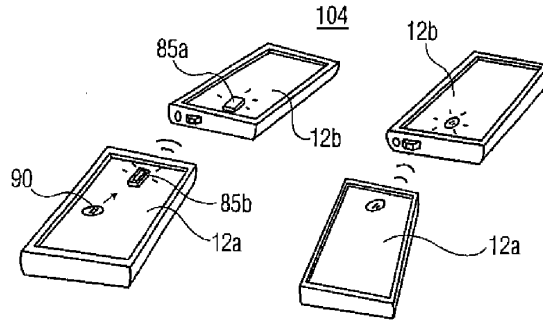


FIG. 3E

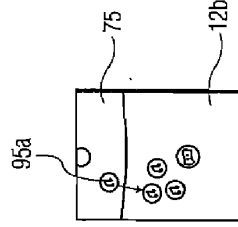
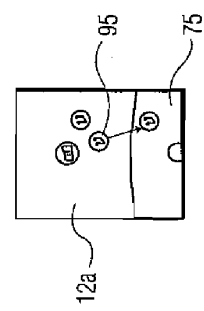


FIG. 4A

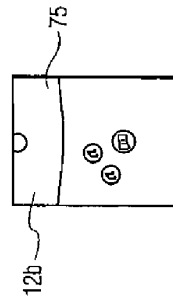
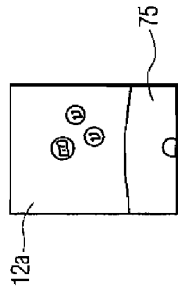


FIG. 4B

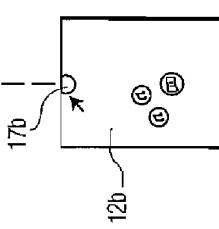
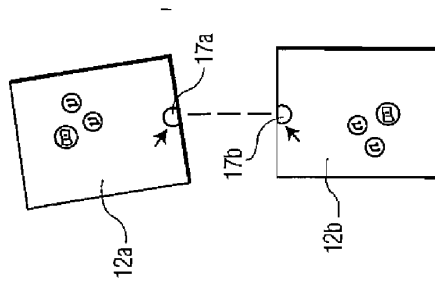


FIG. 4C

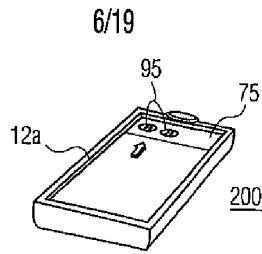


FIG. 5A1

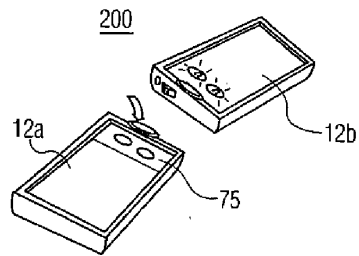


FIG. 5A2

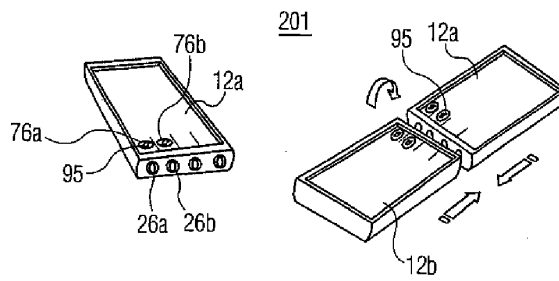


FIG. 5B

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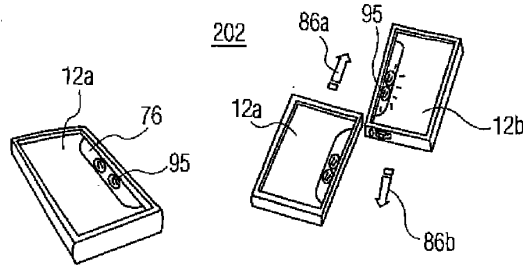


FIG. 5C

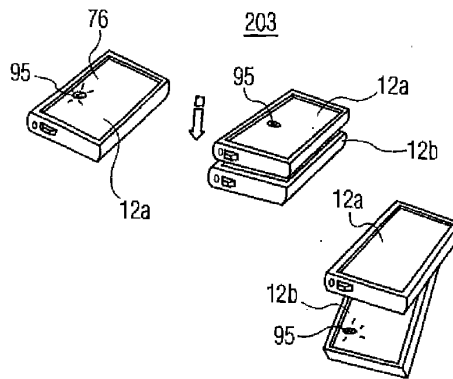


FIG. 5D

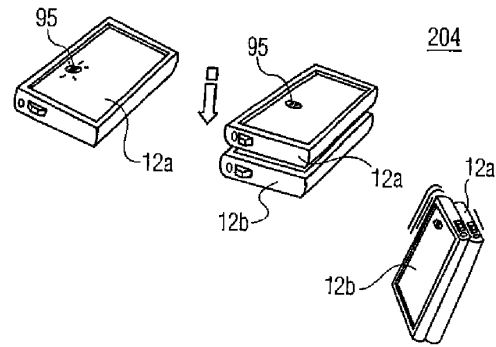


FIG. 5E

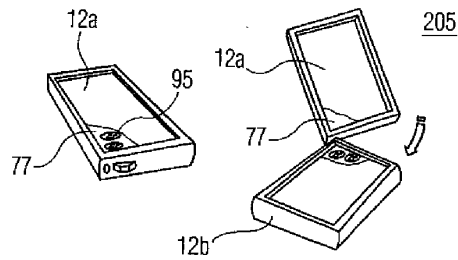


FIG. 5F

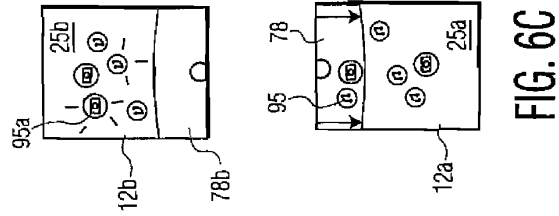


FIG. 6C

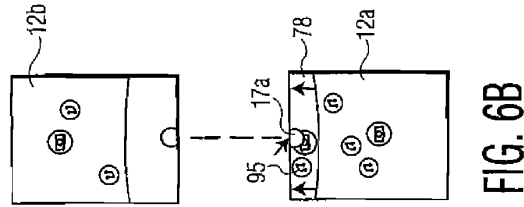


FIG. 6B

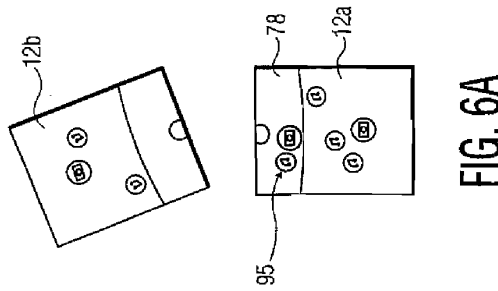


FIG. 6A

BNSDOCID: <WO_2004075169A2_1_>

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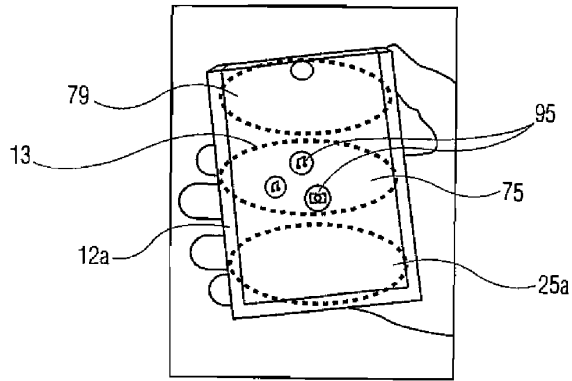


FIG. 7

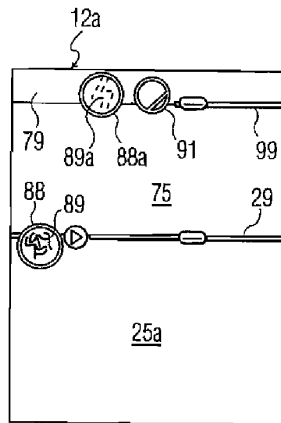


FIG. 8

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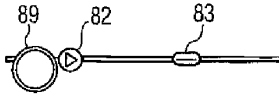


FIG. 9A

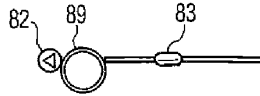


FIG. 9B

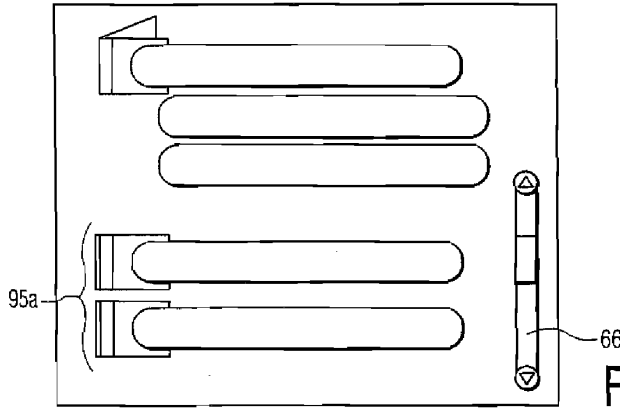


FIG. 10A

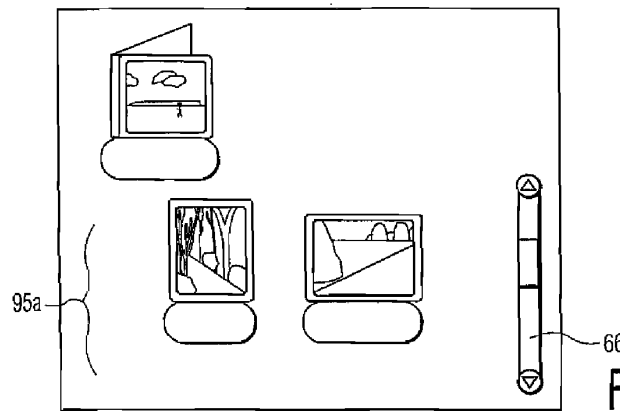
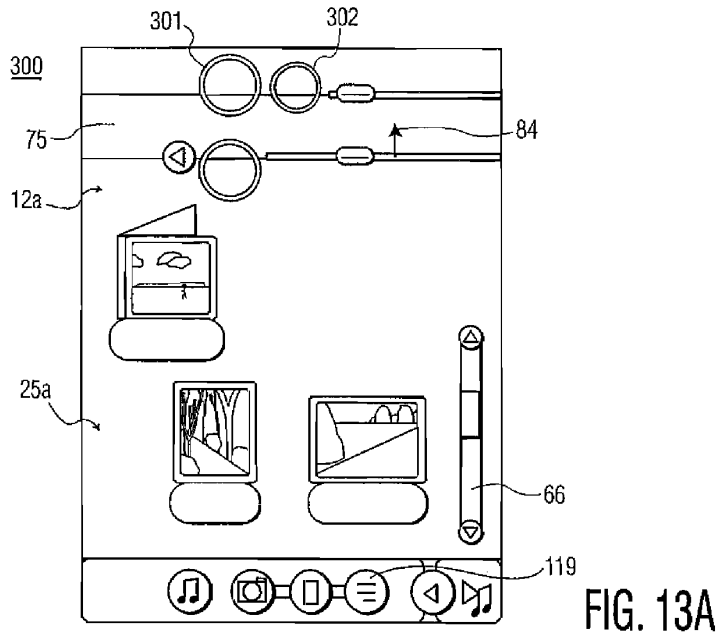
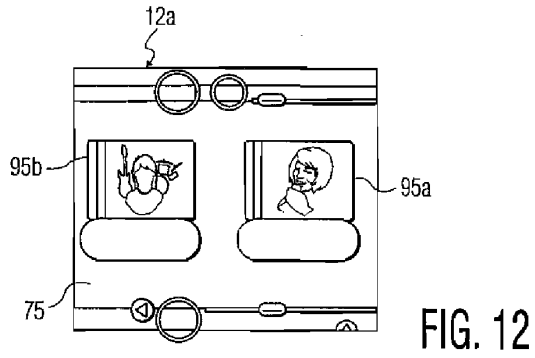
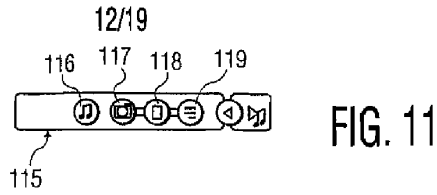


FIG. 10B

BNSDOCID: <WO_2004075169A2_1 >



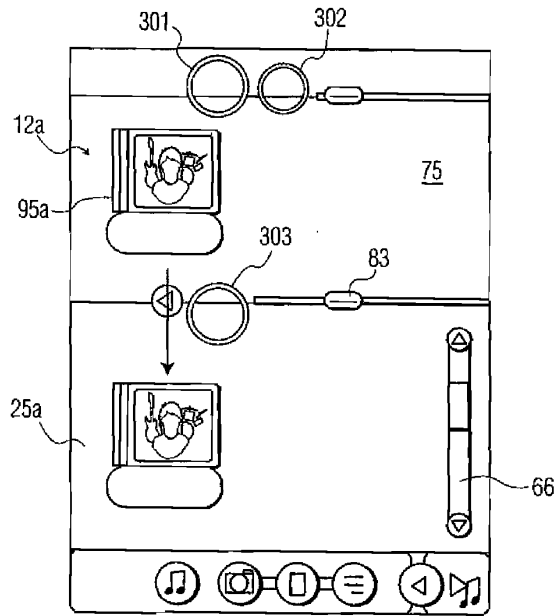


FIG. 13B

BNSDOCID: <WD_2004075189A2_L>

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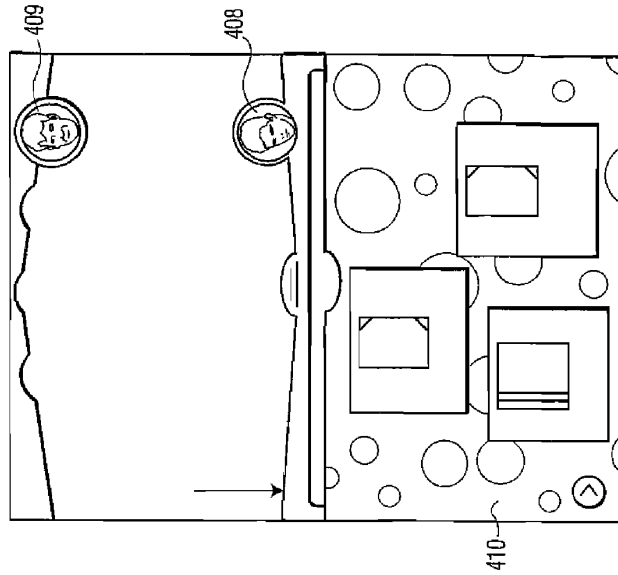


FIG. 14B

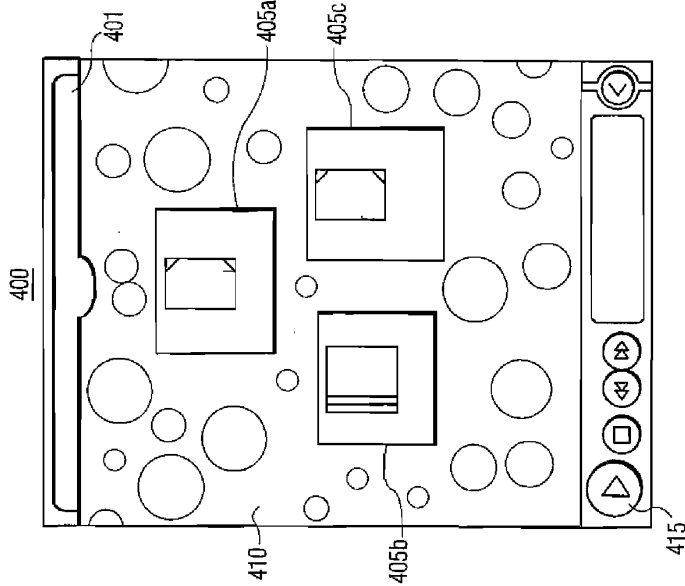


FIG. 14A

BNSDOCD: <WO____2004075169A2_1_>

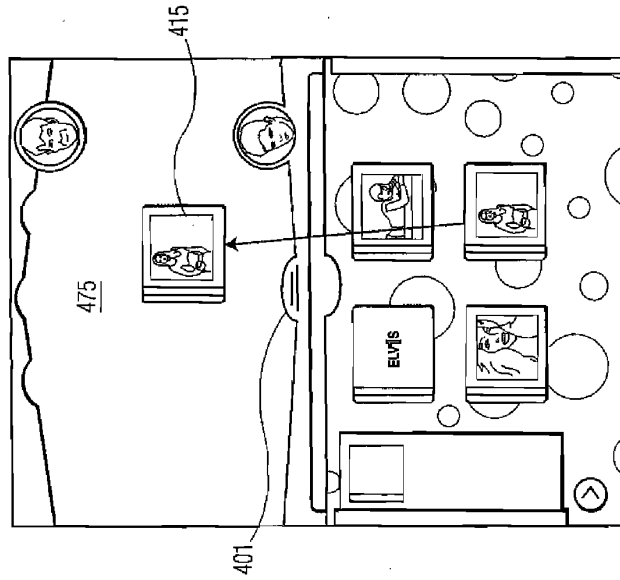


FIG. 14D

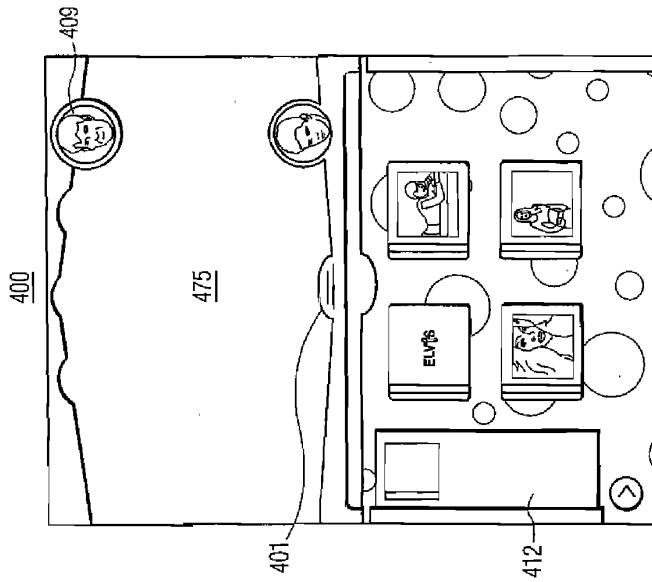


FIG. 14C

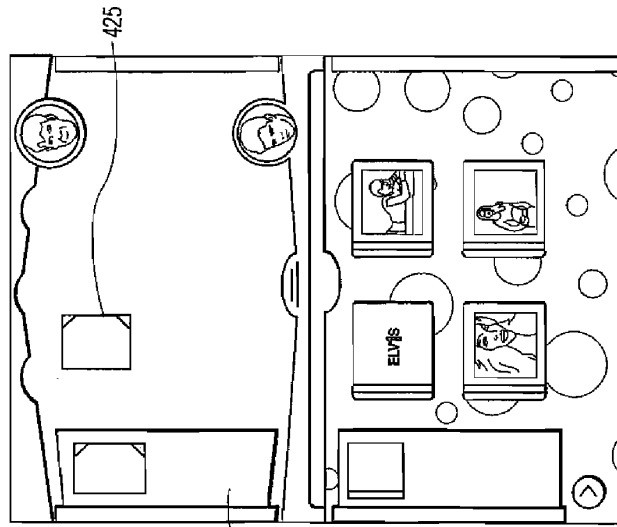


FIG. 14F

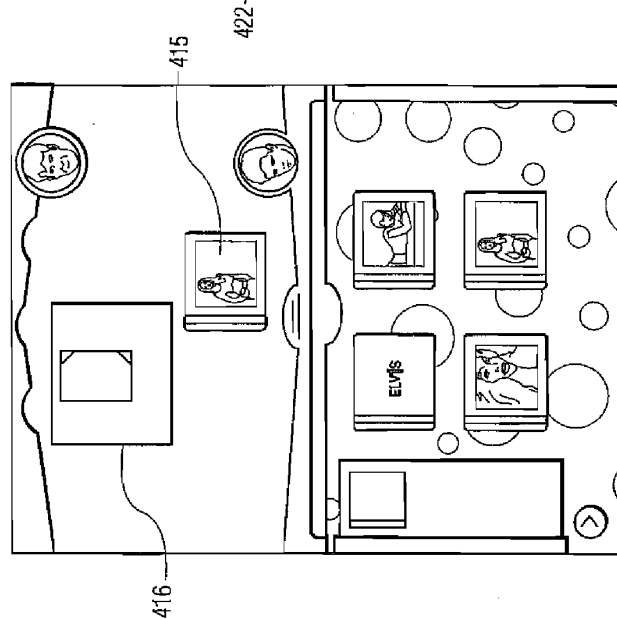


FIG. 14E

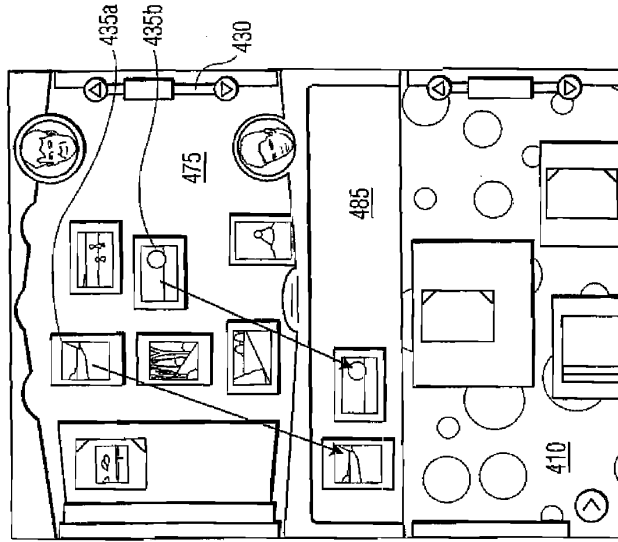


FIG. 14H

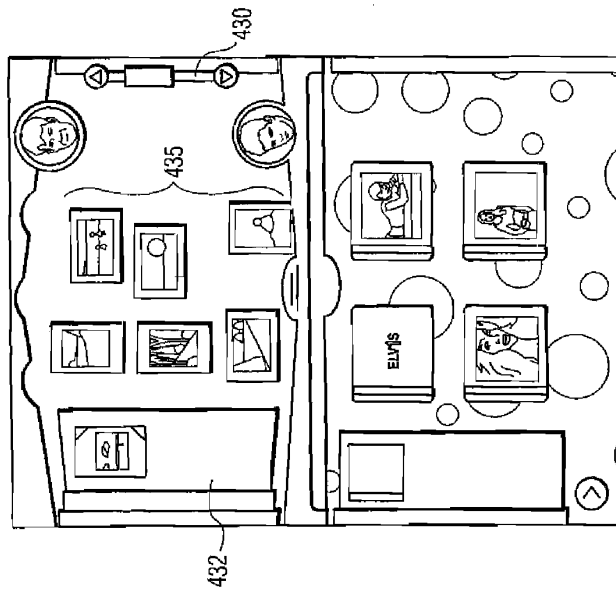


FIG. 14G

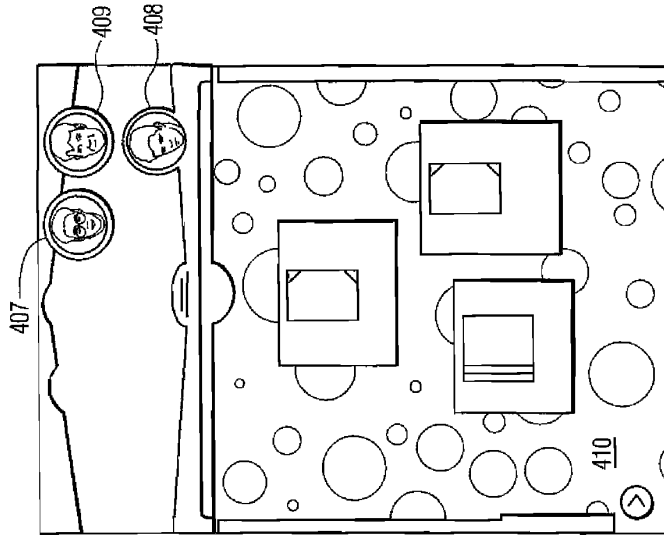


FIG. 14J

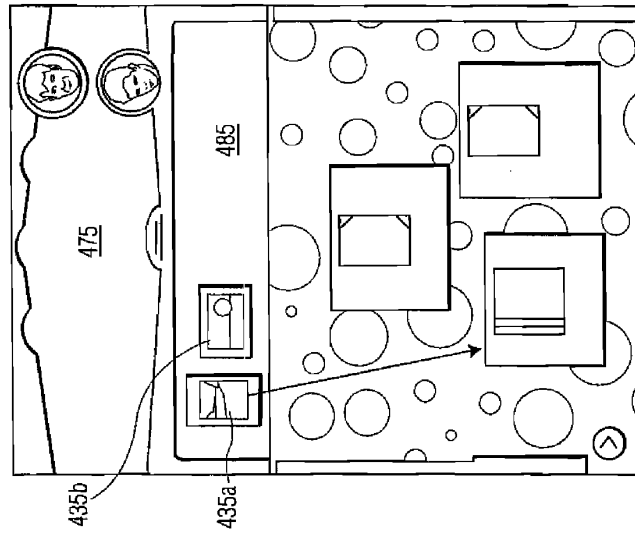


FIG. 14I

BNSDXXCID <WO 2004075169A2.L>

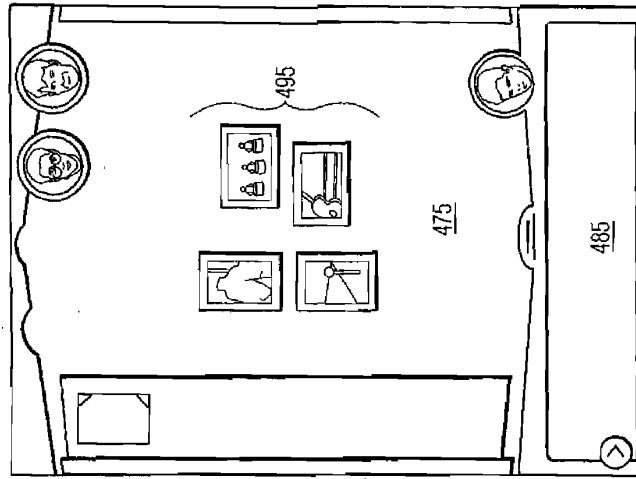


FIG. 14L

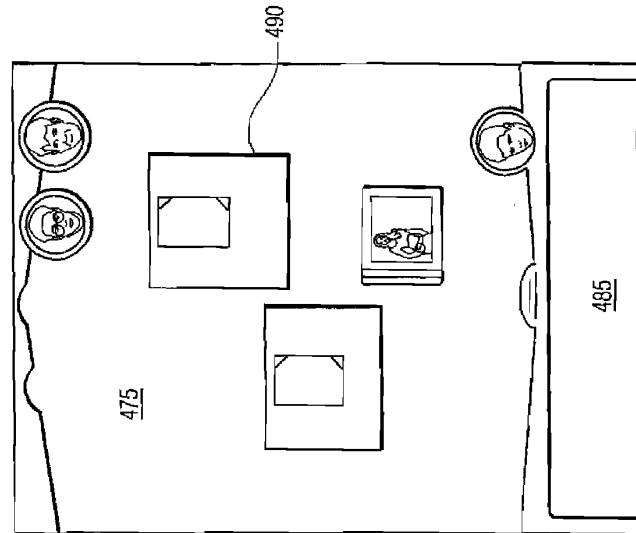


FIG. 14K

(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(19) World Intellectual Property Organization
International Bureau



INTERNATIONAL PATENT COOPERATION TREATY

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2 September 2004 (02.09.2004)

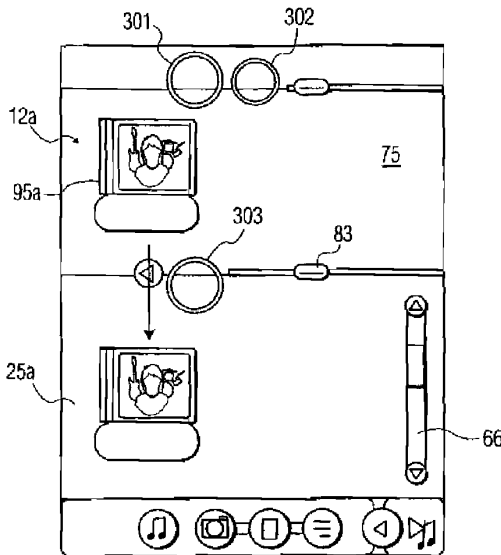
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- (51) International Patent Classification: **H04L 29/06**, 12/28, G06F 3/033, 17/30
- (71) Applicant (for AE only): **U.S. PHILIPS CORPORATION** [US/US]; 1251 Avenue of the Americas, New York, NY 10020 (US).
- (21) International Application Number: **PCT/IB2004/000408**
- (72) Inventors; and
- (75) Inventors/Applicants (for US only): **VAN DE SLUIS, Bartel, Marinus** [NL/NL]; P.O. Box 220, NL-5600 AE Eindhoven (NL). **HOLLEMANS, Gerrit** [NL/NL]; P.O. Box 220, NL-5600 AE Eindhoven (NL). **SOMMEIJER, Muthijs, Alexander** [NL/NL]; P.O. Box 220, NL-5600 AE Eindhoven (NL).
- (22) International Filing Date: 16 February 2004 (16.02.2004)
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60/484,832 3 July 2003 (03.07.2003) US
- (74) Common Representative: **KONINKLIJKE PHILIPS ELECTRONICS, N.V.**; c/o THORNE, Gregory, L., P.O. Box 3001, Briarcliff Manor, NY 10510-8001 (US).
- (81) Designated States (unless otherwise indicated, for every kind of national protection available): AE, AG, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BW, BY, BZ, CA, CH, CN, CO, CR, CU, CZ, DE, DK, DM, DZ, EC, EE, EG, ES, FI,
- (71) Applicant (for all designated States except US): **KONINKLIJKE PHILIPS ELECTRONICS, N.V.** [NL/NL]; Groenewoudseweg 1, NL-5621 BA Eindhoven (NL).

[Continued on next page]

(54) Title: SYSTEM FOR AD HOC SHARING OF CONTENT ITEMS BETWEEN PORTABLE DEVICES AND INTERACTION METHODS THEREFOR



(57) Abstract: A user interface concept for wireless ad hoc content sharing between portable devices referred to as portable content containers (PCCs). A user-centered design approach is provided enabling users to share content such as music and photos. A variety of physical ways of establishing a secure connections between the PCC devices is provided. In addition, a clear view on the location of the content stored on the devices, and a drag & drop interface is provided. Use is made of separate spaces, each containing the corresponding content and includes a "shared" space such that all connected users may transfer content to and from their own personal devices. The use of a drag & drop interface in combination with the subdivision of the screen into several spaces, provided the user with a clear view on the content location. The close proximity of users is assumed and enhances social interaction.

WO 2004/075169 A3



GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MA, MD, MG, MK, MN, MW, MX, MZ, NA, NI, NO, NZ, OM, PG, PH, PL, PT, RO, RU, SC, SD, SE, SG, SK, SL, SY, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, YU, ZA, ZM, ZW.

TM, TN, TR, TT, TZ, UA, UG, UZ, VC, VN, YU, ZA, ZM, ZW. ARIPO patent (BW, GH, GM, KE, LS, MW, MZ, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HU, IE, IT, LU, MC, NL, PT, RO, SE, SI, SK, TR), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG)

(84) Designated States (unless otherwise indicated, for every kind of regional protection available): ARIPO (BW, GH, GM, KE, LS, MW, MZ, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European (AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HU, IE, IT, LU, MC, NL, PT, RO, SE, SI, SK, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

- as to the applicant's entitlement to claim the priority of the earlier application (Rule 4.17(iii)) for all designations
- as to the applicant's entitlement to claim the priority of the earlier application (Rule 4.17(ii)) for all designations

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Declarations under Rule 4.17:

- as to applicant's entitlement to apply for and be granted a patent (Rule 4.17(ii)) for the following designations AE, AG, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BW, BY, BZ, CA, CH, CN, CO, CR, CU, CZ, DE, DK, DM, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MA, MD, MG, MK, MN, MW, MX, MZ, NA, NI, NO, NZ, OM, PG, PH, PL, PT, RO, RU, SC, SD, SE, SG, SK, SL, SY, TJ, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, YU, ZA, ZM, ZW.

(88) Date of publication of the international search report:
29 December 2004

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INTERNATIONAL SEARCH REPORT

International Application No
T/IB2004/000408

A. CLASSIFICATION OF SUBJECT MATTER IPC 7 H04L29/06 H04L12/28 G06F3/033 G06F17/30		
According to International Patent Classification (IPC) or to both national classification and IPC		
B. FIELDS SEARCHED Minimum documentation searched (classification system followed by classification symbols) IPC 7 H04L G06F		
Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched		
Electronic data base consulted during the international search (name of data base and, where practical, search terms used) EPO-Internal, WPI Data, INSPEC		
C. DOCUMENTS CONSIDERED TO BE RELEVANT		
Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	US 2002/052918 A1 (KARASAWA HIDENORI ET AL) 2 May 2002 (2002-05-02) paragraphs '0021!, '0022! paragraphs '0024! - '0028! paragraphs '0030! - '0034! paragraphs '0076!, '0080!, '0083!, '0086! paragraph '0094! paragraphs '0108! - '0112! paragraphs '0120!, '0121! paragraphs '0157!, '0158! paragraphs '0161!, '0162! ----- -/--	1-40
<input checked="" type="checkbox"/> Further documents are listed in the continuation of box C.		
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Date of the actual completion of the international search 28 October 2004		Date of mailing of the international search report 05/11/2004
Name and mailing address of the ISA European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Tx. 31 651 epo nl, Fax: (+31-70) 340-3016		Authorized officer Losseau, D

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INTERNATIONAL SEARCH REPORT

International Application No
 .../IB2004/000408

C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT		
Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	MICHELITSCH G ET AL: "A user-centric view of QoS-aware communication" COMPUTER COMMUNICATIONS, ELSEVIER SCIENCE PUBLISHERS BV, AMSTERDAM, NL, vol. 21, no. 15, 1 October 1998 (1998-10-01), pages 1310-1319, XP004145245 ISSN: 0140-3664 section 3 "Shared Virtual spaces" page 1312, right-hand column - page 1314, right-hand column section 5 "Shared Spaces Implementation Strategies" page 1316, right-hand column - page 1318, left-hand column	1-40
A	US 6 493 001 B1 (ISHIKAWA MASAYUKI ET AL) 10 December 2002 (2002-12-10) column 4, lines 19-36 column 13, line 4 - column 14, line 14	1-3,13, 15,17, 21-23, 33,35,37
A	EP 1 265 157 A (MICROSOFT CORP) 11 December 2002 (2002-12-11) paragraphs '0015!', '0017! paragraphs '0028!', '0031! paragraphs '0037!', '0045! paragraphs '0072!', '0074! paragraph '0082! paragraph '0144! paragraph '0160!	4,6, 14-17, 20,24, 26, 34-37,40
A	US 2002/008693 A1 (GLADWIN S CHRISTOPHER ET AL) 24 January 2002 (2002-01-24) paragraphs '0010!', '0011! paragraphs '0041!' - '0052! paragraphs '0056!' - '0058!	4,6,9, 24,26,29
A	US 5 583 993 A (FOSTER GREGG S ET AL) 10 December 1996 (1996-12-10) column 2, lines 24-31	19,20, 39,40
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3

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INTERNATIONAL SEARCH REPORT

Information on patent family members

International Application No

.../IB2004/000408

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 2002052918 A1	02-05-2002	JP 2002083320 A	22-03-2002
US 6493001 B1	10-12-2002	JP 2000076487 A	14-03-2000
EP 1265157 A	11-12-2002	US 2002186257 A1	12-12-2002
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US 6166734 A	26-12-2000	NONE	

Form PCT/ISA/210 (patent family annex) (January 2004)

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Organization
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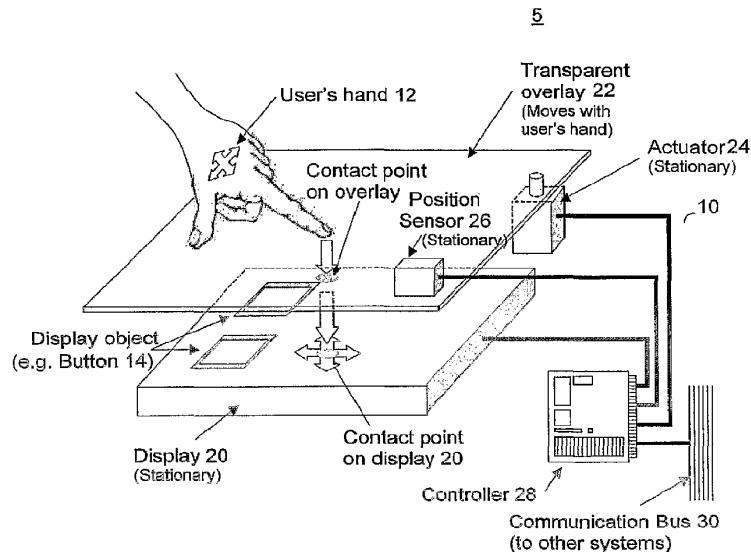
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- (25) Filing Language: English
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2,422,265 14 March 2003 (14.03.2003) CA
- (71) Applicant (for all designated States except US): **HAND-SHAKE INTERACTIVE TECHNOLOGIES INC.** [CA/CA]; 40 Weber Street East, Lobby Suite 50, Kitchener, Ontario N2H 6R3 (CA).
- (72) Inventors; and
- (75) Inventors/Applicants (for US only): **WANG, David** [CA/CA]; 64 Meadowlane Drive, Kitchener, Ontario N2N 1E9 (CA). **ROSSI, Mauro** [CA/CA]; 56 McGill Crescent, Cambridge, Ontario N1T 1Y4 (CA). **TUER, Kevin** [CA/CA]; R.R. #2, Stratford, Ontario N5A 6S3 (CA). **MADILL, Daniel** [CA/CA]; 614 Westfield Drive, Waterloo, Ontario N2T 2P2 (CA).
- (74) Agents: **HARRIS, John, D.** et al.; Gowling Lafleur Henderson LLP, Suite 2600, 160 Elgin Street, Ottawa, Ontario K1P 1C3 (CA).
- (81) Designated States (unless otherwise indicated, for every kind of national protection available): AE, AG, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BW, BY, BZ, CA, CH, CN, CO, CR, CU, CZ, DE, DK, DM, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MA, MD, MG, MK, MN, MW, MX, MZ, NA, NI, NO, NZ, OM, PG, PH, PL, PT, RO, RU, SC, SD, SE, SG, SK, SL, SY, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, YU, ZA, ZM, ZW.
- (84) Designated States (unless otherwise indicated, for every kind of regional protection available): ARIPO (BW, GH, GM, KE, LS, MW, MZ, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European (AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HU, IE, IT, LU, MC, NL, PL, PT, RO, SE, SI, SK, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

[Continued on next page]

(54) Title: A METHOD AND SYSTEM FOR PROVIDING HAPTIC EFFECTS



(57) Abstract: A transparent haptic overlay device, system and method are provided. The transparent haptic overlay device (10) includes a transparent overlay (22) for transmitting the force of the user to a display (20), an actuator (24) for generating forces corresponding to haptic effects and imparting these forces to the user's finger and a controller (28) for simulating the haptic effects. The display (20) may be a touch sensitive display, which has a functionality of sensing the position of the user. Through the overlay (22), the user receives the haptic effects in response to the motion relative to the image of the objects (14) on the display (20).

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Published:

- with international search report
- before the expiration of the time limit for amending the claims and to be republished in the event of receipt of amendments

For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.

A method and system for providing haptic effects

FIELD OF THE INVENTION:

5 This invention relates to virtual effects, more specifically to a method and system for providing haptic effects associated with an image on a display.

BACKGROUND OF THE INVENTION:

10 In many new applications, the implementation of extra functionality to a product has resulted in applications that are more desirable to consumers (e.g. extra vehicle control functions in automobiles). In other cases, the extra functionality is a necessity resulting from the increasing complexity of the overall system (e.g. flight control systems in military aircraft). This presents a challenge for the user of the
15 product/device, since easy access to all the functions can be distracting to the normal operation. Moreover, interfaces that are fixed and not re-configurable can limit the number of functions that are implemented and can also prevent the interface from operating in an intuitive fashion.

 The addition of the sense of touch to the user interface allows the user to
20 navigate through the options primarily based on the sense of touch, instead of relying on visual feedback only. Furthermore, the reconfigurability of the device allows the interface to be designed in an intuitive fashion. Therefore, the addition of haptic effects to a display device has clear benefits.

 However, in the past, when conventional haptic devices have been integrated
25 into display devices, they have tended to be quite expensive and they typically obstruct the view of the display.

 To overcome the obstruction issue, some applications have separated the haptic device and the display (e.g. the force feedback joystick is located on a control console with the display located on the dashboard). However, this creates
30 disconnect between what is seen and what is felt.

 Other applications are limited to implementing haptic effects using only

vibration devices. Specifically, in these applications, when a user passes over a particular area of the display, the user senses a vibration effect. While this provides some haptic feedback to the user, the user still needs to correlate a certain type of vibration to a specific meaning.

5 Some other applications use a virtual world approach as described, for example, in U.S. Patent No. 5,986,643. In this approach, the user is required to wear a glove that has several actuators built-in and a virtual goggle heads up display. As the user reaches out to touch an object that is projected on the virtual goggle display, the actuators are enabled to apply force to individual fingers. This approach is
10 complex and expensive.

 Therefore, it is desirable to provide a new haptic device and method, which can meet that demands of scalability, reliability, reconfigurability and cost reduction.

SUMMARY OF THE INVENTION:

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 It is an object of the invention to provide a novel haptic device and system that obviates or mitigates at least one of the disadvantages of existing systems.

 In accordance with an aspect of the present invention, there is provided a system for providing haptic effects to a user, which includes a display for providing an
20 image of an object; and a transparent overlay haptic device. The device includes: a transparent overlay for translating the motion of the user's finger to the image and providing haptic effects to the user and a haptic effect element for generating the haptic effect on the overlay in response to the motion of the user. The user contacts the image through the overlay.

25 The transparent overlay haptic device may include the overlay, the actuator (active or passive), the position sensor (absolute or relative), the controller and the electrical and mechanical interfaces between the components.

 In accordance with a further aspect of the present invention, there is provided a method of passively or actively applying a force in the x and y axis to a user's finger,
30 via a transparent overlay, in such a way that does not obstruct the view of the display, to simulate haptic effects.

The transparent overlay haptic method of the present invention achieves the reconfigurability of the haptic effects generated on the device to match the display objects.

5 Other aspects and features of the present invention will be readily apparent to those skilled in the art from a review of the following detailed description of preferred embodiments in conjunction with the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS:

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The invention will be further understood from the following description with reference to the drawings in which:

Figure 1 shows a schematic diagram of a transparent overlay haptic system including a transparent overlay haptic device and a display in accordance with an embodiment of the present invention;

Figure 2 shows a schematic diagram of the main components of the transparent overlay haptic system of Figure 1;

Figure 3A shows a schematic top view of the transparent overlay haptic device in accordance with a first embodiment of the present invention;

Figure 3B shows a schematic side view of the transparent overlay haptic device shown in Figure 3A;

Figure 4 shows one example of wall/edge haptic effects;

Figure 5 shows one example of detent haptic effects;

Figure 6A shows a schematic top view of the transparent overlay haptic device in accordance with a second embodiment of the present invention;

Figure 6B shows a schematic side view of the transparent overlay haptic device shown in Figure 6A;

Figure 7A shows a schematic top view of the transparent overlay haptic device in accordance with a third embodiment of the present invention;

Figure 7B shows a schematic side view of the transparent overlay haptic

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device shown in Figure 7A;

Figure 8A shows a schematic top view of the transparent overlay haptic device in accordance with a fourth embodiment of the present invention; and

Figure 8B shows a cross-section view taken along the line A-A in Figure 8A.

5 Figure 9 shows a schematic diagram of the transparent overlay haptic device in accordance with a fifth embodiment of the present invention;

Figure 10A shows a schematic top view of the transparent overlay haptic device in accordance with a sixth embodiment of the present invention;

10 Figure 10B is a schematic side view of the transparent overlay haptic device shown in Figure 10A; and

Figure 11 shows one example of a position sensor shown in Figure 1.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS:

15 Figure 1 illustrates the basic concept for the use of a transparent overlay haptic device 10 in accordance with an embodiment of the present invention. The transparent overlay haptic device 10 is a virtual touch/haptic device that can be used over top of a display 20. The transparent overlay haptic device 10 provides haptic effects to the user 12, corresponding to objects created on the display 20, without
20 obstructing the view of the display.

The display 20 creates images that are used to represent different objects 14 and would be present on a user interface, e.g. dials, sliders or buttons. The user "feels" the objects by touching the transparent overlay haptic device 10 and moving his finger across the display 20. As the user's finger 12 passes over the image of an
25 object, a haptic effect is generated to simulate the user making contact with the object.

Figure 2 illustrates the main components of a transparent overlay haptic system 5 having the device 10 and display 20 of Figure 1, and the illustration can be used to explain how the haptic effects are implemented. The transparent overlay
30 system 5 contains the display 20 and the transparent overlay haptic device 10 which has a transparent overlay 22, one or multiple actuators 24, a position sensor 26, a

controller 28, and housing and other mechanical interfaces.

The transparent overlay 22 lies over the display 20 between the user's hand 12 and the display 20. The transparent overlay 22 is a thin, flexible film that allows the force of the user's hand 12 to be transmitted through to the display 20. When the user makes contact with the overlay 22, there is sufficient friction between the user's finger and the overlay 22, and minimal friction between the overlay 22 and the display 20, so that the overlay 22 easily moves with the user's finger. Hence the overlay 22 does not move, relative to the user's hand 12. In Figure 2, the overlay 22 is larger than the display 20, and an actuator 24 is located in the vicinity of the overlay 22, but out of the field of view of the display 20. The actuator 24 mechanically interfaces with the overlay 22 through a mechanism to impart a force on the overlay 22. Therefore, when the actuator 24 is engaged, this force can be transmitted to the user's finger, via the overlay 22, without obstructing the view of the display 20. The position of the user's finger is obtained by the position sensor 26, and is transmitted to the controller 28. The controller 28 contains the software and hardware interfaces to allow for the processing of the sensor information to control the actuators 24 to simulate the desired haptic effects, and for the communication to external subsystems via a communication bus interface 30.

The position sensor 26 records the initial position of the finger. The position sensor 26 also records the new position of the finger as the user moves the overlay 22 across the display 20. When the user touches an area on the display 20 via the overlay 22, which is to provide a force feedback, the controller 28 processes sensor signals to generate haptic effects on the overlay 22. The homing device may include helical spring, elastic, coil spring, pulleys, sliders or gas spring. The position sensor 26 may include a photo sensor or an optical sensor.

The display 20 may be a touch sensitive Liquid Crystal Display (LCD). In this case, the position of the user's finger is obtained directly from the LCD 20, and is communicated to the controller 28. As the user moves their finger, and thus the transparent overlay 22, over an object that requires a haptic effect (e.g. a line denoting the edge of a button), the controller 28 detects this collision and sends a signal to the actuator 24 that in turn applies a force to the overlay 22. The force is

sensed by the user as a resistance to the desired motion.

If a "bump" type haptic effect is required to simulate the edge of a button, then the actuator 24 may be engaged for a short period of time with a large force. Many other effects can also be simulated. Once the user is within the boundary of a button object 14 on the display 20, the actuator 24 is partially engaged. Thus, additional
5 friction is felt by the user while inside the button object 14.

Figure 3A shows a top view of the transparent overlay haptic device 10A in accordance with a first embodiment of the present invention. Figure 3B shows a side view of the transparent overlay haptic device 10A of Figure 3A.

10 The overlay 22 of the transparent overlay haptic device 10A is a flat rectangular clear sheet. The overlay 22 is thin enough to allow forces applied by the user's finger to pass through to the touch sensitive LCD display 20. The overlay 22 is large enough so that when starting from the home position, the user can place their finger anywhere within the display area 42 and move to any new position, without
15 causing the edge of the overlay 22 to pass within the display area 42. The corners of the overlay 22 are attached to an overlay homing mechanism.

The transparent overlay haptic device 10A includes an overlay homing assembly 44 for the overlay 22. The homing mechanism 44 includes four springs 46 attached between the four corners of the overlay 22 and four spring mounting posts
20 47 grounded to the base 40 of the device 10A. They may be linear in nature, or may be part of a more complex torsional spring mechanism. When the user is not making contact with the device 10A, the springs 46 pull the overlay 22 to a home position. The spring constant for each spring is sufficient to overcome friction between the overlay 22 and any other component of the device, but is small enough not to add
25 significant force to the user's finger when the overlay 22 is moved by the user.

The transparent overlay haptic device 10A includes an actuator assembly 48. The actuator assembly 48 includes a solenoid 50, a brake pad 52 and a brake pad bracket 54. The solenoid 50 is mounted on the base 40 of the device 10A directly below the brake pad 52, which is held in place by the brake pad bracket 54. The
30 overlay 22 passes between the solenoid 50 and the brake pad 52. Figure 3A shows two actuator assemblies that are positioned on the device 10A to eliminate rotation

of the overlay 22 when the actuators have been activated. However, if the mechanical design of the housing prevents rotation of the overlay 22 when one actuator is activated, the second actuator assembly can be removed. When the solenoid 50 is activated, the overlay 22 is pinched between the solenoid shaft and the brake pad 52. The solenoid 50 is driven at various levels to generate various levels of force. This can be utilized to generate a variety of haptic effects.

The display 20 of the transparent overlay haptic device 10A is a touch panel LCD. The touch panel LCD 20 is used to display objects as well as provide position feedback for the user's finger.

The transparent overlay haptic device 10A includes the controller 28 as shown in Figure 2(not shown in Figures 3A-3B). The hardware within the controller 28 of the device 10A includes actuator drive circuitry, position sensing interface circuitry, a microprocessor and memory. The actuator drive circuitry takes a signal from the microprocessor and drives the actuator. The drive circuitry scheme can be any one of a number of solenoid actuation schemes. For example, a pulse width modulation scheme or a variable current source scheme could be used. The position sensing circuitry interface conditions the signal coming from the position sensor and makes it available to the microprocessor. The memory is used to store the software that is run on the microprocessor. The microprocessor loads up the software stored in memory and executes the application.

The software of the controller 28 contains the instructions needed to process the position sensor information to determine the drive signal for the actuator. The software supports simulation of a variety of effects. The software also contains instructions to generate audio feedback to the user. The software for simulating any objects on the display 20, haptic effects and other effects feedback to the user are reprogrammable.

The haptic effects are now described in detail. The transparent overlay haptic device 10A provides walls/edge effects, detent effects and damped region effects to the user. The device can also provide other haptic effects, such as a variety of types of gravity wells, friction, areas of repulsion, simulated inertia, simulated springs, simulated damping and other effects which can be created by those knowledgeable

in the art.

The walls/edge effects are described in detail. Figure 4 shows the wall/edge haptic effects. As shown in Figure 4, two types of walls can be created. A thin wall haptic effect 60 can be described as a barrier that briefly holds the overlay in a fixed position when the user collides with the object. Therefore, as the user passes through a wall, they sense a "bump". The sensed "thickness" of the wall can be adjusted by modifying the force applied to the actuator and the amount of time that the solenoid remains enabled.

A thick wall haptic effect 62 can be described as a barrier that prevents the user from entering an area. This effect is implemented as a highly damped region (described later) where the solenoid 50 is engaged and held when the user's finger is located inside the wall. For the user to exit out of the wall, some slippage between the user's finger and the overlay 22 is required. However, the touch sensitive LCD 20 is able to detect the absolute position of the user's finger, even if there is slippage between the user's finger and the overlay 22. Once the user's finger is outside the thick wall, the solenoid 50 is disengaged.

The detent effects are described in detail. Figure 5 shows detent haptic effects. As shown in Figure 5, detents can be implemented as a series of thin walls placed in succession. The detents can be arranged in a linear or angular configuration. As the user passes over the detent area, they pass through the thin walls, and they sense small ridges. The force for detents is typically smaller than those used for thin walls. However, the "feel" of the detents is adjustable as well by modifying the force, duration and spacing between each thin wall.

The damped region effects are now described in detail. The damped region is an area where the solenoid 50 is engaged, but only to a level that adds a certain amount of friction to the motion of the overlay 22. This resistance to motion is sensed by the user as an area where their motion is damped or restricted. The degree of restriction can be adjusted by modifying the level of force applied by the solenoid 50.

Other haptic effects, which have not been discussed in detail here, can also be created with this haptic device by those knowledgeable in the art.

These haptic effects can be combined to create objects. A button may be

created by using thin walls that surround a damped area. A slider may be created by using a series of detents within a damped area. A slider may be created by using a damped area where the level or restriction is increased as the user slides along the damped area.

5 These effects and objects are only a few examples, and more complex effects and objects are provided by the transparent overlay haptic device 10A.

 Combined with the touch panel LCD 20, the transparent overlay haptic device 10A has two and one half degrees of freedom; translation in the x-axis, y-axis and a selection in the z-axis. The touch pad of the LCD 20 can detect when the user
10 presses down on the display. The device 10A affords enough haptic degrees of freedom to implement unique effects corresponding to different control devices (e.g. knobs, buttons, sliders, etc.). The haptic effects are generated in a passive manner. Only a braking action is applied to the overlay 22 in order to generate the haptic effects. This is in contrast to many more expensive haptic devices where motors are
15 used to generate the haptic effects.

 The overlay 22 is returned to a home position after the user breaks contact with the device. Without a homing mechanism, the overlay 22 may be railed to the limits of the device on subsequent user motions. In the event of a failure of the transparent overlay haptic device 10A (e.g. broken spring), the user can still interact
20 with the application via the touch sensitive LCD 20, and only loses the haptic effects. Hence, only partial functionality is lost in the event of a failure. The software contains instructions to generate audio feedback to further assist the user in determining where the user's finger is located on the display 20.

 Figure 6A shows a top view of a transparent overlay haptic device 10B in
25 accordance with a second embodiment of the present invention. Figure 6B shows a schematic side view of the transparent overlay haptic device 10B shown in Figure 6A. The transparent overlay haptic device 10B includes a clear overlay 22A, a roller 70 for rotating the clear overlay 22A in x-axis, and a roller mounting 72 for the roller 70. The transparent overlay haptic 10B further includes a brake actuator 76 (such as a
30 solenoid) and the brake pad 74 as the braking mechanism for the overlay 22A. The brake actuator 76 may be a hydraulic cylinder, pneumatic cylinder.

The transparent overlay haptic device 10A shown in Figures 3A-3B has two and a half degree of freedom (two degrees of freedom for the x and y axis plus 0.5 degrees of freedom for the z-axis). The transparent overlay haptic device 10B shown in Figures 6A-6B reduces the number of degrees of freedom to one and a half (one
5 degree of freedom for the x axis plus 0.5 degrees of freedom for the z-axis), which allows for the considerable reduction in size of the invention. The reduction in size is accomplished by eliminating haptic effects in the y-axis and by converting the overlay sheet 22A to an overlay roll. The transparent overlay haptic device 10B only needs to be slightly bigger than the display 20.

10 The transparent overlay haptic device 10B also allows for the easy incorporation of motors into the design. This allows for the generation of more complex haptic effects since the actuation becomes active. The difference between a passive device and an active device is that the passive device relies on the user to generate effects, while the active device can generate the effects independently of
15 the user. For example, if the user holds their finger in a fixed location, the passive device cannot generate any force on the user's finger while the active device can.

There is also no need for a homing mechanism (either a passive spring mechanism or active motor drive mechanism) in the transparent overlay haptic device 10B since the overlay 22A only moves in one axis and the continuous roll of overlay
20 material is fed back over the display area as the user moves their finger.

Figure 7A shows a top view of a transparent overlay haptic device 10C in accordance with a third embodiment of the present invention. Figure 7B shows a schematic side view of the transparent overlay haptic device 10C shown in Figure 7A. The transparent overlay haptic device 10C keeps the two and a half degrees of
25 freedom, but still reduces the size of the overall device in one axis (by using the concept of a roll of overlay instead of a sheet).

The transparent overlay haptic device 10C combines some of the advantages of the transparent overlay haptic device 10A in Figure 3 (i.e. 2.5 degrees of freedom) and some of the advantages of the transparent overlay haptic device 10B in Figures
30 6A and 6B (i.e. reduction in size). In the device 10C, a homing mechanism 46A (such as a spring) is provided for one direction (i.e. y-axis), but not in direction of the roller

motion (i.e. x-axis). This embodiment also allows for the easy incorporation of motors into the design (i.e. convert the device to an active device).

Figure 8A shows a schematic top view of a transparent overlay haptic device 10D in accordance with a fourth embodiment of the present invention. Figure 8B shows a schematic cross side view of the transparent overlay haptic device 10D shown in Figure 8A. The transparent overlay haptic device 10D keeps the two and one half degrees of freedom and significantly reduces the size of the device, at the cost of forcing the user place their finger at a predefined location.

In Figures 8A-8B, the full overlay has been replaced with strips of overlay film that pass over one set of rollers 70A for the x-axis and another set of rollers 70B for the y-axis. Two strips 22B and 22 C are shown in Figures 8A-8B. The two strips 22B, 22C are attached together where the two strips intersect above the display 20, and a divot 80 is placed at the same location. The user places their finger on the divot 80 when they make contact with the device 10D. Optional homing mechanisms 46A, 46B, such as springs, ensure that the divot 80 is returned to the home position (e.g. the lower left corner of the display) once the user removes their finger from the device. Each roller 70A, 70B can slide along a spline axle (perpendicular to the axis of rotation) and the axle is attached to the spline mounts 82 through spline bearings 84 that allow the axle to rotate. In Figures 8A-8B, x-axis splines 90 and y-axis splines 92 are shown. As the axle rotates, the roller also rotates, which causes the overlay strip to pass over the roller, thus moving the divot 80 in one axis. A disc 78 is mounted on the axle at a fixed distance from the mount 82 and is part of the braking system. The solenoid brake actuator 76 with the brake pad 74 is mounted opposite the disc 78 so that when the solenoid is engaged, the disc rotation is restricted, which in turn, will restrict the divot 80 from moving in one axis. The transparent overlay haptic device 10D also allows for the easy incorporation or motors on the spline axle assembly, thus easily making the device 10D an active haptic device. Since rollers are incorporated in both axes, the size of the device does not need to be much larger than the actual display.

Figure 9 shows a transparent overlay haptic device 10E in accordance with a fifth embodiment of the present invention. The transparent overlay haptic device 10E

keeps the two and one half degrees of freedom and significantly reduces the size of the device, without forcing the user to place their finger at a predefined location.

The transparent overlay haptic device 10E includes an overlay 22D which has a closed surface (e.g. a sphere). The user can continuously move the overlay 22D in either the x or y axis without having an edge of the overlay pass over the display area.

The actuators in the transparent overlay haptic device 10E are the solenoid brakes 76. An X-Y position sensor is provided if the display 20 is not touch sensitive. In this embodiment, there is no need for a homing mechanism for the overlay 22D. The footprint (i.e. size in the x and y direction) of this embodiment is smaller than the preferred embodiment, but this embodiment is much deeper (i.e. size in the z direction).

Figure 10A shows a top view of a transparent overlay haptic device 10F in accordance with a sixth embodiment of the present invention. Figure 10B shows a schematic side view of the transparent overlay haptic device 10F. The device 10F retains two and one half degrees of freedom and also reduces the size of the device.

The device 10F has a clear plastic overlay 22E, which wraps around a frame 102 which houses the LCD display 20. The frame 102 is coated by Teflon (trade-mark). Attached to the clear plastic overlay 22E on the underside of the frame 102 is a magnet, electromagnet or a series of magnets/electromagnets. In Figures 10A and 10B, a magnetic ring 106 is attached to the underside of the frame 102. As the user moves the clear plastic overlay 22E via the finger rest 108, the attached magnets/electromagnets move relative to the Teflon frame 102. The finger rest 108 is optional if there is sufficient friction between the user's finger and the transparent overlay haptic device 10F. By actuating the electromagnet or by actuating external electromagnets, haptic effects are applied to the user's finger. For example, if the frame 102 is metallic, a braking force may be employed by simply actuating an attached electromagnet. The transparent overlay haptic device 10F can be augmented with a homing device to return the finger rest to a predefined position. The transparent overlay haptic device 10F has the potential to be compact and versatile.

The position sensor 26 of Figure 1 is now described in detail. An absolute position sensor and/or a relative position sensor may be employed as the position

sensor 26.

The absolute position sensor is described in detail. The absolute position sensor provides the absolute position of the user's finger. The touch sensitive LCD falls into this category. Figure 11 shows an alternate absolute position sensing mechanism. The absolute position sensor of Figure 11 includes an array of photo-diodes 110 and photo sensors (or detectors) 112 around the outside of the display 20. In the absolute position sensor of Figure 11, the photo-sensor output is monitored. When the user's finger interrupts the beam of light from the photo-diodes 110, the interruption is monitored by the sensors 114 and 116 within the sensors 112. Thus, the x and y positions of the user's finger are obtained. Some encoders and potentiometers also measure absolute position and may be used.

The relative position sensor is described in detail. The relative position sensor measures the change in position. Examples of sensors that fall into this category are optical sensors (e.g. those used in optical mice), encoders on rollers, and potentiometers on rollers. While these sensors may be less expensive and simpler in design, they require a calibration to be performed to determine a home position. All measurements are then taken relative to the determined home position.

As described above, a LCD may be provided to the transparent overlay haptic device 10. However, any other display technologies can also be used. For example, a Cathode Ray Tube (CRT) display, a plasma display, a projection display, or a Light Emitting Diode (LED) display are applicable.

As described above, the transparent overlay haptic device 10 can be made active with the addition of motors, or other active devices (e.g. solenoids, shape memory alloys, pneumatics, hydraulics). With the addition of the active components, the homing mechanism can also be removed since the active actuator can drive the overlay to the home position after the user removes their finger from the device.

A transparent overlay haptic device, which is similar to the device 10D, can be used to eliminate the requirement that the user always starts from a home position. To accomplish this, the device is made active with the addition of motors to drive the spline axles. The position sensor 26 is accomplished with an array of photo-diodes and photo-sensors, such as the position sensor of Figure 11. The position sensor is

placed far enough from the display 20 so that as the user's finger approaches the display 20, the position is obtained and the controller 28 drives the motor such that the divot 80 is placed just below the user's finger just before contact is made with the display 20. Once the user's finger is on the divot 80, haptic effects can be felt by
5 actively driving the motors.

The braking schemes of Figures 3A-3B uses push rod braking schemes. However, alternate braking schemes can be employed, such as disc braking, locking pin brakes, eddy current brakes, or other mechanical braking mechanisms.

In each of the above embodiments, the user is allowed to initially place their
10 finger at any starting point within the display area. An alternate approach may be applicable, which makes the user always place their finger at a pre-defined initial position. This would remove the requirement for calibration of the relative position sensor, since the pre-defined initial position would be the home position. The initial pre-defined position may be marked with a dimple or rougher texture on the overlay
15 22.

According to the embodiment of the present inventions, the main advantages include, but are not limited to the following:

a) Haptic effects are provided to users without obstructing the view of a display.

20 b) The passive embodiment of the transparent overlay haptic device is less expensive than other conventional haptic devices since motors are not required.

c) The embodiments described can easily be extended to use motors to implement more complex haptic effects if desired.

d) The user can primarily rely on the sense of touch to navigate through the
25 option selection. This further compliments the phenomena known as muscle memory (the phenomena that a user can remember where objects are located in space after repetitive motion). This reduces the amount of attention required to perform other tasks, and provides less distraction to the main task.

e) The reconfigurability of the transparent overlay haptic device allows for
30 intuitive design of the user interface. For example, for adjustment of the mirrors in a vehicle, it may be more intuitive to use the knob as a slider instead or using the

rotational axis of the knob as an input.

f) The reconfigurability of the transparent overlay haptic device allows for the customization of the user interface.

g) If a touch sensitive display is used, then failure of the haptic portion of the device (e.g. the overlay breaks, the roller gets stuck) does not prevent the operation of the device, since the user can still select options by pressing on the display 20.

The transparent overlay haptic device 10 and its system 5 can be used in the automotive industry, aerospace industry, game industry or any other application where several control functions are integrated into a single input device and, for specific reasons (e.g. safety), the user cannot be distracted from other tasks.

While particular embodiments of the present invention have been shown and described, changes and modifications may be made to such embodiments without departing from the true scope of the invention.

What is claimed is:

1. A system for providing haptic effects to a user,
a display for providing an image of an object; and
5 a transparent overlay haptic device, which includes:
a transparent overlay for translating the motion of the user's finger to the
image and providing haptic effects to the user, the user contacting the image through
the overlay, and
a haptic effect element for generating the haptic effect on the overlay in
10 response to the motion of the user.
2. The system according to claim 1, wherein the display is a touch sensitive
display having a functionality of sensing the motion of the user.
- 15 3. The system according to claim 2 wherein the overlay is a clear sheet and is
thin so as to allow forces applied by the user to pass through to the touch sensitive
display.
4. The system according to claim 1, wherein the haptic effect element includes
20 a sensor for sensing the motion of the user, and a controller for processing
information provided from the sensor to simulate the haptic effect.
5. The system according to claim 4, wherein the haptic effect element further
includes an actuator, the controller controlling the actuator for generating the haptic
25 effect on the overlay.
6. The system according to claim 5, further comprising a communication
interface for communication between the controller and an external system.
- 30 7. The system according to claim 1, wherein the haptic effect element includes
an overlay homing assembly to provide a home position to the overlay.

8. The system according to claim 7, wherein the overlay homing assembly has a spring attached to the overlay and a base of the device.
9. The system according to claim 1, wherein the haptic effect element includes an actuator assembly for generating a force to provide the haptic effect on the overlay.
10. The system according to claim 9, wherein the actuator assembly includes a solenoid, a brake pad and a brake pad bracket.
11. The system according to claim 1, wherein the haptic effect element includes a controller for simulating the haptic effects.
12. The system according to claim 11, wherein the controller simulates a thin wall effect.
13. The system according to claim 11, wherein the controller simulates a thick wall effect.
14. The system according to claim 11, wherein the controller simulates a series of wall effect.
15. The system according to claim 11, wherein the controller simulates a haptic effect associated with knobs, rotary dials, sliders or any other mechanical control device.
16. The system according to claim 11, wherein the controller has a functionality of generating audio feedback.
17. The system according to claim 11, wherein the controller has a functionality of controlling the image of the object in accordance with the haptic effect.

18. The system according to claim 1, wherein the haptic effect element generates the haptic effects in a passive manner.

5 19. The system according to claim 1, wherein the haptic effect element generates the haptic effects in an active manner.

20. The system according to claim 1, wherein the haptic effect element includes a braking system for generating the haptic effects in a passive manner.

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21. The system according to claim 1, wherein the overlay is a circular sheet.

22. The system according to claim 21, wherein the haptic effect element includes a roller for rotating the overlay along one axis over the display.

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23. The system according to claim 22, wherein the haptic effect element further includes a braking system for applying a brake to the overlay along one axis.

24. The system according to claim 22, wherein the haptic effect element further
20 includes a homing mechanism to sustain the overlay along an axis.

25. The system according to claim 1, wherein the overlay includes an overlay strip for the x-axis and an overlay strip for the y-axis.

25 26. The system according to claim 25, wherein a divot is placed on an area where the strip for the x-axis intersects the strip for the y-axis.

27. The system according to claim 26, wherein the haptic effect element includes a homing mechanism to provide a home position for the divot.

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28. The system according to claim 26, wherein the haptic effect element includes a roller for the x-axis, a roller for the y-axis, a spline axle for the x-axis and a spline axle for the y-axis, the roller for the x-axis sliding along and being driven by the spline axle for the x-axis and the roller for the y-axis sliding along and being driven by the spline axle for the y-axis.

29. The system according to claim 28, wherein the haptic effect element further includes spline mounts and spline bearings, the axle being attached to the spline mounts through the spline bearings such that the axle rotates.

30. The system according to claim 28, wherein the roller rotates in response to a rotation of the axle, the rotation of the roller allowing the strip to passing over the roller and the divot to move in one axis.

31. The system according to claim 25, wherein the haptic effect element further includes a braking system for applying a brake to the strips.

32. The system according to claim 31, wherein the braking system includes a disc brake applied to a drive mechanism of the strip for the x-axis and a disc brake applied to a drive mechanism of the strip for the y-axis.

33. The system according to claim 32, wherein the braking system further includes solenoid brakes, each of which is mounted such that the rotation of the disc is restricted when the solenoid is engaged.

34. The system according to claim 1, where the haptic effect element includes a position sensor for sensing the motion of the user.

35. The system according to claim 34, where the position sensor includes an absolute position sensor and/or a relative position sensor.

36. The system according to claim 34, where the absolute position sensor includes an array of photodiodes and photo detectors around the outside of the display.

5 37. The system according to claim 35, wherein the relative position sensor includes an optical sensor.

38. The system according to claim 35, wherein the relative position sensor includes encoders.

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39. The system according to claim 35, wherein the relative position sensor includes potentiometers.

40. The system according to claim 1, wherein the display is selected from the group consisting of liquid crystal displays, cathode ray tube displays, plasma displays, projection displays or light emitting diode displays.

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41. The system according to claim 1, wherein the haptic effect element includes a braking system selected from the group consisting of push rod braking mechanisms, disc braking mechanisms, locking pin braking mechanisms, eddy current braking mechanisms and other mechanical braking mechanisms.

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42. The system according to claim 1, wherein the display is wrapped by the overlay.

25

43. The system according to claim 42, wherein the haptic effect element includes a frame for housing the display, an moving element which moves relative to the frame and an actuator for actuating the element, the frame and the display being wrapped by the overlay.

30

44. The system according to claim 43, wherein the moving element is selected from the group consisting of one or more magnets, one or more electromagnets, and a combination of one or more magnets and one or more electromagnets.

5 45. A device for providing haptic effects to a user, whereby a user contacts an image of an object on a display incorporating,
a transparent overlay for translating the motion of the user's finger to the image and providing haptic effects to the user, the user contacting the image through the overlay, and
10 a haptic effect element for generating the haptic effect on the overlay in response to the motion of the user.

46. A method of applying a force in the x and y axis to a user's finger, via a transparent overlay which provides the view of a display to the user, the method
15 comprising the steps of:
sensing the motion of the user relative to an object displayed on the display to generate information on the motion; and
simulating haptic effects based on the information; and
providing, to the user, the force corresponding to the haptic effect, through the
20 transparent overlay.

47. A method of claim 46, wherein the step of providing the force includes the step of passively providing the force to the user.

25 48. A method of claim 46, wherein the step of providing the force includes the step of actively providing the force to the user.

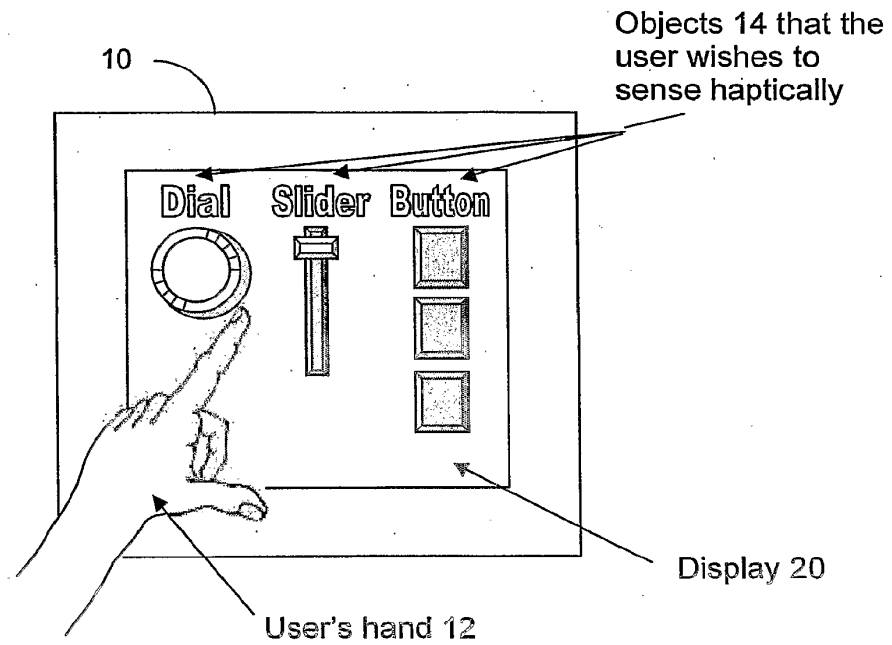


Figure 1

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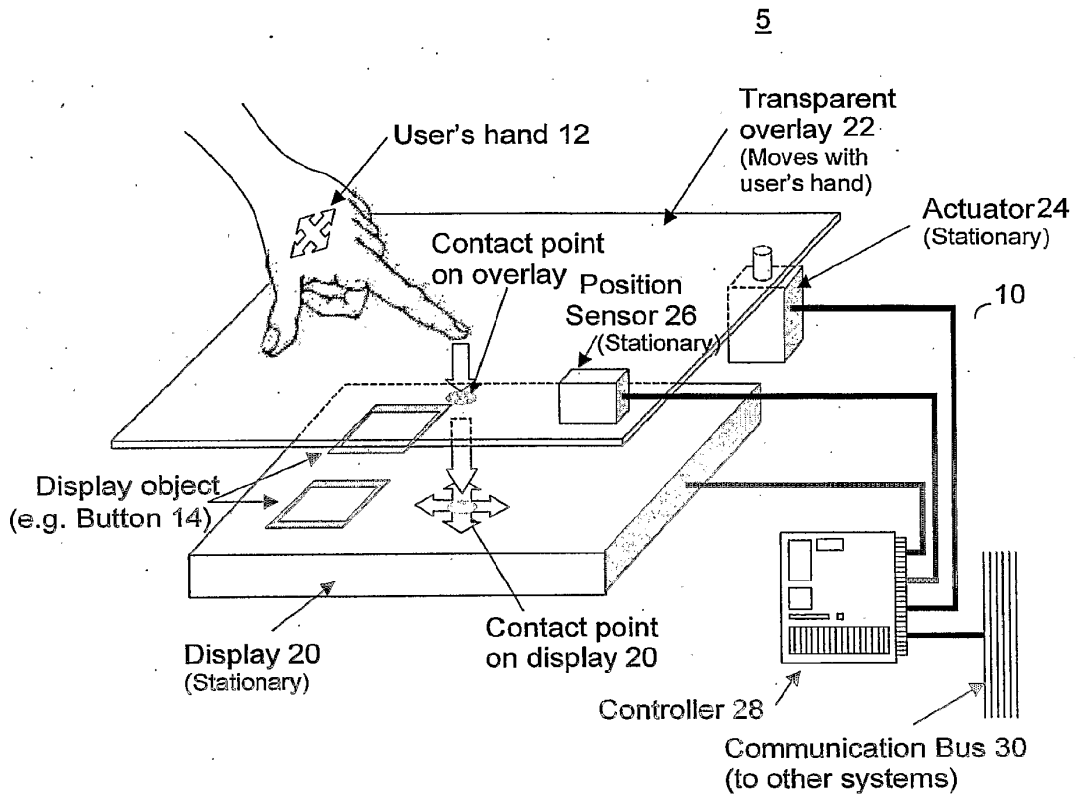


Figure 2

Figure 3A

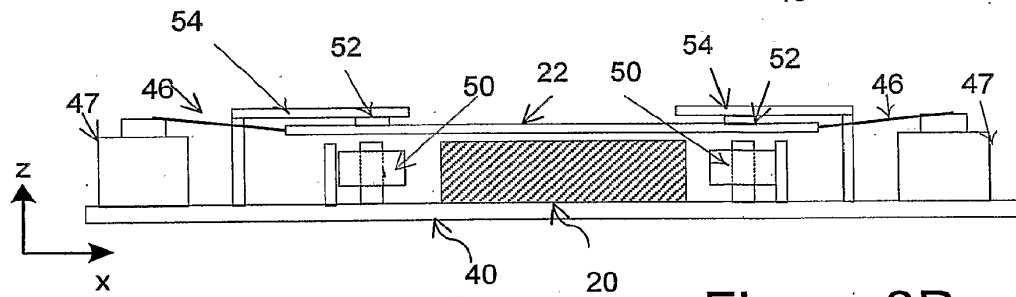
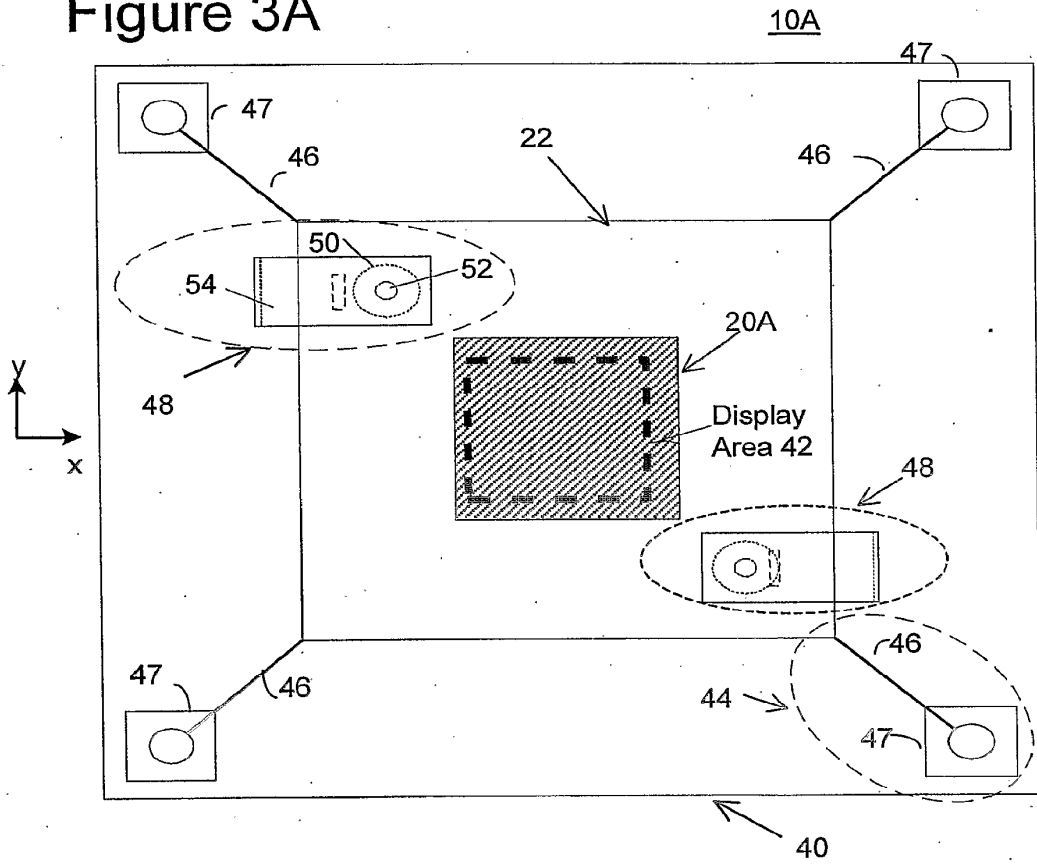


Figure 3B

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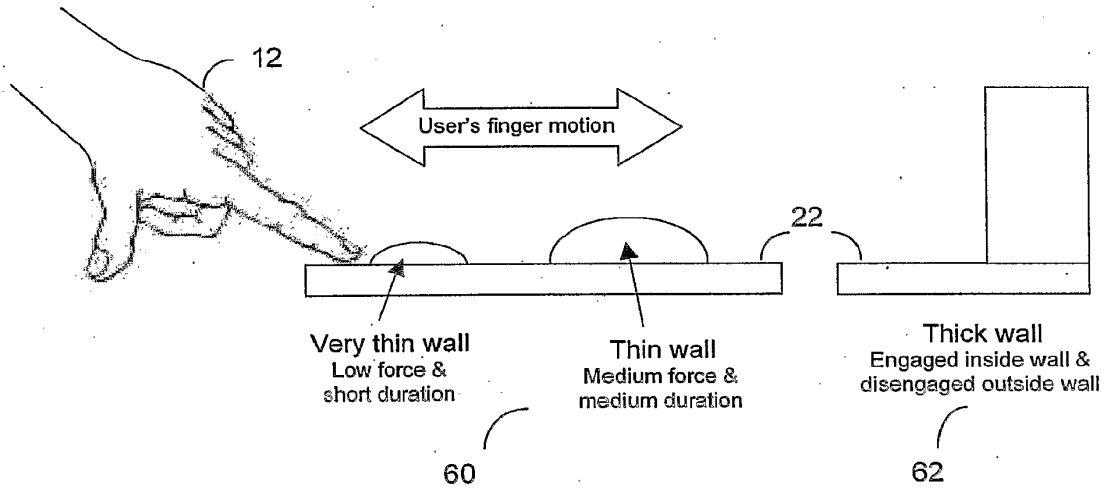


Figure 4

5/11

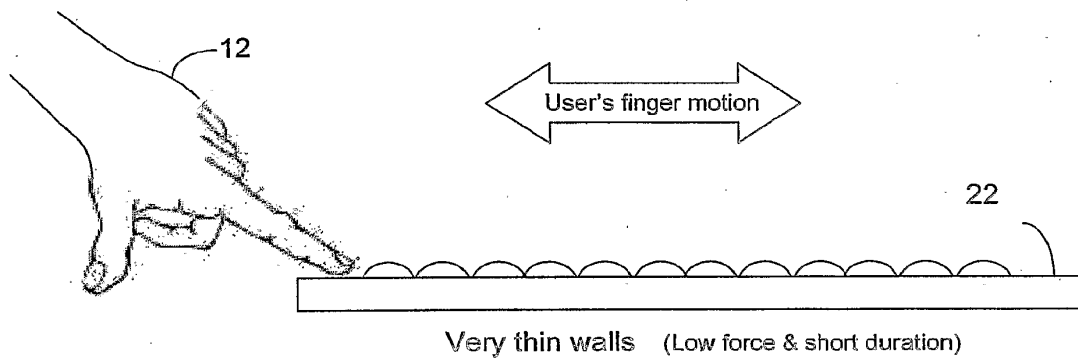


Figure 5

Figure 6A

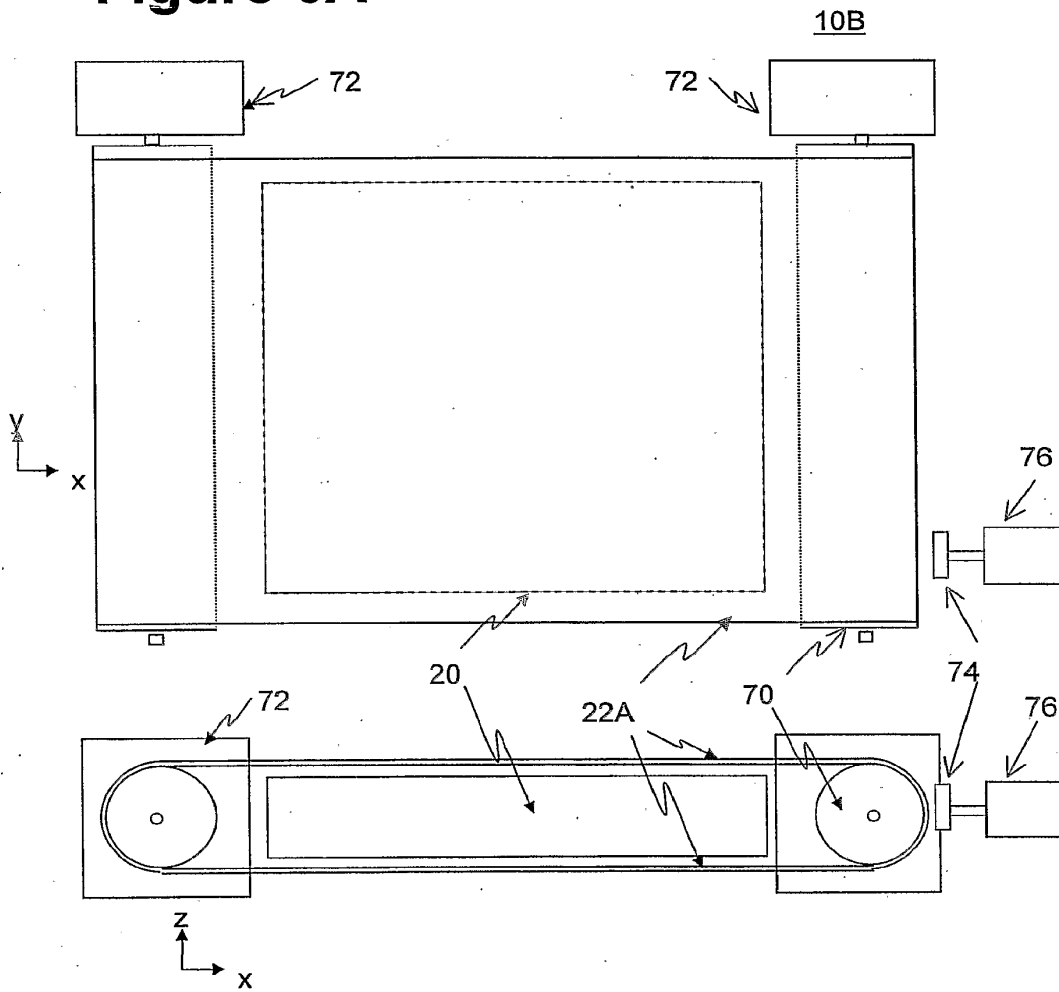


Figure 6B

Figure 7A

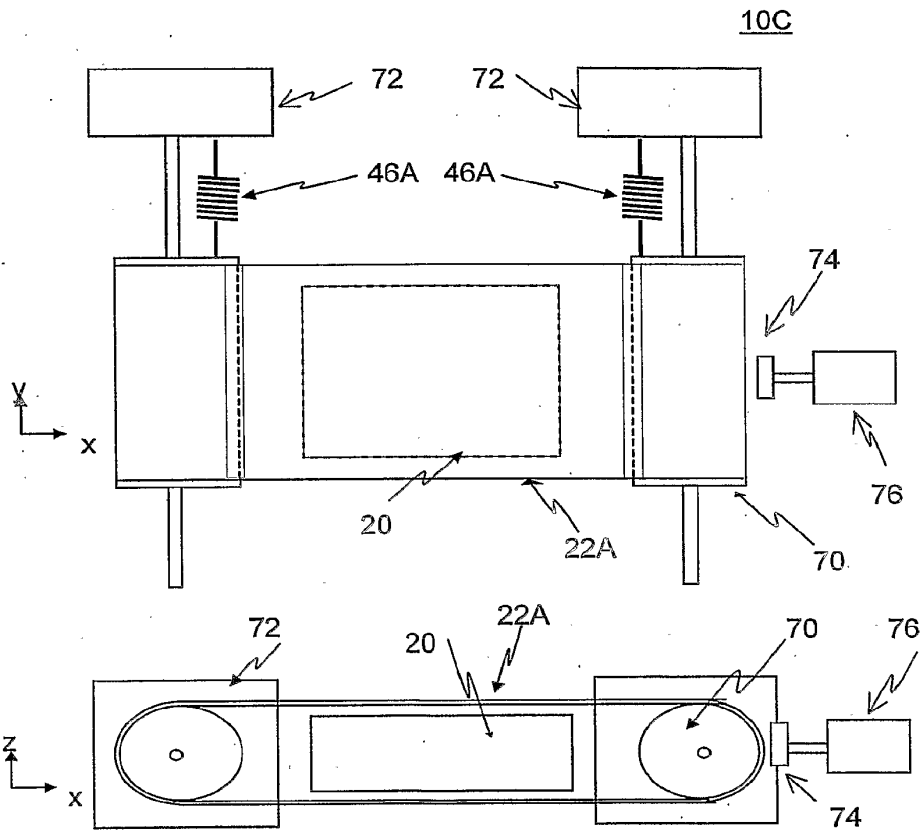


Figure 7B

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Figure 8A

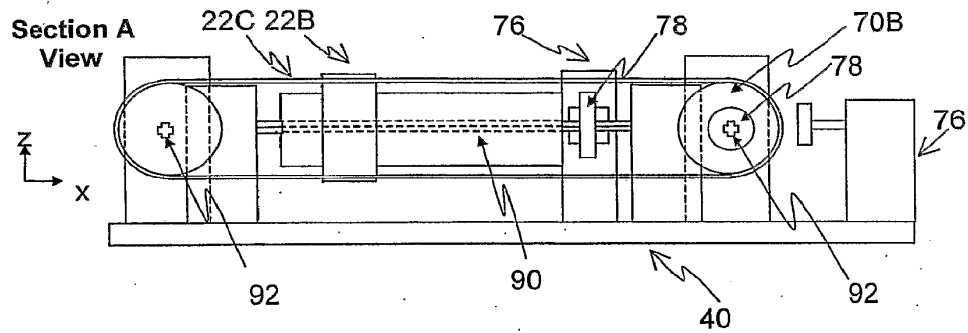
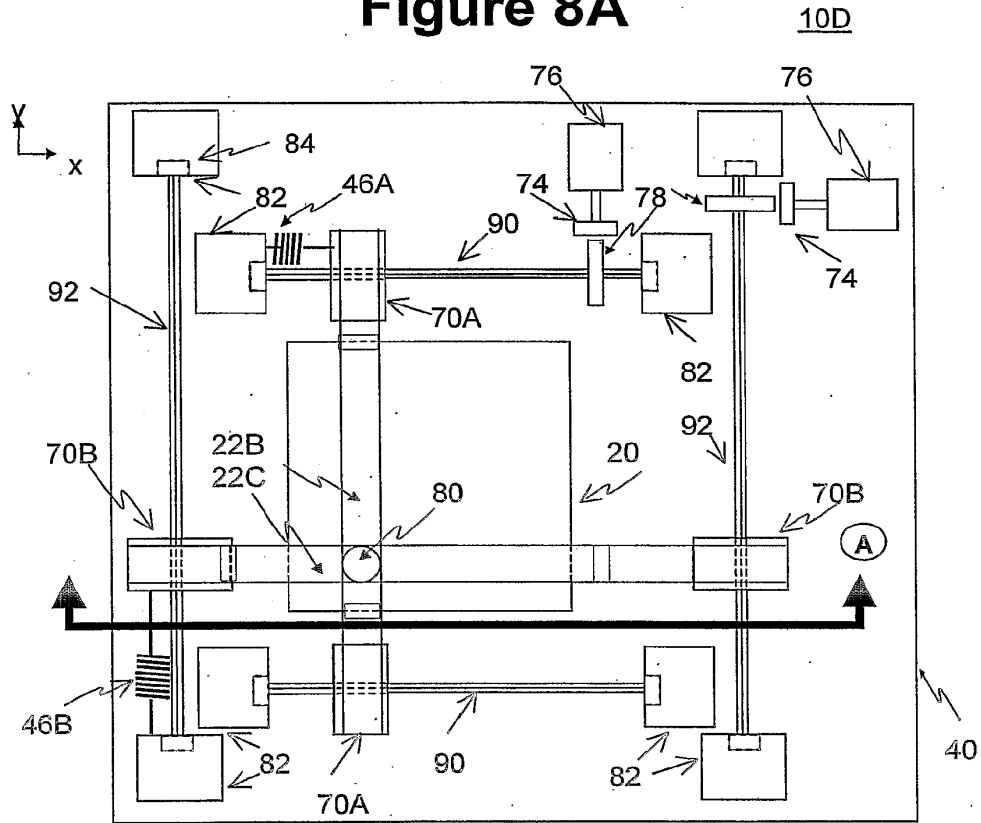


Figure 8B

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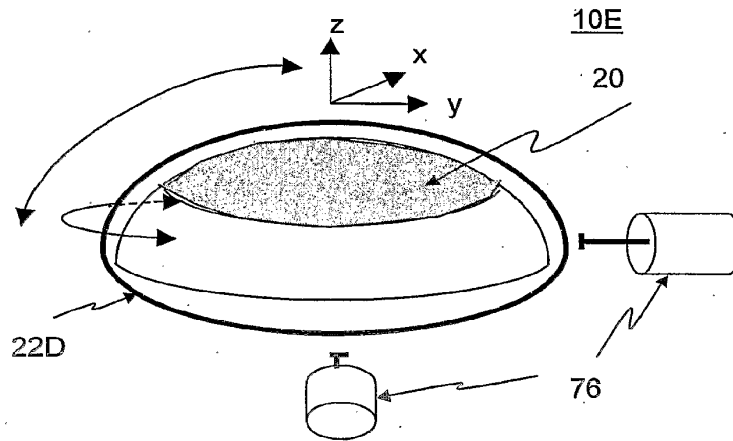


Figure 9

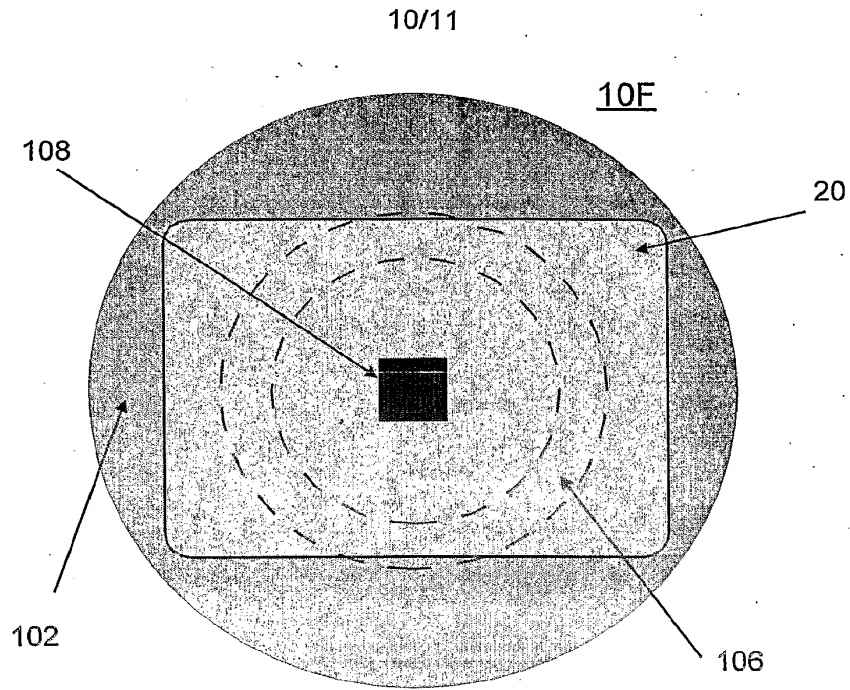


Figure 10A

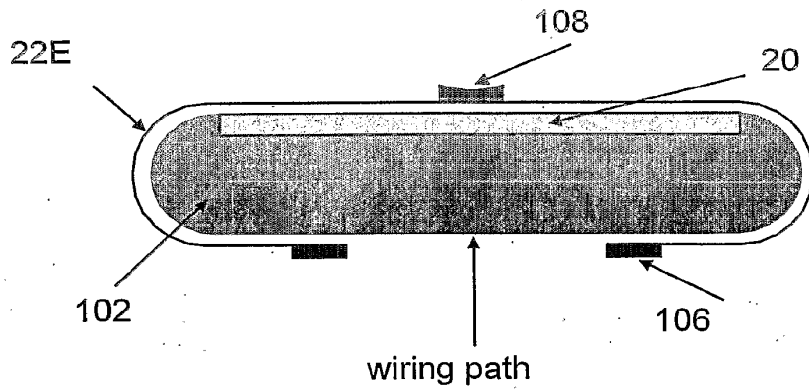


Figure 10B

11/11

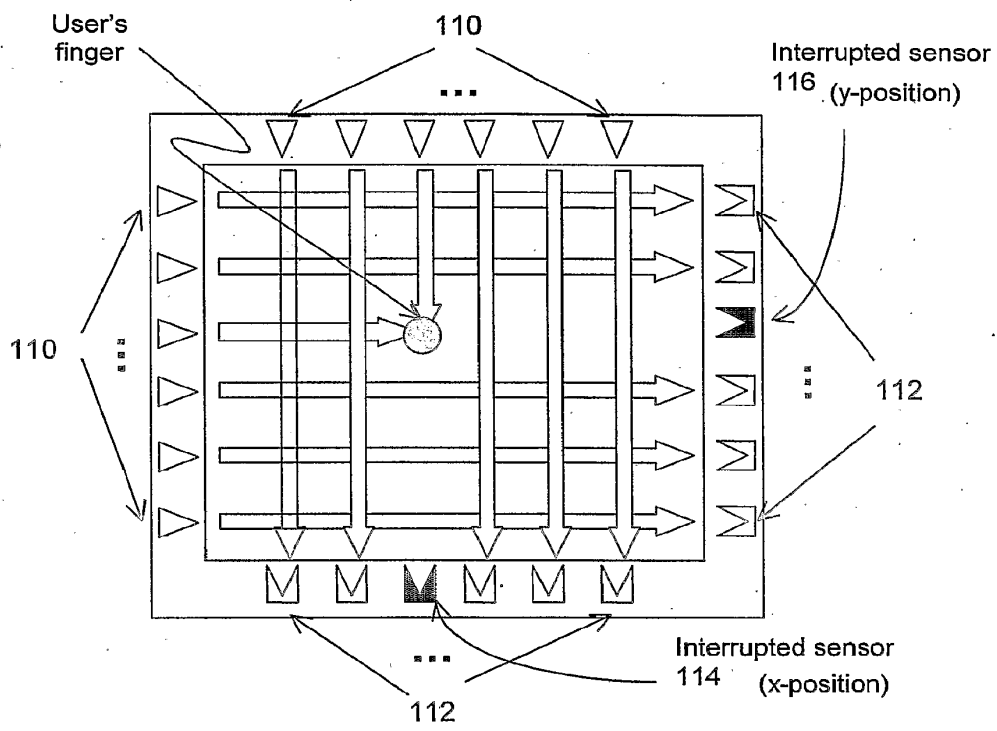


Figure 11

INTERNATIONAL SEARCH REPORT

International Application No
PCT/CA2004/000383

A. CLASSIFICATION OF SUBJECT MATTER IPC 7 G06F3/00				
According to International Patent Classification (IPC) or to both national classification and IPC				
B. FIELDS SEARCHED Minimum documentation searched (classification system followed by classification symbols) IPC 7 G06F A61B B60K				
Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched				
Electronic data base consulted during the international search (name of data base and, where practical, search terms used) EPO-Internal, WPI Data, PAJ, IBM-TDB, INSPEC				
C. DOCUMENTS CONSIDERED TO BE RELEVANT				
Category ^o	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.		
X	WO 02/102616 A (TUER KEVIN L ; WANG DAVID W L (CA); HANDSHAKE INTERACTIVE TECHNOLO (CA) 27 December 2002 (2002-12-27) figures 1-3 page 6, lines 13-15 page 6, line 15 - line 22 page 9, line 10 - line 19 page 5, line 1 - line 6 page 7, line 8 - line 10 page 15, line 23 - line 28	1-48		
A	WO 02/06943 A (STROEMBERG ROLF) 24 January 2002 (2002-01-24) abstract; figures 1-2b ----- -/---	1,21-23, 45,46		
<input checked="" type="checkbox"/> Further documents are listed in the continuation of box C.				
<input checked="" type="checkbox"/> Patent family members are listed in annex.				
^o Special categories of cited documents :				
<table style="width: 100%; border: none;"> <tr> <td style="width: 50%; border: none; vertical-align: top;"> <ul style="list-style-type: none"> *A* document defining the general state of the art which is not considered to be of particular relevance *E* earlier document but published on or after the international filing date *L* document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified) *O* document referring to an oral disclosure, use, exhibition or other means *P* document published prior to the international filing date but later than the priority date claimed </td> <td style="width: 50%; border: none; vertical-align: top;"> <ul style="list-style-type: none"> *T* later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention *X* document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone *Y* document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art. *Z* document member of the same patent family </td> </tr> </table>			<ul style="list-style-type: none"> *A* document defining the general state of the art which is not considered to be of particular relevance *E* earlier document but published on or after the international filing date *L* document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified) *O* document referring to an oral disclosure, use, exhibition or other means *P* document published prior to the international filing date but later than the priority date claimed 	<ul style="list-style-type: none"> *T* later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention *X* document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone *Y* document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art. *Z* document member of the same patent family
<ul style="list-style-type: none"> *A* document defining the general state of the art which is not considered to be of particular relevance *E* earlier document but published on or after the international filing date *L* document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified) *O* document referring to an oral disclosure, use, exhibition or other means *P* document published prior to the international filing date but later than the priority date claimed 	<ul style="list-style-type: none"> *T* later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention *X* document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone *Y* document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art. *Z* document member of the same patent family 			
Date of the actual completion of the international search <p style="text-align: center;">11 August 2004</p>	Date of mailing of the international search report <p style="text-align: center;">17/08/2004</p>			
Name and mailing address of the ISA European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Tx. 31 651 epo nl, Fax: (+31-70) 340-3016	Authorized officer <p style="text-align: center;">Griesbach, A</p>			

INTERNATIONAL SEARCH REPORT

International Application No
PCT/CA2004/000383

C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT		
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A	<p>WO 02/071322 A (FUJITSU SIEMENS COMPUTERS GMBH ; JUERGENS WIELAND (DE)) 12 September 2002 (2002-09-12) page 4, line 29 - line 32 page 7, line 18 - line 21; figure 5 page 2, line 9 - line 15 page 6, line 15 - line 30 figure 1</p> <p>-----</p>	1,7,8, 24,45,46
A	<p>DE 199 07 620 A (ZENTRUM FUER KUNST UND MEDIENT) 17 August 2000 (2000-08-17) column 1, line 29 - line 32 column 1, line 46 - line 62 column 2, line 29 - line 33 figures 1-3 column 2, line 41 - line 45 column 3, line 37 - line 40 column 3, line 48 - line 62</p> <p>-----</p>	1,25-33, 45,46
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A	<p>ISHII T ET AL: "ELECTROSTATIC TACTILE DISPLAY USING THIN FILM SLIDER" INTERNATIONAL CONFERENCE ON MOTION AND VIBRATION CONTROL, XX, XX, 19 August 2002 (2002-08-19), pages 547-552, XP008032598 the whole document</p> <p>-----</p>	1-48
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Information on patent family members

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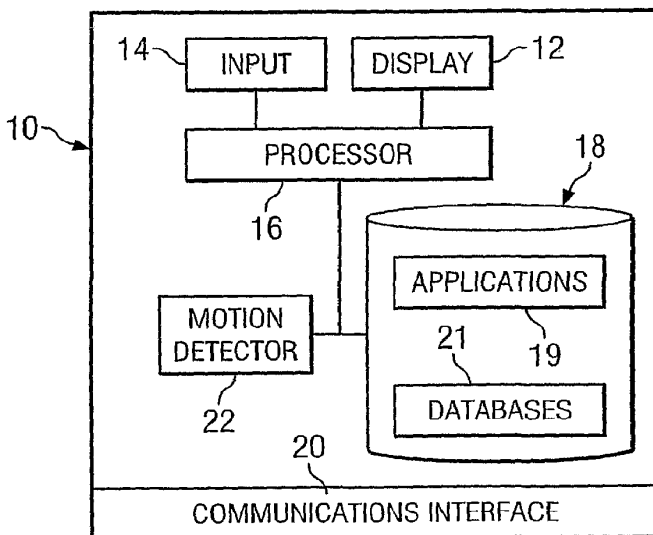
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| 10/807,568 | 23 March 2004 (23.03.2004) | US |
| 10/807,588 | 23 March 2004 (23.03.2004) | US |
| 10/807,561 | 23 March 2004 (23.03.2004) | US |
| 10/807,557 | 23 March 2004 (23.03.2004) | US |
| 10/807,565 | 23 March 2004 (23.03.2004) | US |
| 10/807,562 | 23 March 2004 (23.03.2004) | US |
| 10/807,566 | 23 March 2004 (23.03.2004) | US |
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| 10/807,589 | 23 March 2004 (23.03.2004) | US |
| 10/807,567 | 23 March 2004 (23.03.2004) | US |
- (74) Agent: **SHOWALTER, Barton, E.**; Baker & Botts, L.L.P., 2001 Ross Avenue, Suite 600, Dallas, TX 75201 (US).
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[Continued on next page]

(54) Title: DISTINGUISHING TILT AND TRANSLATION MOTION COMPONENTS IN HANDHELD DEVICES



(57) Abstract: A motion controlled handheld device includes a first accelerometer operable to detect acceleration along a first axis and a second accelerometer operable to detect acceleration along a second axis. The second axis is perpendicular to the first axis. The device includes a tilt detection component operable to detect rotation having a component around at least one of the first axis and the second axis and a display operable to present a current image. The device includes a motion tracking module operable to track motion of the device in three dimensions using the first accelerometer, the second accelerometer, and the tilt detection component. The device also includes a controller operable to generate the current image and to modify the current image in response to the motion of the device.

WO 2005/103863 A2



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DISTINGUISHING TILT AND TRANSLATION MOTION
COMPONENTS IN HANDHELD DEVICES

TECHNICAL FIELD

The present invention relates generally to portable devices and, more particularly, to portable devices with a motion interface.

5 BACKGROUND

The use of computing devices, such as cellular phones and personal digital assistants (PDAs) has grown rapidly. Such devices provide many different functions to users through different types of interfaces, such as keypads and displays. Some computing devices utilize motion as an interface by detecting tilt of the device by a user. Some implementations of a motion interface involve tethering a computing device with fishing lines or carrying large magnetic tracking units that require large amounts of power.

SUMMARY

15 In accordance with the present invention, a handheld device with motion a motion interface is provided.

In accordance with a particular embodiment, a motion controlled handheld device includes a first accelerometer operable to detect acceleration along a first axis and a second accelerometer operable to detect acceleration along a second axis. The second axis is perpendicular to the first axis. The device includes a tilt detection component operable to detect rotation having a component around at least one of the first axis and the second axis and a display operable to present a current image. The device includes a motion tracking module operable to track motion of the device in

three dimensions using the first accelerometer, the second accelerometer, and the tilt detection component. The device also includes a controller operable to generate the current image and to modify the current image in response to the motion of the device.

5 The display may comprise a viewable surface, and the first axis and the second axis may be substantially parallel to the viewable surface. The tilt detection component may comprise a third accelerometer operable to detect acceleration along a third axis, where the third axis is perpendicular to the first axis and perpendicular to the second axis. The motion tracking module may be further operable to distinguish
10 translation within a plane formed by the first axis and the second axis from rotation having a component around at least one of the first axis and the second axis based upon the acceleration measured by the third accelerometer. The tilt detection component may comprise a third accelerometer operable to detect acceleration along a third axis, where the third axis is perpendicular to the first axis and perpendicular to
15 the second axis. The tilt detection component may also comprise a camera operable to generate a video stream and a video analysis module operable to detect a direction of motion based on the video stream.

In accordance with another embodiment, a method for controlling a handheld device comprises detecting acceleration along a first axis using a first accelerometer
20 and detecting acceleration along a second axis using a second accelerometer. The second axis is perpendicular to the first axis. The method also includes detecting rotation having a component around at least one of the first axis and the second axis using a tilt detection component and tracking motion of the device in three dimensions using the first accelerometer, the second accelerometer, and the tilt
25 detection component. The method includes displaying a current image using a display of the device and modifying the current image in response to the tracked motion of the device.

Technical advantages of particular embodiments of the present invention include a handheld device with motion detection components capable of
30 distinguishing between tilt and translation of the device and a plane of translation. Accordingly, the device can recognize a larger number of motions to serve as input thus increasing the device's functionality. In some embodiments, a number of

different types of motion detection components may be combined and utilized thus allowing a manufacturer to design the device using the most suitable components depending on the functionalities desired for the device.

Other technical advantages will be readily apparent to one skilled in the art from the following figures, descriptions and claims. Moreover, while specific advantages have been enumerated above, various embodiments may include all, some or none of the enumerated advantages.

BRIEF DESCRIPTION OF THE DRAWINGS

10 For a more complete understanding of particular embodiments of the invention and their advantages, reference is now made to the following descriptions, taken in conjunction with the accompanying drawings, in which:

FIGURE 1 illustrates a handheld device with motion interface capability, in accordance with a particular embodiment;

15 FIGURE 2 illustrates a motion detector of the handheld device of FIGURE 1, in accordance with a particular embodiment;

FIGURE 3 illustrates the use of motion detector components of the handheld device of FIGURE 1, in accordance with a particular embodiment;

20 FIGURE 4 illustrates an example handheld device with motion detection capability, in accordance with a particular embodiment;

FIGURE 5 illustrates an example of selection and amplification of a dominant motion of a handheld device, in accordance with a particular embodiment;

FIGURE 6 is a flowchart illustrating preferred motion selection, in accordance with a particular embodiment;

25 FIGURE 7 is a flowchart illustrating the setting of a zero-point for a handheld device, in accordance with a particular embodiment;

FIGURE 8 illustrates an example of scrubbing functionality with a handheld device for virtual desktop navigation, in accordance with a particular embodiment;

30 FIGURE 9 is a flowchart illustrating the scrubbing process of FIGURE 8, in accordance with a particular embodiment;

FIGURE 10A illustrates an example of menu navigation using gesture input, in accordance with a particular embodiment;

FIGURE 10B illustrates example gestures which may be used to perform various functions at a handheld device, in accordance with a particular embodiment;

FIGURE 11 illustrates an example of map navigation using motion input, in accordance with a particular embodiment;

5 FIGURE 12A illustrates a form of motion input cursor navigation, in accordance with a particular embodiment;

FIGURE 12B illustrates another form of motion input cursor navigation, in accordance with a particular embodiment;

10 FIGURE 13 is a flowchart illustrating a process for utilizing feedback in response to motion input, in accordance with a particular embodiment;

FIGURE 14 illustrates an example system utilizing spatial signatures with a handheld device, in accordance with a particular embodiment;

15 FIGURE 15 illustrates an example system in which motion input of a handheld device controls multiple other devices, in accordance with a particular embodiment;

FIGURE 16 is a flowchart illustrating an environmental modeling process of a handheld device, in accordance with a particular embodiment;

FIGURE 17 illustrates example gestures which may be mapped to different functions of a handheld device, in accordance with a particular embodiment;

20 FIGURE 18 is a flowchart illustrating the utilization of a preexisting symbol gesture, in accordance with a particular embodiment;

FIGURE 19 is a flowchart illustrating the use of context-based gesture mapping, in accordance with a particular embodiment;

25 FIGURE 20 is a flowchart illustrating the use of user-based gesture mapping, in accordance with a particular embodiment;

FIGURE 21 is a flowchart illustrating the assignment process for user-created gestures, in accordance with a particular embodiment;

FIGURE 22 illustrates three gestures input using a handheld device with varying levels of precision, in accordance with a particular embodiment; and

30 FIGURE 23 is a flowchart illustrating a gesture recognition process utilizing a number of features, in accordance with a particular embodiment.

DETAILED DESCRIPTION

FIGURE 1 illustrates a handheld device 10 with motion interface capability, in accordance with a particular embodiment of the present invention. Handheld device 10 can recognize movement of the device and can perform various functions corresponding to such movement. Thus, movement of the device operates as a form of input for the device. Such movement input may directly alter what is being displayed on a device display or may perform other functions. Handheld device 10 may comprise a mobile phone, personal digital assistant (PDA), still camera, video camera, pocket calculator, portable radio or other music or video player, digital thermometer, game device, portable electronic device, watch or any other device capable of being held or worn by a user. As indicated in the examples listed above, handheld device 10 may include wearable portable devices such as watches as well. A watch may include any computing device worn around a user's wrist.

Handheld device 10 includes a display 12, input 14, processor 16, memory 18, communications interface 20 and motion detector 22. Display 12 presents visual output of the device and may comprise a liquid crystal display (LCD), a light emitting diode (LED) or any other type of display for communicating output to a user. Input 14 provides an interface for a user to communicate input to the device. Input 14 may comprise a keyboard, keypad, track wheel, knob, touchpad, stencil or any other component through which a user may communicate an input to device 10. In particular embodiments, display 12 and input 14 may be combined into the same component, such as a touchscreen.

Processor 16 may be a microprocessor, controller or any other suitable computing device or resource. Processor 16 is adapted to execute various types of computer instructions in various computer languages for implementing functions available within system handheld device 10. Processor 16 may include any suitable controllers for controlling the management and operation of handheld device 10.

Memory 18 may be any form of volatile or nonvolatile memory including, without limitation, magnetic media, optical media, random access memory (RAM), read only memory (ROM), removable media or any other suitable local or remote memory component. Memory 18 includes components, logic modules or software executable by processor 16. Memory 18 may include various applications 19 with

user interfaces utilizing motion input, such as mapping, calendar and file management applications, as further discussed below. Memory 18 may also include various databases, such as gesture databases and function or gesture mapping databases, as further discussed below. Components of memory 18 may be combined and/or
5 divided for processing according to particular needs or desires within the scope of the present invention. Communications interface 20 supports wireless or wireline communication of data and information with other devices, such as other handheld devices, or components.

Motion detector 22 tracks movement of handheld device 10 which may be
10 used as a form of input to perform certain functions. Such input movement may result from a user moving the device in a desired fashion to perform desired tasks, as further discussed below.

It should be understood that handheld device 10 in accordance with particular embodiments may include any suitable processing and/or memory modules for
15 performing the functions as described herein, such as a control module, a motion tracking module, a video analysis module, a motion response module, a display control module and a signature detection module.

In particular embodiments, input movement may be in the form of translation and/or gestures. Translation-based input focuses on a beginning point and endpoint of
20 a motion and differences between such beginning points and endpoints. Gesture-based input focuses on an actual path traveled by the device and is a holistic view of a set of points traversed. As an example, when navigating a map using translation-based input, motion in the form of an "O" may change the display during the movement but may ultimately yield no change between the information displayed
25 prior to the movement and the information displayed at the end of the movement since the device presumably will be in the same point as it started when the motion ends. However, in a gesture input mode the device will recognize that it has traveled in the form of an "O" because in gesture-based input the device focuses on the path traveled during the motion or movement between a beginning point and an endpoint of the
30 gesture (e.g., even though the beginning and endpoints may be the same). This gesture "O" movement may be mapped to particular functions such that when the device recognizes it has traveled along a path to constitute an "O" gesture, it may

perform the functions, as further elaborated upon below. In particular embodiments, movement of the device intended as a gesture may be recognized as by the device as a gesture by matching a series, sequence or pattern of accelerations of the movement to those defining gestures of a gesture database.

5 Handheld devices in accordance with other embodiments may not include some of the components of the device illustrated in FIGURE 1. For example, some embodiments may include a handheld device 10 without an input 14 separate from a motion detector such that motion of the device provides the sole or primary input for the device. It should be noted that handheld devices in accordance with other
10 embodiments may include additional components not specifically illustrated with respect to device 10.

 FIGURE 2 illustrates motion detector 22 of FIGURE 1, in accordance with a particular embodiment of the present invention. In this embodiment, motion detector 22 includes accelerometers 24a, 24b and 24c; cameras 26a, 26b and 26c; gyros 28a,
15 28b and 28c; rangefinders 30a, 30b and 30c; and a processor 32.

 Accelerometers 24a, 24b and 24c detect movement of the device by detecting acceleration along a respective sensing axis. A particular movement of the device may comprise a series, sequence or pattern of accelerations detected by the accelerometers. When the handheld device is tilted along a sensing axis of a
20 particular accelerometer, the gravitational acceleration along the sensing axis changes. This change in gravitational acceleration is detected by the accelerometer and reflects the tilt of the device. Similarly, translation of the handheld device, or movement of the device without rotation or tilt also produces a change in acceleration along a sensing axis which is also detected by the accelerometers.

25 In the illustrated embodiment, accelerometer 24a comprises an x-axis accelerometer that detects movement of the device along an x-axis, accelerometer 24b comprises a y-axis accelerometer that detects movement of the device along a y-axis and accelerometer 24c comprises a z-axis accelerometer that detects movement of the device along a z-axis. In combination, accelerometers 24a, 24b and 24c are able to
30 detect rotation and translation of device 10. As indicated above, rotation and/or translation of device 10 may serve as an input from a user to operate the device.

The use of three accelerometers for motion detection provides certain advantages. For example, if only two accelerometers were used, the motion detector may not be able to disambiguate translation of the handheld device from tilt in the plane of translation. However, using a third, z-axis accelerometer (an accelerometer
5 with a sensing axis at least approximately perpendicular to the sensing axes of the other two accelerometers) enables many cases of tilt to be disambiguated from many cases of translation.

It should be understood that some unique movements may exist that may not be discernible from each other by accelerometers 24a, 24b and 24c. For example,
10 movement comprising a certain rotation and a certain translation may appear to accelerometers 24a, 24b and 24c as the same movement as a different movement that comprises a different particular rotation and a different particular translation. If a motion detector 22 merely included three accelerometers to detect movement (without any additional components to ensure greater accuracy), some unique, undiscernible
15 movements may be mapped to the same function or may not be mapped to a function to avoid confusion.

As indicated above, motion detector 22 also includes cameras 26a, 26b and 26c, which may comprise charge coupled device (CCD) cameras or other optical sensors. Cameras 26a, 26b and 26c provide another way to detect movement of the
20 handheld device (both tilt and translation). If only one camera were installed on a device for movement detection, tilt of the device may be indistinguishable from translation (without using other motion detection components, such as accelerometers). However, by using at least two cameras, tilt and translation may be distinguished from each other. For example, if two cameras were installed on
25 handheld device 10 (one on the top of the device and one on the bottom of the device), each camera would see the world moving to the right when the device was translated to the left. If the device is lying horizontally and is rotated by lifting its left edge while lowering its right edge, the camera on the bottom will perceive the world as moving to the right while the camera on the top will perceive the world as moving
30 to the left. Thus, when a device is translated, cameras on opposite surfaces will see the world move in the same direction (left in the example given). When a device is rotated, cameras on opposite surfaces will see the world move in opposite directions.

This deductive process can be reversed. If both cameras see the world moving in the same direction, then the motion detector knows that the device is being translated. If both cameras see the world moving in opposite directions, then the motion detector knows that the device is being rotated.

5 When the device is rotated, the magnitude of the movement of the world to the cameras is directly related to the magnitude of the rotation of the device. Thus, the amount of the rotation can accurately be determined based on such movement of the world to the cameras. However, when the device is translated, the magnitude of the translation is related to both the magnitude of the movement of the world to the
10 cameras and to the distance to the objects in the field of view of the cameras. Therefore, to accurately determine amount of translation using cameras alone, some form of information concerning the distance to objects in the camera fields of view must be obtained. However, in some embodiments cameras with rangefinding capability may be used.

15 It should be understood that even without distance information, optical information can be of significant value when correlated against the information from accelerometers or other sensors. For example, optical camera input may be used to inform the device that no significant motion is taking place. This could provide a solution to problems of drift which may be inherent in using acceleration data to
20 determine absolute position information for certain device functions.

 As discussed above, distance information may be useful to determine amount of translation when cameras are being used to detect movement. In the illustrated embodiment, such distance information is provided by rangefinders 30a, 30b and 30c. Rangefinders 30a, 30b and 30c may comprise ultrasound rangefinders, laser
25 rangefinders or any other suitable distance measuring component. Other components may also be used to determine distance information. For example, cameras with rangefinding capability may be used, and multiple cameras may be utilized on the same side of the device to function as a range-finder using stereopsis. Determined distance information allows for accurate and explicit computation of the portion of
30 any apparent translation that is due to translation and the portion that is due to rotation.

As indicated above, motion detector 22 additionally includes gyros 28a, 28b and 28c. Gyros 28a, 28b and 28c are used in combination with the other components of motion detector 22 to provide increased accuracy in detecting movement of device 10.

5 Processor 32 processes data from accelerometers 24, cameras 26, gyros 28 and rangefinders 30 to produce an output indicative of the motion of device 10. Processor 32 may comprise a microprocessor, controller or any other suitable computing device or resource, such as a video analysis module for receiving a video stream from each camera. In some embodiments, the processing described herein with respect to
10 processor 32 of motion detector 22 may be performed by processor 16 of handheld device 10 or any other suitable processor, including processors located remote to the device.

As discussed above, motion detector 22 includes three accelerometers, three
15 cameras, three gyros and three rangefinders. Motion detectors in accordance with other embodiments may include fewer or different components than motion detector 22. For example, some embodiments may include a motion detector with three accelerometers and no cameras, gyros or rangefinders; two or three accelerometers and one or more gyros; two or three accelerometers and one or more cameras; or two or three accelerometers and one or more rangefinders. In addition, the location of the
20 motion detection components on the device may vary on different embodiments. For example, some embodiments may include cameras on different surfaces of a device while other embodiments may include two cameras on the same surface (e.g., to add rangefinding functionality).

Altering the type, number and location of components of motion detector 22
25 may affect the ability of motion detector to detect or accurately measure various types of movement. As indicated above, the type and number of components of motion detectors may vary in different embodiments in order to fulfill particular needs. Fewer or less accurate components may be used in particular embodiments when it is desired to sacrifice accuracy to reduce manufacturing cost of a handheld device with
30 motion detection capabilities. For example, some handheld devices may only need to detect that the device has been translated and may not need to detect exact amount of such translation to perform desired functions of the device. Such handheld devices

may thus include a motion detector with cameras and without any sort of rangefinder or other component providing distance information. In particular embodiments, components described above, such as cameras and rangefinders, may also be used for other purposes by the device than those described above relating to motion detection
5 functionality.

FIGURE 3 is a diagram illustrating the use of the motion detector components of handheld device 10 of FIGURE 1. Raw data from motion detection components is processed at processor 32. Such raw data includes x-axis accelerometer raw data 23a, y-axis accelerometer raw data 23b and z-axis accelerometer raw data 23c from
10 accelerometers 24a, 24b and 24c, respectfully; camera raw data 25a, camera raw data 25b and camera raw data 25c from cameras 26a, 26b and 26c, respectfully; gyro raw data 27a, gyro raw data 27b and gyro raw data 27c from gyros 28a, 28b and 28c; and rangefinder raw data 29a, rangefinder raw data 29b and rangefinder 29c from rangefinders 30a, 30b and 30c, respectively. If the handheld device includes more,
15 fewer or different motion detection components as may be the case in some embodiments, the raw data may correspond to the components included.

The raw data is processed at processor 32 to produce motion detector output 34 identifying movement of device 10. In the illustrated embodiment, motion detector output 34 comprises translation along x, y and z axes and rotation with
20 respect to the x, y and z axes. The motion detector output is communicated to a processor 16 of the handheld device which identifies the operation, function or task the device should perform (i.e., device behavior 36) based on the device motion. The performance of certain operations, functions or tasks based on particular movements is further discussed below.

FIGURE 4 is an isometric illustration of an example handheld device 31 with
25 motion detection capability, in accordance with particular embodiments. Handheld device 31 includes an x-axis accelerometer 33, a y-axis accelerometer 35 and a camera 37 oriented towards the z-axis. X-axis 38, y-axis 39 and z-axis 40 are also illustrated with respect to device 31 for reference. Handheld device 31 may detect
30 movement, including tilt and translation in various directions, using accelerometers 33 and 35 and camera 37. Handheld device 31 may also include other components, such as components illustrated and described above with respect to handheld device 10,

such as display 12, input 14, processor 16, memory 18 and communications interface 20. As indicated above, particular embodiments may include handheld devices having various types of motion detection components (including accelerometers, gyros, cameras, rangefinders or other suitable components) in any combination and positioned or oriented in any suitable manner upon the devices.

In particular embodiments, a user interface function may utilize input motion along one axis of motion at a time. For example, a device application may allow a user to scroll through a list displayed on the handheld device by moving the device along a particular axis (e.g., in one direction or in two opposite directions). It may be very difficult for a user to constrain the motion of the device to that particular axis as desired. In other words, some user generated device rotation or movement along another axis may be difficult to avoid. To counter this problem, the device may include preferred motion selection including the selection and amplification of a dominant motion and the minimization of movement in other directions or axes.

FIGURE 5 illustrates an example of selection and amplification of a dominant motion and minimization of movement in another direction as discussed above. In the illustrated example, actual motion 41 represents movement of a handheld device. Actual motion 41 comprises movement 42 along one axis 44 and movement 46 along another axis 48 perpendicular to axis 44. Since the amount of movement 42 is greater than the amount of movement 46, the handheld device may select movement 42 as the dominant motion. The handheld device may then amplify this dominant motion and minimize movement 46 (the other motion) such that actual motion 41 is treated by the device as represented motion 50. The amount or size of amplification of the dominant motion may vary in various embodiments according to particular factors, such as the particular application being run on the device at the time. Moreover, amplification of a dominant motion may also be based on magnitude of acceleration, speed of motion, ratio of a motion in one direction (e.g., movement 42) to motion in another direction (e.g., movement 46), size of underlying desktop being navigated or user preferences. In some embodiments, a handheld device may implement preferred motion selection only when certain motion characteristics occur. For example, in some cases the handheld device may select and amplify a dominant motion if motion in one axis is

more than two times greater than any other motion. The other, smaller motion may then be minimized.

The selection and amplification of the dominant motion and minimization of other motion may further expand a user's ability to take advantage of motion user interfaces and may also allow the handheld device, or applications running on the
5 device, to filter out undesired, user-induced noise. With this capability, the user may be able to, for example, move the device left to pick a list to examine, then scroll that list by moving up and down. Motion along inappropriate axes may be ignored or substantially reduced by the device.

10 In particular embodiments, the selection and amplification of a dominant motion and minimization of other motion may also be applied to rotational motion of the device. Dominant motion around an axis may be selected and amplified in the same manner as motion along an axis as described above with respect to translational motion. Moreover, rotation around another axis (that is not dominant rotation) may
15 be minimized.

FIGURE 6 illustrates a preferred motion selection flowchart 60, in accordance with a particular embodiment of the present invention. In flowchart 60, raw data corresponding to movement of a handheld device is received. In the illustrated embodiment, the movement raw data includes x-acceleration data 62a, y-acceleration
20 data 62b and z-acceleration data 62c that is processed at step 64 to yield an output indicating movement of the device. Other embodiments may include other types of movement raw data, such as optical or camera data, gyro data and/or rangefinder data. After the processing of the raw acceleration data 62, a dominant axis of motion is selected at step 66. If the selected dominant axis of motion is the x-axis, then the
25 movement along the x-axis is augmented at step 68a. If the selected dominant axis of motion is the y-axis, then the movement along the y-axis is augmented at step 68b. If the selected dominant axis of motion is the z-axis, then the movement along the z-axis is augmented at step 68c. The amount of augmentation of movement in the dominant axis of motion may vary in different embodiments according to the application being
30 utilized or other characteristics. In some embodiments, user preferences 69 may be utilized to determine type or amount of movement augmentation. Movement along axes other than the dominant axis of motion may be minimized as discussed above,

such that such movement is ignored by a particular application in use. At step 70, the augmented movement is processed to yield device behavior 72. This processing step may include accessing an application being used to determine the particular device behavior to perform based on the augmented movement. Augmented movement may yield any of a number of types of device behavior according to the application in use, a particular user or otherwise.

For particular user interfaces utilizing motion input, there may be value in having the position of a virtual display, or the information displayed at display 12 of handheld device 10, linked to the position of the device. For example, in particular embodiments using translation-based input such as for navigating a map displayed at the device, the position of the handheld device may directly determine the portion of the map displayed at display 12. However, if device position information is kept in absolute terms (e.g., as with global positioning satellite (GPS) based systems) the utility for many tasks such as map or menu navigation may be impaired. Thus, it is beneficial in certain circumstances to define a "zero point," or an origin in a local context, that may be used to determine the behavior of the device. For example, if a zero point is defined when the device is at a point A, then motion between point A and a point B may be used as input. Particularly useful applications of setting a zero point may include external behaviors such as moving the virtual display or locating applications in the space around a user's body. Setting a zero point also addresses internal behaviors such as instructing the device to ignore the gravitational acceleration at the current orientation to allow the device to act only on additional, and presumably user generated, accelerations.

Handheld devices according to particular embodiments may include application user interfaces that utilize motion input only at certain times. At other times, for example, the motion of the device may not be utilized as input, and it may be useful to disengage or "turn off" motion sensitivity or the motion detection capability of the device. Disengagement of motion sensitivity may comprise, for example, deactivation of motion detector 22 of device 10 or other component, such as a motion response module of the device. Particular embodiments thus allow for the selective engagement and disengagement of the motion sensitivity of the device.

As an example, a motion response module which modifies display 12 based on motion detected at motion detector 22, may have a mode of operation in which it awaits a trigger for switching to another mode of operation in which motion sensitivity is enabled. When motion sensitivity is not enabled, any motion of the device may be disregarded. The trigger may also set a zero-point for the device. When the zero-point is set, the motion response module may measure a baseline orientation of the device based on measurement from motion detection components. The baseline orientation may comprise the position of the device (determined from information from motion detector components) when the trigger is received. Future movement of the device will be compared against the baseline orientation to determine the functions to perform or the modifications which should be made at display 12 based on the user's motion of the device.

Particular embodiments provide for any number of user-initiated actions to act as a single trigger for zero-point selection and selective engagement/disengagement of the motion sensitivity of the device. Such actions may include, for example, the pressing of a key on input 14, moving device 10 in a particular way (e.g., movement corresponding to a particular gesture), and tapping display 12. It should be understood that any user-initiated action may set a zero-point and engage motion sensitivity of the device at the same time.

In some embodiments, a period of inactivity or minimal activity (i.e., relative stillness) may also set a zero-point and engage or disengage motion sensitivity. FIGURE 7 illustrates a flowchart 80 for the passive setting of a zero-point for a handheld device. Change in acceleration with respect to an x-axis is detected at step 82a, change in acceleration with respect to a y-axis is detected at step 82b and change in acceleration with respect to a z-axis is detected at step 82c. At steps 84a, 84b and 84c, it is determined whether any acceleration change detected is greater than a particular respective threshold. If detected acceleration change along each of the three axes is not greater than a set threshold, then the device may be considered at rest, and at step 86 a zero-point will be set. An at rest position may be determined, for example, from stabilization of the raw data or motion components of components of motion detector 22. However, if detected acceleration change along any of the three axes is greater than a set threshold, then the process returns to acceleration change

detection at steps 82. Thus, this method of passively setting a zero-point may ensure that when the handheld device is at rest, a zero point will be set. Moreover, if a device is in constant motion but not being moved by a user at a particular time (e.g., resting in a train moving at a constant speed), a zero-point will be set since there will
5 be no detected change in acceleration. The use of thresholds to determine whether an acceleration change is high enough so as not to trigger the setting of a zero-point enables a user to hold the device still to passively set the zero-point. Otherwise, this may be difficult since a device with highly sensitive accelerometers may detect acceleration change as a result of very minor unintended, user-initiated movement. It
10 should be understood that similar methods may be used in connection with motion detectors with components other than accelerometers. Thresholds may also be used in such similar methods to account for small, unintended movements that may otherwise prevent setting of a zero point.

Particular embodiments of the present invention include the ability to allow a
15 user to repeatedly selectively engage and disengage the motion sensitivity of the handheld device in order to allow greater movement through a virtual desktop (or information space) using motion input in a limited amount of physical space. This process can be analogized to "scrubbing" with a mouse controlling a cursor, or lifting the mouse off of a surface and replacing the mouse on the surface at a different
20 location to allow greater movement of the cursor. Lifting the mouse breaks the connection between the motion of the mouse and the motion of the cursor. Similarly, a user may be able to engage and disengage the connection between the motion of a handheld device, such as device 10, and the operations, functions or actions based on movement of the device.

25 FIGURE 8 illustrates an example of the use of scrubbing functionality to navigate across a virtual desktop, or information space, larger than the display of a handheld device. In the illustrated example, a handheld device is used to navigate through virtual desktop 90. Virtual desktop 90 is illustrated as a grid map and may represent any suitable information through which a user may desire to navigate.
30 Information of virtual desktop displayed at the handheld device is represented by box 92. In this embodiment, translation of the handheld device is used to navigate through virtual desktop 90. For example, a user may move the handheld device from right to

left to navigate from right to left through information of virtual desktop 90. It should be understood that while the example illustrated describes moving the device to the right to implement the scrubbing process, it should be understood that handheld devices of particular embodiments may be moved in any suitable manner to
5 implement the scrubbing process.

As indicated above, box 92 represents the information of virtual desktop 90 currently displayed at the device. If a user desired to view information represented at box 94, the user may move the handheld device from left to right. For purposes of this example, imagine that the user moves the device to the right, and the information
10 of virtual desktop 90 contained in box 94 is displayed at the device. Also imagine that the user's arm is now outstretched to the user's right such that the user must walk or otherwise move further right in order to view at the display of the device information of virtual desktop 90 that is to the right of box 94. If this were the case, and the user could not, or did not desire to, walk or otherwise move further to the
15 right so that the device would be moved further to the right, then the user could selectively disengage the motion sensitivity of the handheld device, move the device back to the left, selectively reengage the motion sensitivity of the device and move the device back to the right to display information to the right of box 94. In this manner, the user could display information of virtual desktop 90 contained in box 96, and this
20 process could be repeated to display information contained in box 98, which is further to the right of box 96.

The selective disengagement and reengagement of the motion sensitivity of the device in order to allow greater movement within a virtual desktop in a limited amount of physical space may be enabled in any of a variety of ways, such as by a
25 key on an input of the device, moving the device according to a particular gesture or movement (e.g., an arc movement) or tapping the device display. Any other user-initiated action may be used to disengage and reengage motion sensitivity for this purpose. Particular embodiments may allow multiple actions to disengage and reengage motion sensitivity of the device. Moreover, a user action that disengages
30 motion sensitivity of the device may be different from a user action that reengages motion sensitivity. This scrubbing process may be performed in any suitable application, such as map navigation, menu navigation and scrolling through a list.

FIGURE 9 is a flowchart illustrating the steps of the scrubbing process described above with respect to FIGURE 8, in accordance with a particular embodiment. The flowchart begins at step 100, where the handheld device is moved to the right to go from displaying information of box 92 of virtual display 90 to information of box 94. As indicated above, the user may desire to display information further to the right of box 94 but may have run out of physical space to move the device further to the right. Thus, the user disengages the motion sensitivity of the device at step 102. Any suitable user action may perform such disengagement, such as the pressing of a button on the device or moving the device according to a particular gesture. At step 104, the user moves the device to the left so that the user will have more physical space through which the user may move the device to the right when motion sensitivity is reengaged.

At step 106, the user reengages motion sensitivity of the device. Again, such reengagement may be performed by any suitable user action, and such user action may be different from the user action performed to disengage motion sensitivity in step 102. Since motion sensitivity has been reengaged, the user moves the device to the right at step 108 in order to change the information being displayed at the device from the information of box 94 to the information of box 96. At step 110, it is determined whether further movement of the device to the right is needed. If further movement is needed (e.g., to display the information of virtual display 90 in box 98), then the process returns to step 102 where motion sensitivity of the device is again disengaged. If no further movement is needed, then the process ends. As indicated above, this scrubbing process may be utilized in any suitable application of the device that supports motion input, and the device may be moved in any suitable manner in order to implement this functionality.

As indicated above, a particular movement of the device (e.g., a particular gesture) may be utilized in the scrubbing process to signal to the device not to change the information presented on the display during such movement. This allows the user to return the device to a position from which the user may move the device to further change the information presented on the display. For example, the device may be at a base reference position from which movement of the device changes the information displayed. A particular predetermined movement (e.g., an arc movement) may be

used which may signal to the device not to change the information displayed based on motion until the movement is completed. Once the predetermined movement is completed, the base reference position may be reset such that future movement of the device from the base reference position further changes the information displayed.

5 The base reference position may identify a baseline orientation of the device represented by baseline components of the motion data received by the motion detection components of the device. In particular embodiments, gestures may be received, as determined by movement from the base reference position, to perform particular commands which change the information displayed at the device.

10 As discussed with respect to various embodiments described above, handheld devices in accordance with particular embodiments may utilize multiples types or modes of input to operate the device. Such input modes include motion input modes, such as a translation input mode and a gesture input mode. While multiple input modes may sometimes be used in combination with each other, in some cases the
15 handheld device may be set to recognize a certain mode type at one time. In some situations, the handheld device may be set to function based on multiple types of non-motion input and only one type of motion input (e.g., translation or gesture) at a particular time.

To facilitate this flexibility of the handheld device in recognizing multiple
20 input modes, in particular embodiments a certain trigger may be used to switch between input modes. For example, a user may press a particular key or may move the device in a certain manner (e.g., a particular gesture) to switch input modes. In some cases where an application of the device recognizes and functions based upon multiple types of motion input, a particular key may be pressed or a particular gesture
25 may be formed using the device to switch between a translation motion input mode and a gesture motion input mode. The trigger may also comprise the mere switch from one application to another or the switch from one displayed image to another. In some situations, the trigger may switch between a non-motion input mode and a motion input mode. Any particular user-action may be implemented to act as a
30 trigger to switch between different input modes, such as between different motion input modes. In some embodiments, a voice command or physical action upon the device (e.g., a device or screen tap) may be utilized to switch input modes.

In particular embodiments, a user action that reengages motion sensitivity of a device may also contain other information that might otherwise affect device behavior. For example, if a user makes one motion to reengage translation sensitivity, it may render the device more sensitive to motion than if the user makes a different
5 motion to reengage motion sensitivity. A reengaging motion may comprise a gesture that indicates the user's identity or context, thereby engaging a variety of operational settings, such as user preferences.

As indicated above, particular embodiments include the ability to receive motion input to control various functions, tasks and operations of a handheld device
10 and may be used to alter information displayed at the device in the process. In some cases, such motion input may be in the form of gestures, as opposed to mere translation-based input. Gesture input may be used to navigate through a multidimensional menu or grid in some applications. For example, as discussed above with respect to the scrubbing process, a display of a handheld device may be
15 smaller than the amount of information (e.g., menu options, map information) that can be presented on the display. This may lead to a menu structure that is narrow and deep. In many cases, broad, shallow menu structures may be preferred over a narrow, deep menu structure because a user is not required to remember as much information concerning where functionalities are located.

20 FIGURE 10A illustrates an example of menu navigation using gesture input, in accordance with a particular embodiment. In the illustrated embodiment, a handheld device is used to navigate through virtual desktop 120. Virtual desktop 120 includes a menu tree with menu categories 122 for selection. Each menu category 122 may include respective sub-categories for selection. In some embodiments, menu
25 categories 122 may comprise categories of functions, while sub-categories of each menu selection may include the actual functions under each such category. In other embodiments, menu categories may comprise nouns (e.g., "folder," "document," "picture"), while sub-categories comprise verbs (e.g., "move," "paste," "cut"). If the handheld device comprised a cellular phone, menu categories 122 may include
30 "calls," "phone book," "messages," "planner," "sounds," "setup" or other items. Each menu category 122 may include functions which may be accessed once a menu category 122 is selected. While two menu levels are illustrated in FIGURE 10A, it

should be understood that a multidimensional desktop or display of information for motion interface navigation may include any number of selections (e.g., menus) utilizing any number of levels.

In the illustrated example, menu category 122e has been selected, and sub-
5 categories 124 of menu category 122e are displayed as available for selection. Boxes 126 and 128 represent information displayed at the handheld device for the user. As illustrated, virtual desktop 120 includes more information, or menus, which can be displayed at the device at one time. A user may move the device according to particular gestures to navigate across or through the virtual desktop. Gestures may
10 also be used to navigate through different menu levels and to make menu selections. As an example, a user may move device 10 in the form of a clockwise circle 130 to navigate a predetermined amount to the right across virtual desktop 120 (e.g., moving from information of box 126 to information of box 128). A particular menu category 122 may be selected by an away gesture 132, or a downward gesture (e.g., to select
15 menu category 122e), and thus display sub-categories 124 for selection. Similarly, to move to the left across virtual desktop 120, a user may move device 10 in the form of a counterclockwise circle 134. In some cases, navigation may be accomplished through four gestures: a forward gesture, a backward gesture, a left gesture and a right gesture. In some embodiments, gestures comprising motion vectors in perpendicular
20 directions may be used for navigation.

In particular embodiments, gestures may be used that are mirror images of other used gestures to execute opposite functions from those accomplished by the other gestures. For example, a motion toward a user might zoom in while an opposite motion, a motion away from the user, may zoom out. Using mirror image or
25 reciprocal gestures mapped to opposite functions may make a motion user interface for a device easier to learn and to use.

In some cases, the menu item at the center of the display may be highlighted for selection, while in other cases a particular gesture may indicate which menu selection of a plurality of displayed selections a user desires to select. It should be
30 understood that the menus or other information through which a user may navigate using gestures may be presented at the handheld device in any number of ways. In some embodiments, only one level of information (i.e., one menu level) may be

displayed at once, while sub-levels or higher levels are not displayed until they are available for selection.

FIGURE 10B illustrates example gestures which may be utilized to perform various functions, such as functions enabling a user to navigate through a virtual desktop. The illustrated example gestures include an "up" gesture 133 to navigate in an upward direction through the desktop, a "down" gesture 135 to navigate down, a "left" gesture 136 to navigate left, a "right" gesture 137 to navigate right, an "in" gesture 138 to navigate in a direction towards the user and an "out" gesture 139 to navigate away from the user. It should be understood that these are mere example gestures and commands for particular embodiments, and other embodiments may include different gestures or similar gestures mapped to different commands for navigating through a desktop or performing other functions with a handheld device.

FIGURE 11 illustrates another example of map navigation using motion input, in accordance with a particular embodiment of the present invention. FIGURE 11 includes a virtual desktop 140 representing an information grid divided into sixteen portions, each referenced by a respective letter (A, B, C, . . . P). Portions of virtual desktop 140 are identified using reference letters only for purposes of describing particular embodiments, and portions of virtual desktops in accordance with other embodiments may or may not be identified in a device application by a reference character or otherwise. Virtual desktop 140 includes more information that can be displayed at a particular handheld device at one time. Virtual desktop 140 may represent any suitable information through which a user may desire to navigate using a handheld device, such as a street map. A user may desire to navigate across virtual desktop 140 to display different portions of information on the handheld device display and may also desire to zoom in (and out of) virtual desktop 140 (i.e., change the granularity of the information displayed) to more clearly view certain portions of the information of virtual desktop 140.

In the illustrated example, box 142 represents information currently displayed at handheld device 10. Box 142 includes portions A, B, E and F of virtual desktop 140. In particular embodiments, if a user desires to change the information of desktop 140 displayed at the device to, for example, information of boxes C, D, G and H, then the user can use motion input to move box 142 representing the display of the device

to the right the necessary amount (two portions to the right in the illustrated example). Such motion input may comprise translation input (moving the handheld device 10 to the right an applicable amount to change the information displayed) or a gesture input (moving the handheld device 10 according to a particular gesture mapped to this function). As an example, one gesture may be mapped to moving the display one portion to the right, while another gesture may be mapped to moving the display two portions to the right. Thus, using translation input or gesture input, the user may navigate across desktop 140.

The handheld device 10 may also allow the user to zoom in on certain information displayed for a clearer view of such information, for example, through translation input or gesture input. As an example using gesture input, if the information displayed at the device included four of the sixteen portions (e.g., box 142 displaying portions A, D, E and F), then a user may use one of four gestures, each mapped to zoom in on a particular portion, to zoom in on one of the four displayed portions. If the user moved the handheld device according to the gesture mapped to zoom in on portion B, then the device may display information represented by box 144 (portions B1, B2, B3, B4, B5, B6, B7, B8 and B9) collectively forming the information of portion B of virtual desktop 140 in an enlarged view. Thus, the information of portion B may be more largely and clearly displayed. When viewing the information of box 144 on the device, the user may zoom out or zoom in again on a particular portion currently displayed using appropriately mapped gestures. If the user moved the handheld device according to a gesture mapped as zooming in on portion B2 (this could be the same gesture as that used to zoom in on portion B when information of box 142 was displayed), then the device may display information of box 146 (portions B2a, B2b, B2c, B2d, B2e, B2f, B2g, B2h and B2i). The user may also be able to navigate across the virtual desktop when zoomed in on a particular portion. For example, when zoomed in on portion B (viewing information of box 144), the user may use translation or gesture input to move across the virtual desktop to view enlarged views of portions other than portion B. As an example, when viewing information of box 144 the user may make a gesture that moves the information displayed to the right such that the entire display shows only information of portion C of virtual desktop 140 (i.e., zoomed in on portion C showing portions C1,

C2, C3, C4, C5, C6, C7, C8 and C9). It should be understood that a user may navigate through the information of virtual desktop 140 (both navigating across and zooming in and out) in any suitable manner using motion input.

As indicated above, any suitable gestures may be used to both navigate across
5 a virtual desktop (or across a particular level) and to navigate between or through
different levels or dimensions of a multidimensional desktop. Moreover, in some
embodiments motion, such as gestures, may be used to navigate across the
multidimensional desktop, and non-motion actions may be used to select or navigate
between dimensions. Such non-motion actions may include the pressing of a key in a
10 device input. Thus, a combination of motion and non-motion actions may be used for
multidimensional virtual desktop or menu navigation in particular embodiments.

Particular embodiments may allow gesture-based navigation through any
suitable application, such as a multidimensional grid, menu, calendar or other
hierarchical application. For example, in a calendar application certain gestures may
15 be used to navigate within one level, such as months, while other gestures may be
used to navigate between levels, such as between years, months, days, hours and
events. Moreover, different applications implemented in the handheld device that use
such gesture navigation may use different gestures. Thus, the particular navigation
gestures may change according to the particular application in use. In some
20 embodiments, translation-based interfaces may be used to navigation through
multidimensional information of a virtual desktop, as opposed to merely using
gesture-based movements. For example, movement along x and y-axes may be used
to travel within a level of a hierarchy, while movement along a z-axis may be used to
travel between levels of the hierarchy.

25 Another example might involve using a telephone directory with institutions,
letters of the alphabet, names, contact details (e.g., office, cellular and home phone
numbers, email) and action to initiate contact all along different levels of a hierarchy.
In this example, the hierarchy may contain information (nouns) and actions (verbs).
One could map this example onto only two axes with, for example, a y-axis being
30 used to select within a level of hierarchy and an x-axis being used to move between
levels. A z-axis could be used to confirm the actions and help prevent inadvertent
execution of actions.

In some cases, the number of levels traversed may depend on the magnitude of the motion, particular in translation-based navigation. Moving the device a small amount may navigate one level at a time, while moving the device a large amount may navigate multiple levels at a time. The greater the magnitude of motion, the more levels may be navigated at once. As applied to gesture-based motion inputs, different gestures may be used to navigate different numbers of levels in the hierarchy at once. These gestures may be different magnitudes of the same motion or entirely different motions.

The use of motion interface navigation through a multidimensional desktop or information display increases may allow menus to be flattened since a user may more easily navigate across a particular menu or dimension of a virtual desktop too large to fit on a device's display. As a result of the menu flattening, the user may be required to memorize less information thus increasing functionality and capability of the device for the user.

As discussed above, handheld devices in particular embodiments allow a user to navigate across a virtual desktop using motion input. In some cases, a user may utilize a cursor to navigate across information displayed at the handheld device. For example, certain information may be displayed at the device, and the user may utilize motion input to move the cursor around the device display and to select particular items displayed to perform certain functions. In some cases, motion input may be utilized to move a cursor, while a non-motion action (such as pressing a button) may be used to select an item currently indicated by the cursor. It should be understood that both gesture and translation motion input may be utilized in various embodiments of cursor navigation.

In particular embodiments, information displayed may be fixed with respect to the device, and the cursor may remain fixed in space such that movement of the device is used to navigate the cursor across the information. FIGURE 12A illustrates an example utilizing this form of motion input cursor navigation. Display 147 represents a display of a handheld device. In order to describe this cursor navigation example, display has been divided into a grid to show information being displayed. The grid includes portions A-P. Display 147 includes a cursor 148 between portions C, D, G and H. As stated above, in this embodiment the information displayed

remains fixed with respect to the device when the device is moved, and the cursor remains fixed in space. However, the cursor's position with respect to the information displayed changes according to motion input. When the device is translated to the right, according to right movement 149, the cursor is translated according to a motion
5 opposite to the translation of the device.

Display 150 represents a possible display after the device is moved according to right movement 149, with cursor 148 now between portions A, B, E and F. It should be understood that since this example involves translation-based input, the magnitude of the movement of the device (e.g., to the right in this example) may
10 directly affect the magnitude of the movement of the cursor with respect to the information displayed. Display 152 represents another display after the handheld device has been moved according to up movement 151, with cursor 148 now between portions I, J, M and N. As evident, the cursor will have moved down with respect to information displayed since it remains fixed in space. Display 154 represents another
15 display after the handheld device has been moved according to left movement 153, with cursor 148 now between portions K, L, O and P. As evidence, the cursor will have moved to the right with respect to information displayed. Thus, in this form of cursor navigation, motion of the device changes the position of the cursor on the information. In this manner for example, the handheld device may be moved instead
20 of using a stylus to point to certain portions of information displayed.

At any point in the cursor navigation process, a user may utilize any form of input (e.g., gesture, key press, etc.) to select or otherwise perform a function according to the information currently indicated at the cursor. For example, with
25 respect to display 152, a user may use a particular gesture or press a button to zoom in, select or perform some other function based on information between portions I, J, M and N currently indicated by cursor 148.

As described above with respect to FIGURE 12A, particular embodiments may translate the cursor in a motion opposite from the motion of the device to move the cursor across the information displayed. In one example of implementation, input
30 motion of the device may be divided into motion along each of three axes, two of which are parallel to the device display (e.g., an x-axis and a y-axis). While motion of the device in the x-axis and y-axis plane changes information displayed at the device

based on such motion, the cursor may be moved at the same time according to a translation vector that is opposite to the sum of movement in the x-axis direction and the y-axis direction to substantially maintain the position of the cursor in space. In some cases, when the cursor would move past a display edge off of the display according to the translation vector, the vector may be reduced in order to keep the cursor within the display. Such reduction may include reducing one or more components of the translation vector to maintain the cursor within a certain distance from the display edge.

It should be understood that the division of information displayed into portions A-P is done only for illustrating and describing the embodiments described above, and information displayed at handheld devices of particular embodiments may not include such a division or other type of reference information.

FIGURE 12B illustrates another form of motion input cursor navigation, in accordance with a particular embodiment. In this example, the cursor remains in a fixed position with respect to the display while motion input is used to navigate across a virtual desktop larger than the device display. FIGURE 12B includes virtual desktop 158 which comprises information through which a user may navigate using motion input at a handheld device, such as a street map. Virtual desktop 158 includes more information that can be displayed at a particular handheld device at one time. In order to describe this cursor navigation example, virtual desktop 158 has been divided into a grid to differentiate between information presented at the desktop. The grid includes 6 rows (A-F) and 7 columns (1-7). Portions of the grid may be identified herein for this example using their row letter and column number (e.g., portion B7 or D2). It should be understood that the division of virtual desktop 158 into portions referenced by row and column number is done only for illustrating and describing the embodiments described above, and the virtual desktops of particular embodiments may not include such a division or other type of reference information.

Box 160 represents information of virtual desktop 158 currently displayed at a handheld device. Display 161 represents the display of a handheld device showing information of box 160. Display 161 also includes a cursor 159 positioned at the intersection of portions B2, B3, C2 and C3. As indicated above, as a user utilizes motion input to move around the virtual desktop (i.e., to change the information

displayed at the device), the cursor remains in a fixed position with respect to the display. However, the cursor's position changes with respect to the information of the virtual desktop displayed at the handheld device. For example, a user may utilize motion input to change the information displayed at the device to that represented at box 162. The information displayed at the device changes (to portions B5, B6, C5 and C6); and cursor 159 will remain fixed at the device display (e.g., in this case at the center of the display) such that its position changes with respect to the information of virtual desktop 158, as illustrated at display 163. If the user desired to use motion input to change the information displayed at the device to that represented at box 164, the information displayed at the device changes to portions E3, E4, F3 and F4, as illustrated at display 165. Cursor 159 is positioned between these illustrated portions in the center of the display since its position relative to the display remains fixed in this embodiment.

Thus, according to the form of cursor navigation illustrated with respect to FIGURE 12B, the cursor will remain at a position fixed with respect to the device display, while its position with respect to the information of a virtual desktop changes. As discussed above with respect to the embodiment described and illustrated with respect to FIGURE 12A, at any point in the navigation process, a user may utilize any form of input (e.g., gesture, key press, etc.) to select or otherwise perform a function according to the information currently indicated at the cursor. For example, with respect to display 163, a user may use a particular gesture or press a button to zoom in, select or perform some other function based on information between portions B5, B6, C5 and C6 currently indicated by cursor 159.

It should be understood that any particular input, such as a gesture or key press, may be used to switch cursor navigation modes at the device. For example, a user may switch between the translation-controlled cursor mode of FIGURE 12A and the fixed cursor mode of FIGURE 12B.

As discussed above, particular embodiments allow a user to move handheld device 10 according to a gesture to perform particular functions or operations. In some cases however, a user may not move the device according to the particular gesture intended, and the device may, as a result, not be able to recognize the movement as the intended gesture. In order to indicate that a particular movement of

the device by a user is recognized as a particular gesture, handheld devices in some embodiments provide feedback to notify the user that the movement was in fact recognized as a gesture.

This feedback may comprise an audio format, such as speech, a beep, a tone or
5 music, a visual format, such as an indication on the device display, a vibratory format
or any other suitable feedback format. Audio feedback may be provided through a
user interface speaker or headphone jack of device 10, and vibratory feedback may be
provided through a user interface vibration generation module of device 10. Audio,
10 visual and vibratory feedback may be varied to provide capability for multiple
feedback indicators. As an example, vibratory feedback may be varied in duration,
frequency and amplitude, singly or in different combinations over time. The richness
and complexity of the feedback may be expanded by using feedback of different types
in combination with one another, such as by using vibratory feedback in combination
15 with audio feedback. In some cases, the feedback may be gesture-specific, such that
one or more recognized gestures have their own respective feedback. For example,
when a certain gesture is recognized the device may beep in a particular tone or a
particular number of times, while when one or more other gestures are recognized the
beep tones or number of beeps may change. The use of audio feedback may be
20 especially valuable for gestures that do not have an immediately visible on-screen
manifestation or function, such as calling a certain number with a cellular phone.
Different types of feedback may also be context or application specific in some
embodiments. Different contexts might include device state, such as what application
is in focus or use, battery level, and available memory, as well as states defined by the
user, such as quiet or silent mode. For example, a handheld device may utilize
25 vibratory feedback in response to gesture input while in silent mode when audio
feedback would otherwise be used. This feedback process may also be utilized by a
handheld motion input device of a computer or other component.

Similar to the feedback relating to gesture recognition described above,
handheld devices in particular embodiments may also provide feedback for the user in
30 the event that a particular user movement was not recognized as a gesture when the
device is in a gesture input mode. For example, if a motion appears intended to be a
gesture, but cannot be assigned to a particular gesture that is known to the device, it

may play a sound indicating failure. This notifies the user that the user must make another attempt at moving the device according to the intended gesture for the device to perform the operation or function desired. The feedback notifying the user that a movement was not recognized may also comprise an audio, visual, vibratory or other suitable format and may be a different feedback than that communicated when a particular movement is recognized by the device as a particular gesture. In order to determine whether a user's intent was to input a gesture, handheld device 10 may look at certain characteristics of the movement that imply that the motion was intended to be a gesture. Such characteristics may include, for example, the amplitude of the motion, the time course of the above-threshold motion and the number and spacing of accelerations. If a particular gesture is unrecognized by the device, a system of gestural feedback may be used to determine the gesture intended. For example, audio feedback may indicate possibilities determined by the handheld device, and the user may utilize gestures to navigate an auditory menu to select the intended gesture.

In particular embodiments, a system of audio or vibratory feedback may be used such that a user could operate handheld device 10 without having to resort to viewing display 12. For example, handheld devices in some embodiments may provide audio, visual or vibratory feedback to a user navigating a menu or other information of a virtual desktop. In effect, this device feedback combined with the motion input of a user could act as a type of "conversation" between the user and the device. As indicated above, multiple types and complexities of feedback may be utilized. The feedback process could be particularly advantageous in environments where it may be inconvenient, unsafe or impractical to look at the device display (e.g., while driving or while in a dark environment).

It should be understood that feedback, such as audio, visual and vibratory feedback, may also be used in some embodiments in connection with translation motion input. For example, a feedback indicator may be given when a user reached a limit or edge of a virtual desktop using translation input.

FIGURE 13 is a flowchart 170 illustrating a process for utilizing feedback in response to motion input, in accordance with a particular embodiment. At step 172 of the process raw motion data is received at handheld device 10. As described above, the raw motion data may be received by any combination of accelerometers, gyros,

cameras, rangefinders or any other suitable motion detection components. At step 174, the raw motion data is processed to produce a motion detector output indicative of the motion of the device. Such processing may include various filtering techniques and fusion of data from multiple detection components.

5 At step 176, the device state may be checked, because in some embodiments the feedback for a particular motion depends on the state of the device when the motion is received. As indicated above, example device states may include the particular application in focus or use, battery level, available memory and a particular mode, such as a silent mode. At step 178, the motion detector output is analyzed with
10 respect to the device state. At step 180, it is determined whether the motion indicated by the motion detector output is meaningful or otherwise recognizable given the particular device state. For example, a particular gesture may perform a certain function in one application (e.g., a calendar application) while the gesture serves no function in another application. If the gesture is recognizable or meaningful give the
15 state of the handheld device, then at step 182 feedback is provided. As indicated above, in particular embodiments feedback may be in an audio, visual or vibratory format. In some cases the feedback may merely be an indication that the device recognizes the gesture given the state of the device. In other cases, the feedback may be a further query for additional input, for example if the user was utilizing a
20 particular application of the device that provided for a series of inputs to perform one or more functions. At step 184, the device behaves according to the motion input and device state, and the process may return to step 172 where additional raw motion data is received.

 If it is determined at step 180 that the motion indicated by the motion detector
25 output is not meaningful or recognizable given the particular device state, then the process proceeds to step 186. At step 186, it is determined whether the motion is above a particular threshold. This determination may be made to determine whether particular motion input was, for example, intended to be a gesture. As indicated above, threshold characteristics for this determination may include the amplitude of
30 the motion input, the time course of the motion input and the number and spacing of accelerations of the motion. If it is determined that the motion input was not above a particular threshold, then the process may return to step 172 where additional raw

motion data is received. If, however, the motion input was above a threshold such that a gesture may have been intended but was not recognized or meaningful given the device state, feedback is provided at step 188. The feedback may include audio, visual and/or vibratory feedback and may indicate that the gesture was not
5 recognizable or meaningful. In particular embodiments, the feedback may also provide a query regarding the intended gesture or may otherwise provide the user with a number of potentially intended gestures from which the user may select the particular gesture intended by the motion. It should be understood that particular
10 embodiments may not include some of the steps described (e.g., some embodiments may not include the threshold determination of step 186), while other embodiments may include additional steps or the same steps in a different order. As suggested above, particular embodiments may utilize motion input feedback (e.g., including feedback "conversations") in any of a number of applications and ways and the type and complexity of feedback systems may vary greatly in different embodiments.

15 As indicated above, handheld devices according to particular embodiments may receive gesture motion input to control any number of functions of any number of applications running at the device. Some applications that utilize gesture involve may comprise mobile commerce (mCommerce) applications in which a mobile device, such as handheld device 10, is used to conduct various transactions, such as
20 commercial or consumer purchases. Many mCommerce applications utilize some form of authentication to authenticate a user, such as personal identification numbers (PINs), credit card information and/or possession of the mobile device. However, many forms of authentication can be "leaked." They can be shared intentionally or inadvertently. Another form of authentication is a user's written signature, which
25 does not suffer from such leaking problems since forgery is typically difficult to accomplish and may be easy to detect. Particular embodiments may utilize motion input to receive a user's signature as a form of authentication in mCommerce or other transactions through the handheld device.

A written signature may be considered a two dimensional record of a gesture.
30 When utilizing a handheld device with motion input, a user's signature may be in three dimensions and may thus comprise a "spatial signature." Moreover, when combined with other forms of input received at the device, a user's signature can take

on any number of dimensions (e.g., four, five or even more dimensions). For example, a three-dimensional gesture "written" in space using the device and detected at motion detector 22 may be combined with key-presses or other inputs to increase the number of dimensions of the signature.

5 These spatial signatures can be tracked, recorded, and analyzed by motion detectors 22 of handheld devices. They can be recorded with varying degrees of precision with varying numbers of motion detector components to serve as an effective form of authentication. A user's spatial signature may take comprise a three-dimensional form based on the user's traditional two-dimensional written signature or
10 may comprise any other suitable gesture which the user records at the handheld device as his or her signature.

 In some embodiments, the process for recognizing a spatial signature may involve pattern recognition and learning algorithms. The process may analyze relative timings of key accelerations associated with the signature. These may
15 correspond to starts and stops of motions, curves in motions and other motion characteristics. In some cases, some hash of a data set of a points of a signature motion may be stored, and subsequent signatures may be compared against the hash for recognition. This may further verify if the signature was genuine by determining whether it was unique. For example, in particular embodiments, a signature may be
20 detected (e.g., by a signature detection module of device 10) by comparing a particular movement of the device with respect to an initial or reference position. Such comparison may be made by comparing a sequence of accelerations of the movement with a predetermined sequence of accelerations of a stored spatial signature. This determination may be made regardless of the scale of the user's input
25 motion signature.

 In some embodiments, the device can detect whether motion of the device matches the signature by determining whether positions of the device in motion relative to an initial position match the spatial signature.

 FIGURE 14 illustrates an example system 200 utilizing spatial signatures as
30 authentication for mCommerce transactions. System 200 includes handheld device 10, mCommerce application 202, authenticator 204 and communication network 206. mCommerce application 202 may comprise any suitable application for transacting

business with a handheld device of a user. Such transactions may include consumer purchases, such as products or services of a business or other user from a website, online bill paying, account management or any other commercial transaction. Authenticator 204 authenticates, or verifies, a spatial signature input by the user at
5 handheld device 10 to complete an mCommerce transaction. Authenticator 204 may store one or more spatial signatures of one or more users for authentication in an mCommerce transaction. In some embodiments, authenticator may be located within handheld device 10, within mCommerce application 202 or at any other suitable location. Communication network 206 is capable of transmitting information or data
10 between components of system 200 and may include one or more wide area networks (WANs), public switched telephone networks (PSTNs), local area networks (LANs), the Internet and/or global distributed networks such as intranets, extranets or other form of wireless or wireline communication networks. Communication network 206 may include any suitable combination of routers, hubs, switches, gateways or other
15 hardware, software or embedded logic implementing any number of communication protocols that allow for the exchange of information or data in system 200.

In operation, when a user utilizes handheld device 10 to conduct a transaction with mCommerce application 202, the user may utilize motion input to communicate an authentication signature, for example by moving the device according to the user's
20 three-dimensional signature. As an example, a user might use their cellular phone at a point-of purchase (e.g., store) instead of a credit card. Instead of signing a paper document that then needs to be shipped and processed, the user could simply move device 10 according to the user's spatial signature. As indicated above, the user's signature may include more than three dimensions in some embodiments. The
25 signature may have been previously recorded by the user using handheld device 10 or another mobile device, and the recorded signature may be stored at handheld device 10, mCommerce application 202, authenticator 204 or other suitable location such as a signature storage database for signatures of multiple mCommerce users.

The motion of handheld device 10 may be processed at the device, and motion
30 output indicative of the motion may be transmitted to mCommerce application 202. mCommerce application 202 may communicate the motion output to authenticator 204 for verification that the motion input received at device 10 was in fact the

signature of the user attempting to transact mCommerce. If authenticator 204 verifies the user's signature, then mCommerce application may complete the transaction with the user. As indicated above, authenticator 204 may be located within handheld device 10 or at mCommerce application 202 in particular embodiments and may
5 access signatures for verification stored at device 10, mCommerce application 202 or any other suitable location.

Authentication may also be used by handheld devices in a non-mCommerce application, for example when electronic security is desired to perform functions such as sending private or secure data using the device. A user desiring to transmit data or
10 other information using handheld device 10 may use their spatial signature in the encryption process. Spatial signatures may be used in any of a variety of ways to secure data for communication through a network and may be utilized in connection with public/private key encryption systems. For example, in some embodiments handheld device 10 may authenticate a user's signature received through motion input
15 and then use its own private key to encrypt data for transmission. In other cases, data may be communicated to handheld device 10 such that an intended recipient must input their spatial signature to receive the decrypted data. In some embodiments, data may be communicated to a computer wirelessly connected to handheld device 10, and the intended recipient must use handheld device 10 as a way to communicate the
20 user's signature to the computer for data decryption. Moreover, in particular embodiments, a user's spatial signature itself may represent an encryption key such that motion of the device generates the encryption key instead of the signature motion merely being used for authentication. In some cases a device may recognize a combination of accelerations as a signature by converting the signature into the
25 equivalent of a private key. The handheld device may then use the private key as part of an authentication process for a transaction.

In particular embodiments, a spatial signature may be used to manage physical access to a building or event. For example, the signature input by a user at a device may be checked against a list of people allowed to enter as IDs are checked at "will
30 call" for an event.

In particular embodiments, a user may utilize motion input for handheld device 10 to control other devices, such as audio/video equipment, home appliances

and devices, computing devices or any other device capable of being controlled by a handheld device. Devices may be controlled by handheld device 10 through communications interface 20 of device 10 utilizing any of a number of wireless or wireline protocols, including cellular, Bluetooth and 802.11 protocols. In some
5 embodiments, device 10 may receive motion input to control, through wireless or wireline communication, other devices through a network. Thus, devices controlled through motion input of device 10 may be at any location with respect to device 10, such as in the same room or across a country. Moreover, control of the other device may be implemented through any number of intermediate devices (e.g., through a
10 network).

As an example, if handheld 10 device were a Bluetooth-enabled cellular phone, then particular gestures or other motion of the cellular phone may wirelessly communicate commands to control another device, such as a laptop across a room to drive a PowerPoint presentation. Other devices which may be controlled through
15 motion input of handheld device 10 may include televisions, radios, stereo equipment, satellite receivers, cable boxes, DVD players, digital video recorders, lights, air conditioners, heaters, thermostats, security systems, kitchen appliances (e.g., ovens, refrigerators, freezers, microwaves, coffee makers, bread makers, toasters), PDAs, desktop and laptop PCs, computer peripheral equipment, projectors, radio controlled
20 cars, boats and planes and any other device. As another example, a commuter may shake their cellular phone in a certain manner to tell their heater at home to turn on before the commuter arrives at home. In some embodiments, a handheld device may receive and process raw motion data to determine commands or intended functions for communication to other devices. In other embodiments, a motion detector of a
25 handheld device may output raw data received from its motion detection components for communication to one or more devices controlled by device 10 through the motion of device 10. As a result, different devices controlled by device 10 may treat the same raw motion data of device 10 differently. For example, a particular gesture of device 10 may perform different functions of different devices controlled by device 10.

30 FIGURE 15 illustrates an example system 220 in which handheld device 10 controls multiple other devices through motion input of device 10. System 220 includes handheld device 10, laptop 222 and remote device 224 connected, through

wireless or wireline links, to handheld device 10 through communication network 226. Handheld device 10 receives raw motion data of a particular motion of the device through motion detection components, such as accelerometers, cameras, rangefinders and/or gyros. The raw motion data is processed at the handheld device.

5 Particular databases, such as gesture and gesture mapping databases, may be accessed to determine a matching gesture and intended function based on motion tracked by a control module of the device. The intended function may be for another device to be controlled by handheld device 10, such as laptop 222 or remote device 224. Thus, the motion input is the interface for the underlying operational signal communicated from

10 device 10 to the controlled device. In other embodiments, the raw motion data or other data merely indicating a particular motion input for device 10 may be directly sent to laptop 222 and/or remote device 224 without determining a function at device 10. In these embodiments, laptop 222 and/or remote device 224 may themselves process the raw motion data received from handheld device 10 to determine one or

15 more intended functions or operations they should perform based on the raw motion data. In some embodiments, a user of device 10 may indicate to device 10 through motion or otherwise the other devices that handheld device 10 should communicate raw motion data or intended functions of such other devices, as applicable. While two devices controlled by handheld device 10 are illustrated, it should be understood that

20 particular embodiments may include any number of devices of varying types to be controlled by handheld device 10 through motion input as discussed above.

As indicated above, particular embodiments include the ability to control other devices, such as other local or remote devices, through motion input of handheld device 10. In some embodiments a user of handheld device 10 selects the other

25 device that a particular motion input of device 10 is intended to control. For example, a user may use input 14 of handheld device 10 (e.g., by pressing a button or moving a trackwheel) to select a local or remote device to control before moving device 10 according to a particular motion mapped to a function or operation desired for the other device. In particular embodiments however, a user may move handheld device

30 10 according to a particular gesture in order to select the other device (e.g., other local or remote device) to be controlled at the time through motion input of device 10.

Thus, particular embodiments provide gesture motion selection of other devices to be controlled by handheld device 10.

Handheld device 10 may include a device selection module operable to detect a device selection gesture which indicates that a user desires to control a particular device. Each controllable device may include its own gesture command maps which correlate gestures to be input using device 10 and commands of the controllable device. A control module of the handheld device may select a particular command map corresponding to the controllable device selected for control. In some embodiments, device 10 may include a device locator operable to detect, for each of a plurality of remote devices, a direction from the handheld device to each remote device. In this case, the user may move handheld device 10 in the direction of a particular remote device the user desires to control in order to select that remote device for control.

While motion input for device 10 may be used for such control of the other devices, other types of input (e.g., utilizing input 14) may also be used to control other local or remote devices selected for control by gesture input. In some embodiments different gestures may be each mapped to control a different device. In other embodiments, device 10 may display possible other devices for control and particular gesture(s) to utilize to indicate a user's selection as to which other device the user desires to presently control through device 10. Handheld devices according to the present invention may utilize any particular manner of gesture selection of one or more local or remote devices to be controlled by the handheld devices.

As discussed above, particular embodiments include handheld devices 10 capable of detecting motion of the device through a motion detector 22 to modify the behavior of the device in some way according to the motion detected. Handheld devices 10 in some embodiments are capable of modeling their particular environment and subsequently modifying their behavior based on such environment. One distinction between modeling an environment of a handheld device and detecting a particular motion of the device is that in the former case there may be reasoning involved and in the latter case there may be no such reasoning. As an example, if a handheld device changes its behavior when moved according to a particular gesture, that may be considered sensing or detecting a particular motion and reacting based on

the motion detected. If, on the other hand, the handheld device determines that it is sitting face down on a table and reacts accordingly, that may be considered modeling its environment. As another example, if a handheld device moves to the left and changes its behavior based on such movement, that may be considered detecting motion and reacting. If the handheld device finds itself in free fall and powers-down so as to survive an impending collision with the ground, that may be considered modeling its environment. A further distinction may be that environmental modeling may not require an immediate response to a user input, while detecting an event, such as a particular motion, generally does require such an immediate response. Modeling an environment may thus involve sensing or detecting a pattern of motion (or lack thereof), matching it to a predefined set of environmental conditions and modifying the behavior of the device based on the modeled environment. The behavior implemented based on the environment modeled may also change based on a particular application in use or in focus. In some cases, the device may change its sensitivity to particular motions based on the environment modeled.

As an example, a handheld device may recognize, through accelerometers or other motion detection components, that it is at rest on an approximately horizontal surface. Such recognition may result from a determination that the device is not moving, or still, with a static 1g of acceleration orthogonal to a surface. The device may be able to differentiate resting on a table from resting in a user's hand, for example, because a user's hand typically will not be able to hold the device perfectly still. The device may, as a result, behave in a certain manner according to the recognition that it is at rest on an approximately horizontal surface. For example, if handheld device 10 recognized that it was lying at rest on a table, it may power off after lying in such position for a certain amount of time. As another example, a cellular phone in a vibrate mode may vibrate more gently if it recognizes it is on a table upon receipt of a call or upon any other event that may trigger vibration of the phone. In some embodiments, the device may recognize its orientation while lying on a table such that it may behave in one manner when lying in a "face down" position (e.g., it may power off) while it may behave in a different manner when lying in a non-face down position. If handheld device 10 comprised a cellular phone, it may enter a speaker mode when it is on a call and recognizes that it is placed by a user in a

"face up" position on a table while on the call. If, on the other hand, the cellular phone is on a call and is placed face down on the table, it may enter a mute mode.

As another example, handheld device 10 may recognize through a brief period of approximately 0g that it is in free-fall and then may behave to reduce damage due to impending impact with the ground or another surface. Such behavior may include, for example, powering down chips and/or hard drives, retracting lenses, applying covers or any other device behavior. In particular embodiments, non-hand-held devices or devices that do not otherwise detect motion for input may also be able to model their environment and to behave based on the environment modeled. As an additional example, acceleration patterns may be detected to recognize that a handheld device 10 is in a moving environment (e.g., being held by a user in a car or on a train) and may adjust various sensitivities, threshold and/or other characteristics to enable better performance of the device in that environment.

In other embodiments, handheld device 10 may comprise a digital camera. Through its motion detection components, the camera may determine whether it is on a tripod or is being held by a user when a picture is taken. The camera may set a shutter speed for the picture based on that determination (e.g., slow shutter speed if on a tripod or fast shutter speed if being held by a user).

If handheld device 10 comprised a device that utilized a cradle for syncing up with another device, such as a PC, then device 10 may recognize that it is in the cradle based on its stillness (or supported state) and its particular orientation. The device may then operate or function according to its state of being in the cradle (e.g., it may then sync up with its associated PC).

FIGURE 16 is a flowchart illustrating an environmental modeling process, in accordance with a particular embodiment. At step 232, raw motion data is received at handheld device 10. As described above, the raw motion data may be received by any combination of accelerometers, gyros, cameras, rangefinders or any other suitable motion detection components. At step 234, the raw motion data is processed to produce a motion detector output from which motion and orientation of the device is determined at step 236. Boxes 237 represent example motions and orientations of the device, such as rotating around the z-axis in box 237a, translating along the x-axis in box 237b, oriented at particular angles α , θ , ω in box 237c and still

in box 237n. These are mere example motions and orientations of the device, and any number of motions may be utilized that are determined at step 236. In some embodiments, the determined orientations may comprise an orientation of the device with respect to gravity.

5 At step 238, handheld device 10 determines its environment based on the motion and orientation determined at step 236. Boxes 239 represent example environments of the device, such as face down on a table in box 239a, falling in box 239b, on a train in box 239c and held in hand at box 239n. Any number of environments may be determined based on motions and orientations determined at
10 step 236. In particular embodiments, the environmental determination may also be based on a history of the device, such as a motion/orientation history. For example, when implementing a speaker mode function of a cellular phone, the device may detect a quiet period when horizontal in the middle of a call after a short jarring is detected (e.g., the short jarring caused by a user placing the phone face up on a table).
15 The phone can detect that it was jarred so that stillness and a perpendicular position relative to gravity may take on a different meaning than had the jarring not occurred. Thus, the determination of the environment may be based on the motion and orientation of the device and its history. The history may comprise a previous motion/orientation of the device or any other information relating to a device's
20 history.

 At step 240, the determined environment is mapped to a particular behavior. The mapped behavior may depend on any number of factors in addition to the determined environment, such as desired characteristics of the particular user using the device at the time or the particular application in use or focus at the time. For
25 example, the behavior according to a particular modeled environment may include engaging a mute function of the handheld device in box 241a, powering down chips of the device to survive an impact in box 241b and increasing a motion activation threshold of the device in box 241n. The mute behavior indicated in box 241a may be implemented when a cell phone's environment comprises laying face down on a table
30 while on a call. The powering down chips behavior in box 241b may be implemented when the environment of handheld device 10 comprises a free fall of the device. The increasing a motion activation threshold behavior of box 241n may be implemented

when a handheld device's environment comprises being in a car or train where bumpiness may require a greater movement threshold for a user's motion input to register as an intended input. Particular embodiments may include any number of behaviors mapped to one or more modeled environments. At step 242, the handheld
5 device behaves according to the behavior to which its environment is mapped at step 240.

As indicated above, users may move handheld devices according to particular gestures to cause the devices to perform desired functions, operations or tasks. In particular embodiments, gestures used as motion input for the device may comprise
10 pre-existing symbols, such as letters of the alphabet, picture symbols or any other alphanumeric character or pictographic symbol or representation. For example, gestures used as motion input may mimic upper and lower case members of an alphabet in any language, Arabic and Roman numerals and shorthand symbols. Preexisting gestures may be used for handheld input devices for other local and
15 remote devices as well. Using preexisting gestures for handheld device input may facilitate the learning process for users with respect to gesture motion interfaces.

FIGURE 17 illustrates example gestures which may be mapped to particular functions. For example, if handheld device 10 comprised a cellular phone, a user may move device 10 in the form of heart 250 to call the user's girlfriend, boyfriend or
20 spouse or house 252 to call the user's home. As another example, if handheld device 10 were a PDA or other device running an application managing files or data, moving the device in the form of C-gesture 254 may be a command for copying data, O-gesture 256 may be a command for opening a file, D-gesture 258 may be a command for deleting data and X-gesture 260 may be an exit command for a file or application.
25 The logical connection between gestures and their intended functions or operations (e.g., "O" for opening a file) further facilitates user interaction and learning.

Any number of pre-existing symbols may be used as gestures for motion input as commands for performing any number of functions, operations or tasks of a handheld device. Many preexisting gestures typically exist in two dimensions.
30 Handheld device 10 may recognize such gestures. In some cases, for example, handheld device 10 may disable receipt of a particular dimension so that any movement in a third dimension when a user is attempting to input a two-dimensional

gesture is not received or detected in order to facilitate recognition of the two-dimensional gesture. In some embodiments, handheld device 10 may receive three-dimensional gestures that may be based on preexisting two-dimensional gestures. Receiving and detecting three-dimensional gestures increases the capabilities of the device by, for example, increasing the number and types of gestures which may be used as motion input.

FIGURE 18 is a flowchart 270 illustrating the utilization of a preexisting symbol gesture, the letter "O," as motion input. As illustrated in step 272, a user moves handheld device 10 in the form of the letter "O." At step 274, handheld device 10 receives raw motion data of the "O" movement from motion detection components and process such raw motion data at step 276 to determine the actual motion of the device. At step 278, handheld device 10 accesses a gesture database 280 which may include a plurality of gestures recognizable by the device to map the motion to the gesture "O." The plurality of gestures of the gesture database may each be defined by a series of accelerations of a movement. The actual motion of the device may be matched to a series of accelerations of one of the gestures of the gesture database. At step 282, handheld device 10 maps the gesture "O" to a particular function by accessing a function database 284 (or a gesture mapping database) which may include a plurality of functions that may be performed by one or more applications running on the device. In particular embodiments, the gesture and function databases may be comprised in memory 18 of the device. The particular function mapped to the gesture "O" may depend on a particular application in focus or being used by the user at the time. For example, in some applications "O" be comprise a command to open a file, while in other applications it may comprise a command to call a certain number. In some cases, one gesture may be mapped to the same function for all applications of the device. At step 286, the device behaves according to the mapped function, such as opening a file.

As indicated above, gestures used as motion input for handheld device 10 may have different meanings (e.g., functions, operations, tasks) based on a particular context, such as a particular application in use or in focus, a particular device state with respect to an application or otherwise, a particular modeled environment or any combination of these or any other context. For example, a particular gesture may be

mapped as a command to scroll a page up when running a web browser at the device, while the gesture may be mapped as a command to examine a different date when running a calendar program. The ability for particular gestures to be mapped to different commands depending on the context, such as the application in use, increases the functionality of the device.

Handheld devices in some embodiments may be able to utilize simpler motion detection components if gestures are mapped to different commands depending on the context. As an example, a handheld device may include particular motion detection components such that the handheld device may only be able to recognize and distinguish between twenty different gestures. If each gesture is mapped to a different function for each of four different applications, then the ability to only recognize twenty unique gestures still provides eighty different functions on the device (twenty for each application). If each gesture were mapped to its own function, no matter what application was in focus; then the overall capability of the device would be reduced, and some gestures would likely not be used in some applications. The ability to use less complex components that are able to recognize and distinguish between fewer gestures as a result of mapping gestures to a plurality of functions depending on the context can lead to reduced costs in the components utilized in the device and can also simplify the task of physically learning gestures required to control the device. As indicated above, gestures may be mapped to different functions, operations or tasks depending on the application in use, device state, modeled environment or other context. In some cases, gestures may be mapped to different functions depending on the state of a particular application. For example, in the case of a word processing program, some gestures may have some functions when in one state of the program (e.g., a menu state) while the same gestures may have different functions when in another state of the word processing program (e.g., a document editing state). In this case, a command map associated with the gesture function mappings may include gesture mappings for each such state.

FIGURE 19 is a flowchart 290 illustrating the use of context-based gesture mapping, in accordance with a particular embodiments. In the illustrated embodiment, a gesture has different functions assigned based on the application in focus. At step 292, handheld device 10 receives raw motion data of a particular

gesture movement and process such raw motion data at step 294 to determine the actual motion of the device. At step 296, handheld device 10 maps the motion to a gesture, for example, by accessing a gesture database. At step 298, handheld device 10 determines which application is in focus. For example, if the device were capable
5 of running four different applications, then it would determine which of the four was in focus or was being used at the time. The device then performs the function mapped to the gesture according to the application in focus. The identification of such function may be accomplished in some embodiments by accessing a function database which may also be referred to as a gesture mapping database since it correlates
10 gestures of a gesture database to functions. In the illustrated embodiment, if Application 1 is in focus, then the device performs Function 1 at step 300a; if Application 2 is in focus, then the device performs Function 2 at step 300b; if Application 3 is in focus, then the device performs Function 3 at step 300c; and if Application 4 is in focus, then the device performs Function 4 at step 300d.

15 As a further example of context-based gesture mapping, a handheld device with phone and PDA capabilities may run four applications: a phone application, a calendar application, a file management application and an e-mail application. A gesture input mimicking the letter "S" may have different functions depending on the application in focus. For example, if the phone application is in focus, then receiving
20 the gesture input "S" may be a command for calling a particular number designated to the "S" gesture. If the calendar application is in focus, then receiving the gesture input "S" may be a command for scrolling to the month of September in the calendar. If the file management application is in focus, then receiving the gesture input "S" may be a command for saving a file. If the e-mail application is in focus, then
25 receiving the gesture input "S" may be a command for sending an e-mail. Particular embodiments contemplate great flexibility in the ability to map gestures to different functions depending on the context.

As discussed above, gestures may have different functions depending on a particular context at the time. In particular embodiments, handheld devices may be
30 customizable to allow users to assign device functions to pre-defined gestures. The functions may be context-based such that some gestures may have different functions depending on an application in use, a device state or a modeled environment.

Handheld devices in some embodiments may allow different users of the same device to assign different functions to the same gesture, and such functions may also be context-based as discussed above.

For example, a handheld device 10 may be utilized by a number of different users at different times. Each user may assign different functions for the same gestures. When the handheld device receives a gesture input, it must thus know which user is using the device at the time to determine which function the user intends the device to perform. The device may determine the user in any of a variety of ways. In some embodiments, users may log into the device prior to use by using a username and password or otherwise. In other embodiments, the handheld device may be able to identify the user based on the manner in which the user moves the device for motion input, such as the way the user forms a gesture using the device. As indicated above, each user may also assign commands to gestures based on context, such as based on the application in focus at the device. The ability for the handheld device to map functions to gestures based on particular users further increases the device's capabilities and flexibility, particularly if the device is able to recognize and distinguish only a particular number of gestures.

FIGURE 20 is a flowchart 310 illustrating the use of user-based gesture mapping, in accordance with a particular embodiment. In the illustrated embodiment, a gesture has different functions assigned based on the user using the device. At step 312, handheld device 10 receives raw motion data of a particular gesture movement and process such raw motion data at step 314 to determine the actual motion of the device. At step 316, handheld device 10 maps the motion to a gesture, for example, by accessing a gesture database. At step 318, handheld device 10 determines which user is using the device. Such determination may be made, for example, through a log in system in which users log into the device prior to use. Handheld device 10 may determine the current user through other suitable methods as well. At steps 320, the device performs the functions assigned to the gesture input based on the user using the device. In the illustrated embodiment describing the process with four possible users, if User 1 is using the device, then the device performs Function 1 at step 320a; if User 2 is using the device, then the device performs Function 2 at step 320b; if User 3 is

using the device, then the device performs Function 3 at step 320c; and if User 4 is using the device, then the device performs Function 4 at step 320d.

As indicated above, in some embodiments, gestures may be assigned different functions based on both users using the device and a context. In this situation, the illustrated flowchart 310 described above may have an additional step to determine the context at the time (e.g., step 298 of flowchart 290 determining the application in focus). The particular function desired for performance by a certain gesture thus depends on both the user using the device at the time and the context, such as the particular application in focus at the time.

As previously discussed, some embodiments include handheld devices with the ability to receive preexisting symbols as gestures for motion input. Some of those embodiments as well as other embodiments may include the ability for user's to create their own gestures for mapping to functions and/or keys. The gestures may comprise any user-created symbol or other motion that the user desires to utilize as motion input for one or more particular functions, operations or tasks that the device is able to perform. Users may be able to create motions with some personal significance so they may more easily remember the motion's command or intended function.

FIGURE 21 is a flowchart 330 illustrating the assignment process for user-created gestures, in accordance with a particular embodiments. At step 332, an indication is received from a user for gesture creation. The indication may be received in any of a variety of ways using any suitable input format (e.g., keys, trackwheel, motion, etc.). The user may move the device according to the user-created gesture such that raw motion data for the user-created gesture is received at the handheld device at step 334. The raw motion data may comprise a sequence of accelerations of a movement after stabilization of the device from a base reference position until an indication is received to stop recording the reference positions. Indications to start and stop recording a user-created gesture may include motion or non-motion indications (e.g., key presses and key releases). The raw motion data is processed at step 336. At step 338, the motion is stored as a gesture, for example, at a gesture database. In particular embodiments, the indication for gesture creation may be received after the user moves the device according to the user-created gesture. For example, the user may move the device according to a user-created gesture that is

currently unrecognizable by the device. The device may query the user to determine if the user desires to store the unrecognized gesture for a particular function. The user may respond in the affirmative so that the user may utilize the gesture as motion input in the future.

5 At step 340, function mapping information for the gesture is received from the user. The function mapping information may comprise functions, operations or tasks of the device that the user desires the user-created gesture to command. In particular embodiments, such function mapping information may comprise a series of functions (e.g., a macro) that one gesture may command. The user may assign different
10 functions for a gesture according to an application in focus. In some cases, a user may desire to map different gestures to different keys or keystrokes of the device. One examples of mapping a series of functions to a gesture may include mapping a long string of characters to a gesture (e.g., telephone numbers including pauses, where appropriate). At step 342, the function mapping information is stored, for example, at
15 a function database or gesture mapping database.

As indicated above, it may be difficult for a user to move handheld device 10 in the same precise manner for one or more gestures each time those gestures are used as input. Particular embodiments thus allow for varying levels of precision in gesture input. Precision describes how accurately a gesture must be executed in order to
20 constitute a match to a gesture recognized by the device, such as a gesture included in a gesture database accessed by the device. The closer a user generated motion must match a gesture in a gesture database, the harder it will be to successfully execute such gesture motion. As discussed above, in particular embodiments movements may be matched to gestures of a gesture database by matching a detected series of
25 accelerations of the movements to those of the gestures of the gesture database.

As the precision of gestures required for recognition increases, one may have more gestures (at the same level of complexity) that can be distinctly recognized. As an example, if the precision required was zero, then the device could only recognize a single gesture but it would recognize it easily because anything the user did would be
30 recognized as that gesture. If, however, the precision required was infinite then it would be virtually impossible for a user to form a gesture that was recognized by the device, but the device could support an infinite number of gestures with only

infinitesimal differences between them. One area in which the precision requirement is especially applicable is in the area of spatial signatures. With spatial signatures, the level of precision correlates well with the level of security.

5 In particular embodiments, the precision required by handheld device 10 for gesture input may be varied. Different levels of precision may be required for different users, different regions of the "gesture space" (e.g., similar gestures may need more precise execution for recognition while gestures that are very unique may not need as much precision in execution), different individual gestures, such as signatures, and different functions mapped to certain gestures (e.g., more critical
10 functions may require greater precision for their respective gesture inputs to be recognized). Moreover, in some embodiments users may be able to set the level(s) of precision required for some or all gestures or gestures of one or more gesture spaces. As an example, a user may set the precision required for spatial signatures higher than for other gestures for the user thus increasing security for spatial signature input.

15 As indicated above, in particular embodiments gestures may be recognized by detecting a series of accelerations of the device as the device is moved along a path by a user according to an intended gesture. Recognition occurs when the series of accelerations is matched by the device to a gesture of a gesture database.

In some embodiments, each gesture recognizable by handheld device 10, or
20 each gesture of a gesture database, includes a matrix of three-dimensional points. In addition, a user movement intended as a gesture input includes a matrix of three-dimensional points. Handheld device 10 may compare the matrix of the movement with the matrices of each recognizable gesture (or each gesture in the gesture database) to determine the intended gesture. If a user moves the device such that the
25 movement's matrix correlates to each point of an intended gesture's matrix, then the user may be deemed to have input the intended gesture with perfect precision. As the precision required for gesture input is reduced, then the greater the allowable differences between a user gesture movement and an intended gesture of a gesture database for gesture recognition.

30 FIGURE 22 illustrates three gestures input using a handheld device with varying levels of precision. In the illustrated embodiment, the intended gesture comprises an "O." Gesture movement 350 is input as a perfect "O," or with 100%

precision for the intended gesture. Gesture movement 352 is input with less than 100% precision as it does not form a perfect "O." Gesture movement 354 is input with less precision than gesture movement 352. The precision requirement for the input of gesture "O" may be set at handheld device to accept varying levels of precision. For example, the precision level may be set such that only gesture movement 350 is recognized as gesture "O," gesture movements 350 and 352 are both recognized as gesture "O" or gesture movements 350, 352 and 354 are all recognized as gesture "O." As indicated above, the higher the precision requirement, then the more space available for additional recognizable gestures. For example, if the precision level for handheld device 10 were set such that only gesture movement 350 was recognized as gesture "O," then gesture movements 352 and 354 may be recognized as other, distinct gestures.

In particular embodiments, handheld devices may alter gestures recognized for performing particular functions based on a user's personal precision. In this manner, a handheld device may have dynamic learning capability of gesture mappings. For example, if a particular gesture of a gesture database is mapped to a particular function, and a user's repeated attempts to input the gesture lack precision in a consistent manner; then the handheld device may alter the gesture in the gesture database to match the consistent gesture movement of the user such that the user's consistent gesture motion input will be mapped to the particular function.

As an example, if a particular gesture comprises a square motion and a user's motion intended for the gesture comprises more of a triangular motion on a consistent basis (e.g., on multiple consecutive times), then the handheld device may be able to recognize this consistent difference in an intended gesture and the actual user motion to change the intended gesture (e.g., a square) in the gesture database mapped to the function intended to the user's actual consistent motion (e.g., triangle). Thus, after such change is made, any time the user inputs the triangle gesture then the function previously mapped to the square gesture will be commanded. The device may determine the gesture intended in any of a variety of ways, such as through two-way communication with the user through any form of input. In particular embodiments, this dynamic learning of users' input characteristics may be applied on a user-specific

basis. For example, in the example described above another user may still input the square gesture using the same handheld device to command the same function.

As indicated above, as the precision of user motion with respect to intended gestures increases, then the number of gestures available for mapping to functions increases. In some embodiments, handheld devices may recognize that a user's precision increases over time and the devices may, as a result, increase the gestures available for use. Increasing gestures available for input may also increase the functions capable of being commanded through gesture input.

As an example, a user's personal precision for inputting gestures may be such that the user is only able to input a certain number of gestures that will be recognized by the handheld device. However, over time, the user's personal precision may increase. This increase may be recognized by the handheld device and, as a result, the device may enable additional gestures that the user may use as gesture input. In some embodiments, the enabling of additional gestures may occur when the user's precision increases over a particular precision threshold, or a certain precision level. Since the user's precision has increased, the handheld device will be able to recognize when the user attempts to input these additional gestures. As indicated above, providing additional gestures for input by a user may also increase the number of functions that the user is able to command through gesture input, since each gesture may be mapped to command a different function.

Handheld devices in particular embodiments may also allow users to set and vary noise thresholds of the device. Noise thresholds are the magnitude of motion of the device that must be detected in order to be considered intended motion input (e.g., an intended gesture) of the user. For example, if noise thresholds are set low, then minimal motion of the device may be considered by the device as motion input. However, if noise thresholds are set high, then greater movement of the device would be required before the motion is considered intended input from the user. If, for example, a user is travelling in a car on a bumpy road, the user may desired to set the noise threshold higher so that when the device moves as a result of bumps in the road then such movement may not be considered by the device to be intended motion input.

In particular embodiments, noise thresholds may automatically change at the device based on a modeled environment. For example, if a device determines that the environment comprises traveling in a car, then the device may automatically increase the noise threshold so that minimal movements resulting from the car will not register as user-intended motion.

FIGURE 23 is a flowchart 370 illustrating a gesture recognition process utilizing a number of features described herein, in accordance with a particular embodiment. At step 372, raw motion data of a particular gesture movement is received. The raw motion data is processed at step 374 where the actual motion of the device is determined. Such processing may include various filtering techniques and fusion of data from multiple detection or sensing components. At step 376, the actual motion is mapped to a gesture. Mapping the actual motion to a gesture may include accessing a user settings database 378, which may include user data 379 comprising, for example, user precision and noise characteristics or thresholds, user-created gestures and any other user-specific data or information including user identities 381. User-specific information may be important, for example, because different users of the handheld device may have different settings and motion input characteristics. For example, an older user may have less precision than a younger user when inputting gestures such that the older person may have fewer gestures available. Moreover, a more experienced user may have more device functionality available through gesture input.

User settings database 378 may also include environmental model information 380 which may factor in determining the gesture applicable at the time. As discussed above, through environmental modeling, the device can internally represent its environment and the effect that environment is likely to have on gesture recognition. For example, if the user is on a train, then the device may automatically raise the noise threshold level. The device may also reduce the precision required, depending upon how crowded the gesture space is near the gesture under consideration. Mapping the actual motion to a gesture may also include accessing gesture database 382.

At step 384, the gesture is mapped to a function for the device. This step may include accessing a function mapping database 386 which may include correlation

between gestures and functions. Different users may have different mappings of gestures to functions and different user-created functions. Thus, function mapping database 386 may also include user-specific mapping instructions or characteristics, user-created functions (e.g., macros and/or phone numbers) and any other function information which may be applicable to mapping a particular gesture to one or more functions. In some embodiments, gestures may be mapped to individual keystrokes. User identities 381 may also be accessed in this step. In addition, device context information 388 may also be accessed and utilized in mapping the gesture, which may include environmental model information 389, application in focus information 390 and device state information 391, such as time and date information, location information, battery condition and mode information (e.g., silent mode). At steps 392, the device performs the appropriately-mapped one or more function(s), such as Function 1 at step 392a, Function 2 at step 392b or Function 3 at step 392c.

As discussed above, in particular embodiments handheld device 10 may comprise a cellular phone with many of the capabilities described herein. For example, cellular phones with motion input capabilities may use motion input to flatten menus as discussed above. The cellular phone may detect device states and environments, such as free fall or the cellular phone being face down or face up to map to behaviors such as mute, speaker phone and power-off. Other detection of device states may include detecting that the phone is being held to disengage mute or speakerphone states. The cellular phone may utilize gestures to control dialing (e.g., through gestural speed dial) or to lock/unlock a keypad of the device. For example, the device may be moved in a clockwise circle to dial home, a counterclockwise circle to dial work and in the shape of a heart to dial a significant other. Users may also be able to program the cellular phone to customized gestural mappings.

In particular embodiments handheld device 10 may comprise a digital camera utilizing motion input for at least some of the functions described herein. For example, digital cameras with motion input capabilities may use motion input to flatten menus as discussed above. Motion may also be used to allow a user to zoom in (and back out) on still photos or video to examine it more closely for smoother and more intuitive functionality. Motion may be used to zoom in and out of a number of thumbnails of photographs or video clips so that it is easy to select one or more to

review. Virtual desktops may be used to review many thumbnails of many digital photos or video clips or to review many digital photos or video clips by translating the camera or using gestural input. Gestures and simple motions may be used alone or in combination with other interface mechanisms to modify various settings on digital still and video cameras, such as flash settings, type of focus and light sensing mode. Moreover, free fall may be detected to induce the camera to protect itself in some way from damage in an impending collision. Such protection may include dropping power from some or all parts of the camera, closing the lens cover and retracting the lens.

In particular embodiments handheld device 10 may comprise a digital watch utilizing motion input for at least some of the functions described herein. For example, digital watches with motion input capabilities may use motion input to flatten menus as discussed above. In some embodiments, the tapping of the watch or particular gestures may be used to silence the watch. Other functions may also be accessed through taps, rotations, translations and other more complex gestures. These functions may include changing time zones, setting the watch (e.g., setting the time and other adjustable settings), changing modes (e.g., timers, alarms, stopwatch), activating the backlight, using a stopwatch (e.g., starting, stopping and splitting the stopwatch) and starting and stopping other timers.

In some embodiments, motion detection may be separate from a display. For example, a display may be worn on glasses or contacts, and other parts of the handheld device may be dispersed across a user's body such that the display may not be part of the same physically component as the motion input device or component.

As discussed above, particular figures illustrate various methods, flowcharts and processes which may be performed in particular embodiments. It should be understood that steps may be performed in any order, and steps from a particular method, flowchart or process may be combined with other methods, flowcharts or processes or other steps from the same method, flowchart or process in various embodiments without departing from the scope of the invention.

Although the present invention has been described in detail with reference to particular embodiments, it should be understood that various other changes, substitutions, and alterations may be made hereto without departing from the spirit and scope of the present invention. For example, although the present invention has

been described with reference to a number of elements included within handheld device 10, these elements may be combined, rearranged or positioned in order to accommodate particular architectures or needs. In addition, any of these elements may be provided as separate external elements to each other where appropriate. The
5 present invention contemplates great flexibility in the arrangement of these elements as well as their internal components.

Numerous other changes, substitutions, variations, alterations and modifications may be ascertained by those skilled in the art and it is intended that the present invention encompass all such changes, substitutions, variations, alterations
10 and modifications as falling within the spirit and scope of the appended claims.

WHAT IS CLAIMED IS:

1. A motion controlled handheld device comprising:
 - a first accelerometer operable to detect acceleration along a first axis;
 - a second accelerometer operable to detect acceleration along a second axis, the
 - 5 second axis perpendicular to the first axis;
 - a tilt detection component operable to detect rotation having a component around at least one of the first axis and the second axis;
 - a display operable to present a current image;
 - a motion tracking module operable to track motion of the device in three
 - 10 dimensions using the first accelerometer, the second accelerometer, and the tilt detection component; and
 - a controller operable to generate the current image and to modify the current image in response to the motion of the device.
- 15 2. The motion controlled handheld device of Claim 1, wherein:
 - the display comprises a viewable surface; and
 - the first axis and the second axis are substantially parallel to the viewable surface.
- 20 3. The motion controlled handheld device of Claim 1, wherein:
 - the tilt detection component comprises a third accelerometer operable to detect acceleration along a third axis, the third axis perpendicular to the first axis and perpendicular to the second axis; and wherein:
 - the motion tracking module is further operable to distinguish translation within
 - 25 a plane formed by the first axis and the second axis from rotation having a component around at least one of the first axis and the second axis based upon the acceleration measured by the third accelerometer.

4. The motion controlled handheld device of Claim 1, wherein the tilt detection component comprises:

a third accelerometer operable to detect acceleration along a third axis, the third axis perpendicular to the first axis and perpendicular to the second axis;

5 a camera operable to generate a video stream; and

a video analysis module operable to detect a direction of motion based on the video stream.

10 5. The motion controlled handheld device of Claim 4, wherein the tilt detection component further comprises:

a range finder operable to determine distance information including a distance between the device and an object in the video stream; and wherein:

the video analysis module is further operable to determine a magnitude of translation of the device using the distance.

15

6. The motion controlled handheld device of Claim 1, wherein the tilt detection component comprises:

20 a first camera operable to generate a first video stream, the first camera aligned to focus in a first direction along a third axis, the third axis perpendicular to the first axis and perpendicular to the second axis;

a second camera operable to generate a second video stream, the second camera aligned to focus in a second direction along the third axis, the second direction opposite the first direction; and

25 a video analysis module operable to detect a direction of motion of the device based on the first video stream and the second video stream.

7. The motion controlled handheld device of Claim 6, wherein the tilt detection component further comprises a third accelerometer operable to detect acceleration along the third axis.

30

8. The motion controlled handheld device of Claim 6, wherein the video analysis module is further operable to:

detect first edges of objects in the first video stream;

detect second edges of objects in the second video stream;

5 identify movement of the first edges and the second edges;

determine a differential between the movement of the first edges and the movement of the second edges; and

determine tilt components and translation components based on the differential.

10

9. The motion controlled handheld device of Claim 1, further comprising:
a gesture database comprising a plurality of gestures, each gesture defined by a motion of the device with respect to a first position of the device; and

15 a gesture mapping database mapping each of the gestures to a corresponding command; and wherein

the controller is further operable to compare the tracked motion of the device against the gestures to determine a received gesture, to identify the corresponding command mapped to the received gesture, and to execute the identified command to modify the current image.

20

10. The motion controlled handheld device of Claim 1, wherein:
the motion tracking module is further operable to identify translation of the device within a plane formed by the first axis and the second axis based upon motion of the device;

25 the current image displays a subsection of a larger image; and

the controller is further operable to continuously modify the current image to display another subsection of the larger image based on a resulting position of the device resulting from the translation.

30 11. The motion controlled handheld device of Claim 1, wherein the motion tracking module is further operable to disregard acceleration detected by the first

accelerometer and acceleration detected by the second accelerometer that register below a noise threshold.

12. A method for controlling a handheld device comprising:
- 5 detecting acceleration along a first axis using a first accelerometer;
detecting acceleration along a second axis using a second accelerometer, the second axis perpendicular to the first axis;
detecting rotation having a component around at least one of the first axis and the second axis using a tilt detection component;
- 10 tracking motion of the device in three dimensions using the first accelerometer, the second accelerometer, and the tilt detection component; and
displaying a current image using a display of the device and modifying the current image in response to the tracked motion of the device.

- 15 13. The method of Claim 12, wherein:
the display comprises a viewable surface; and
the first axis and the second axis are substantially parallel to the viewable surface.

- 20 14. The method of Claim 12, further comprising:
detecting acceleration along a third axis using a third accelerometer of the tilt detection component, the third axis perpendicular to the first axis and perpendicular to the second axis; and
distinguishing translation within a plane formed by the first axis and the
25 second axis from rotation having a component around at least one of the first axis and the second axis based upon the acceleration measured by the third accelerometer.

- 15 15. The method of Claim 12, further comprising:
 detecting acceleration along a third axis using a third accelerometer of the tilt
5 detection component, the third axis perpendicular to the first axis and perpendicular to
 the second axis; and
 monitoring a video stream generated by a camera of the device; and
 detecting a direction of motion based on the video stream.
- 10 16. The method of Claim 15, further comprising:
 determining distance information including a distance between the device and
 an object in the video stream; and
 determining a magnitude of translation of the device using the distance.
- 15 17. The method of Claim 12, further comprising:
 monitoring a first video stream generated by a first camera of the device, the
 first camera aligned to focus in a first direction along a third axis, the third axis
 perpendicular to the first axis and perpendicular to the second axis;
 monitoring a second video stream generated by a second camera of the device,
20 the second camera aligned to focus in a second direction along the third axis, the
 second direction opposite the first direction; and
 detecting a direction of motion of the device based on the first video stream
 and the second video stream.
- 25 18. The method of Claim 17, further comprising:
 detecting first edges of objects in the first video stream;
 detecting second edges of objects in the second video stream;
 identifying movement of the first edges and the second edges;
 determining a differential between the movement of the first edges and the
30 movement of the second edges; and
 determining tilt components and translation components based on the
 differential.

19. The method of Claim 12, further comprising:

comparing the tracked motion of the device against a gesture database, the gesture database comprising a plurality of gestures with each gesture defined by a motion of the device with respect to a first position of the device;
5 identifying a command mapped to the received gesture; and
executing the identified command to modify the current image.

20. Logic for controlling a handheld device, the logic embodied in a computer readable medium and operable when executed to perform the steps of:

detecting acceleration along a first axis using a first accelerometer;
detecting acceleration along a second axis using a second accelerometer, the second axis perpendicular to the first axis;
detecting rotation having a component around at least one of the first axis and the second axis using a tilt detection component;
15 tracking motion of the device in three dimensions using the first accelerometer, the second accelerometer, and the tilt detection component; and
displaying a current image using a display of the device and modifying the current image in response to the tracked motion of the device.

20

21. The logic of Claim 20, further operable when executed to perform the steps of:

detecting acceleration along a third axis using a third accelerometer of the tilt detection component, the third axis perpendicular to the first axis and perpendicular to the second axis; and
25

distinguishing translation within a plane formed by the first axis and the second axis from rotation having a component around at least one of the first axis and the second axis based upon the acceleration measured by the third accelerometer.

22. The logic of Claim 20, further operable when executed to perform the steps of:

5 detecting acceleration along a third axis using a third accelerometer of the tilt detection component, the third axis perpendicular to the first axis and perpendicular to the second axis; and

monitoring a video stream generated by a camera of the device; and
detecting a direction of motion based on the video stream.

10 23. The logic of Claim 20, further operable when executed to perform the steps of:

determining distance information including a distance between the device and an object in the video stream; and

determining a magnitude of translation of the device using the distance.

15

24. The logic of Claim 20, further operable when executed to perform the steps of:

20 monitoring a first video stream generated by a first camera of the device, the first camera aligned to focus in a first direction along a third axis, the third axis perpendicular to the first axis and perpendicular to the second axis;

monitoring a second video stream generated by a second camera of the device, the second camera aligned to focus in a second direction along the third axis, the second direction opposite the first direction; and

25 detecting a direction of motion of the device based on the first video stream and the second video stream.

25. The logic of Claim 24, further operable when executed to perform the steps of:

detecting first edges of objects in the first video stream;

detecting second edges of objects in the second video stream;

5 identifying movement of the first edges and the second edges;

determining a differential between the movement of the first edges and the movement of the second edges; and

determining tilt components and translation components based on the differential.

10

26. The logic of Claim 20, further operable when executed to perform the steps of:

comparing the tracked motion of the device against a gesture database, the gesture database comprising a plurality of gestures with each gesture defined by a

15 motion of the device with respect to a first position of the device;

identifying a command mapped to the received gesture; and

executing the identified command to modify the current image.

27. A motion controlled handheld device comprising:

20 means for detecting acceleration along a first axis;

means for detecting acceleration along a second axis, the second axis perpendicular to the first axis;

means for detecting rotation having a component around at least one of the first axis and the second axis;

25 means for tracking motion of the device in three dimensions based upon the acceleration along the first axis, the acceleration along the second axis, and the rotation; and

means for displaying a current image using a display of the device and modifying the current image in response to the tracked motion of the device.

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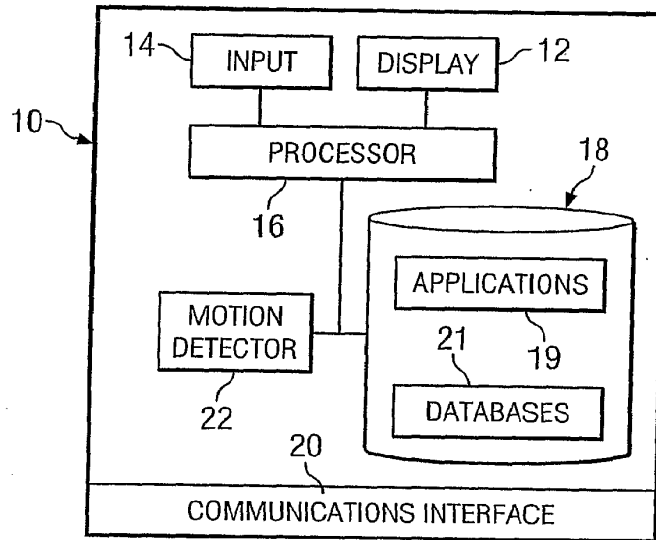


FIG. 1

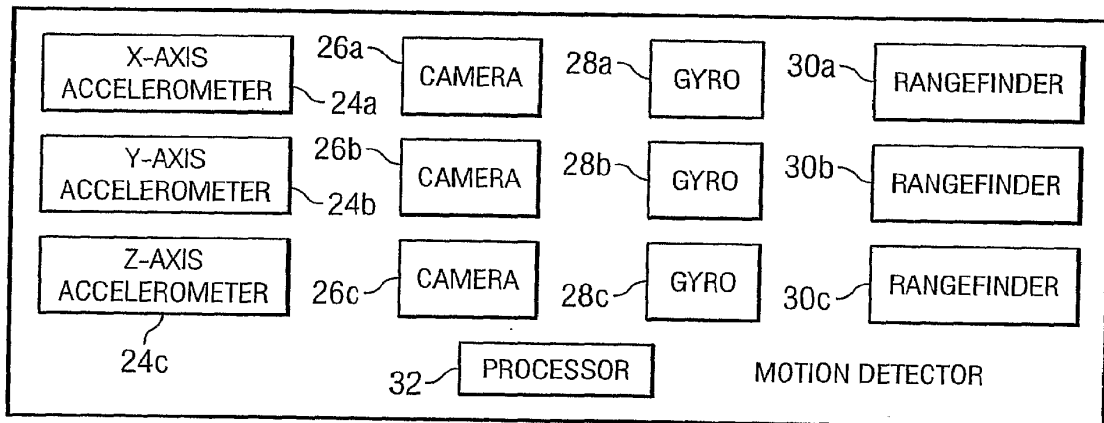


FIG. 2

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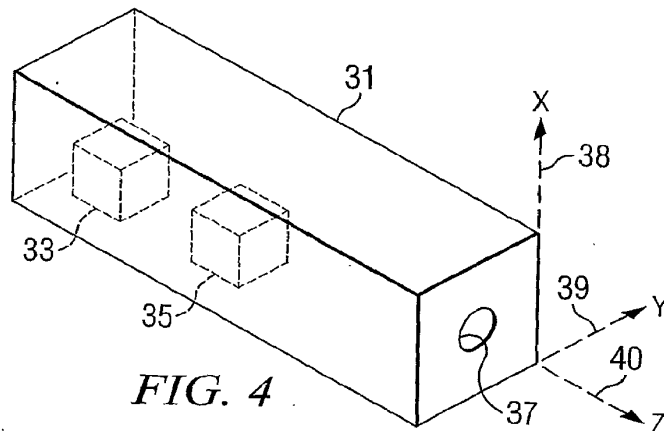


FIG. 4

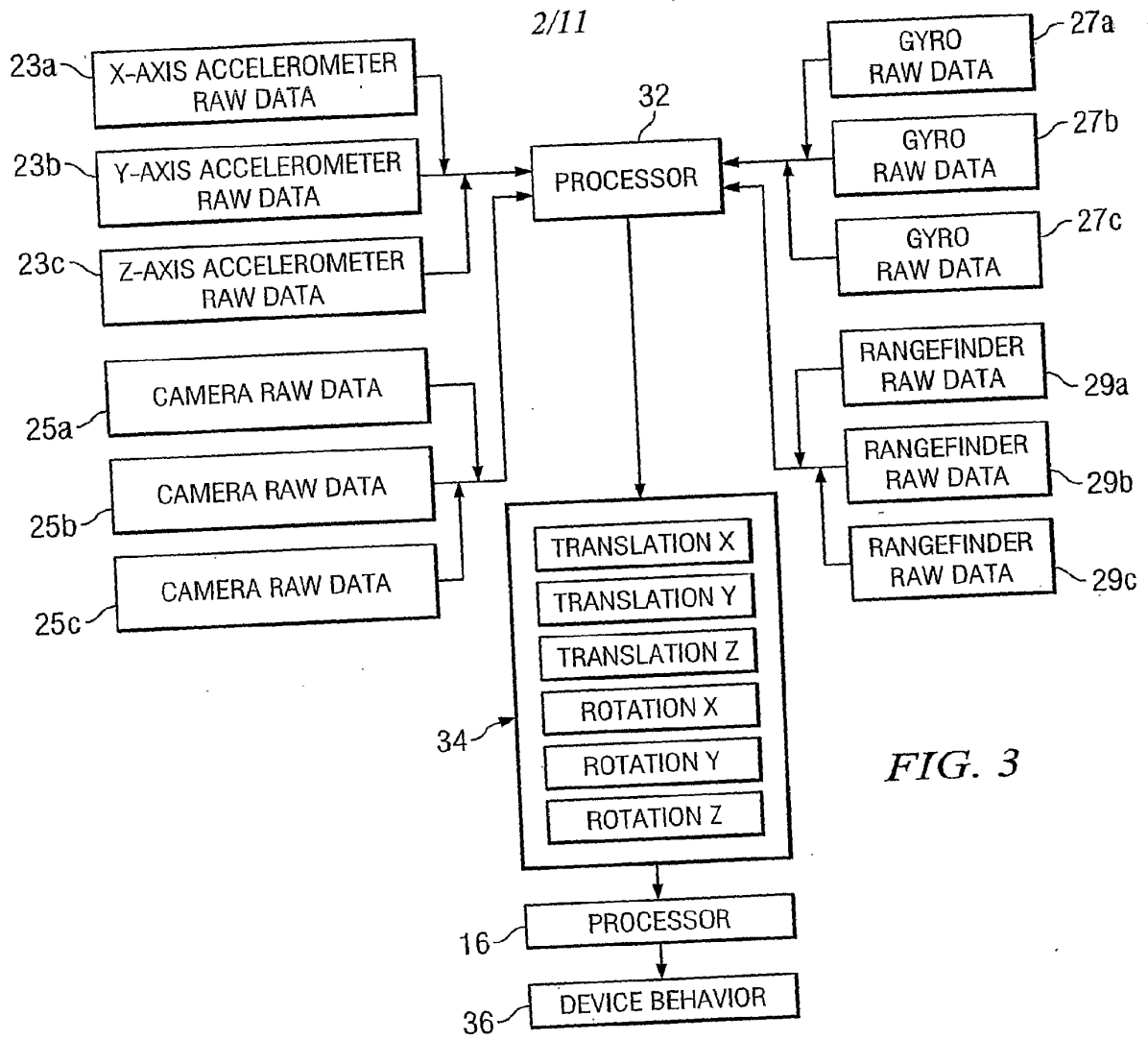


FIG. 3

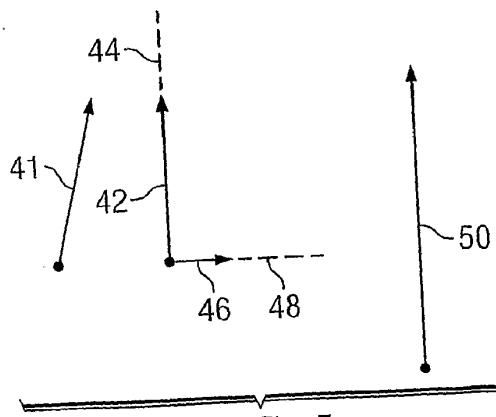


FIG. 5

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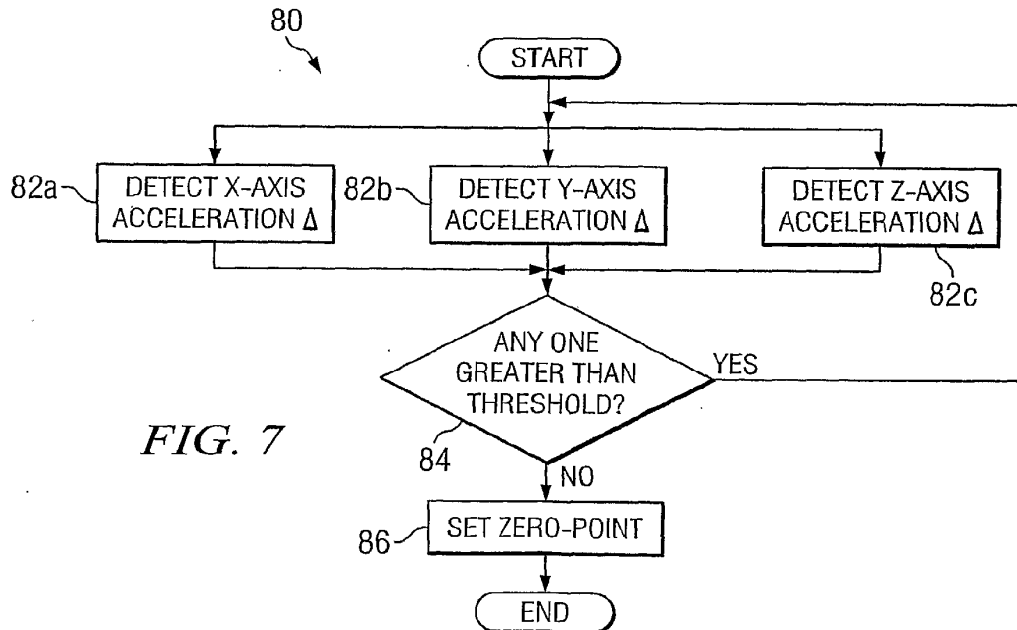
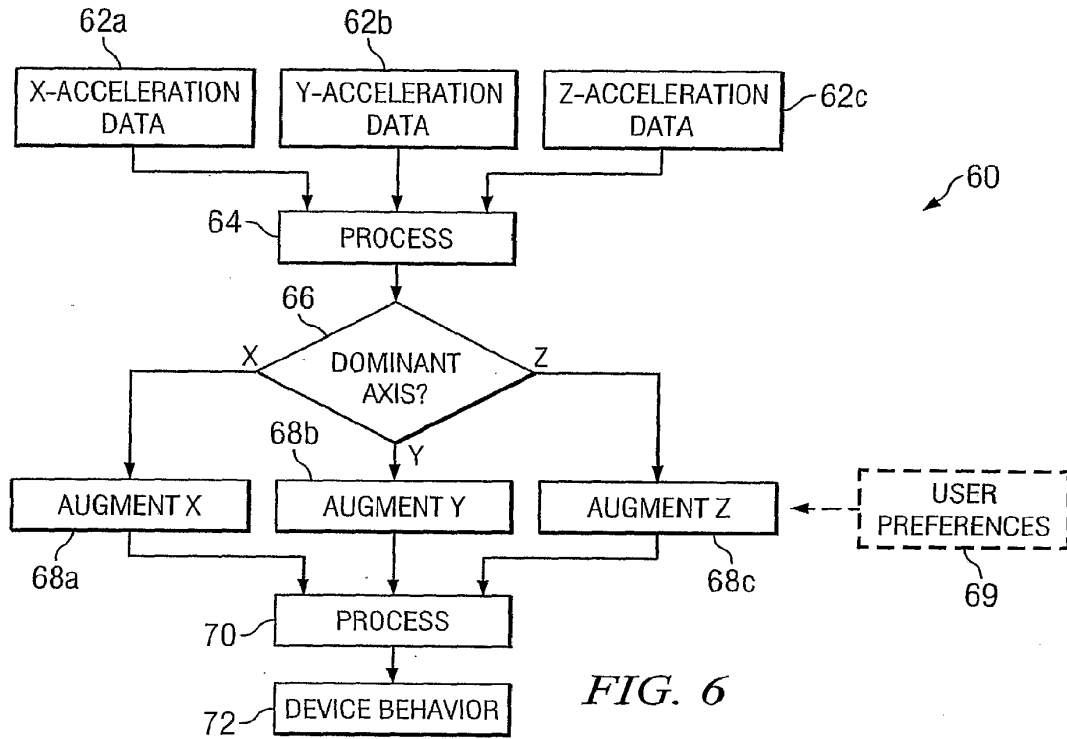


FIG. 8

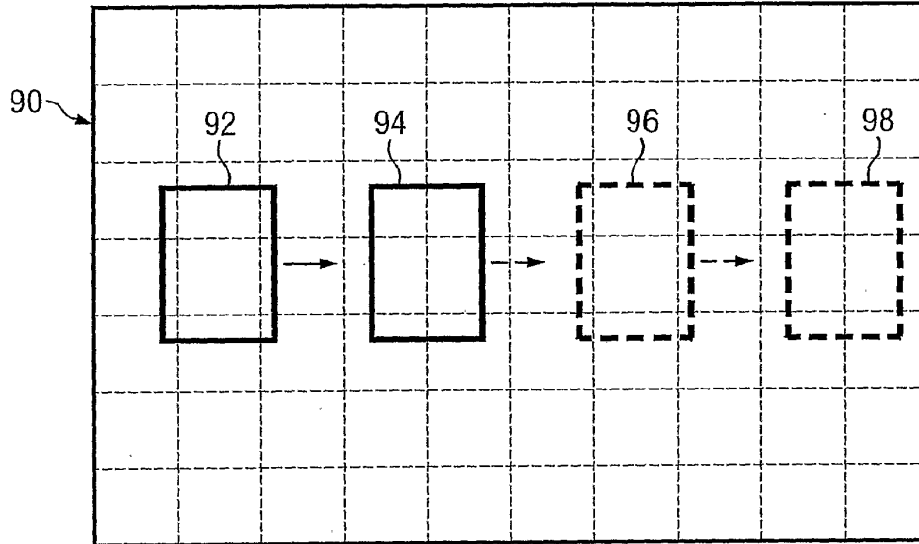
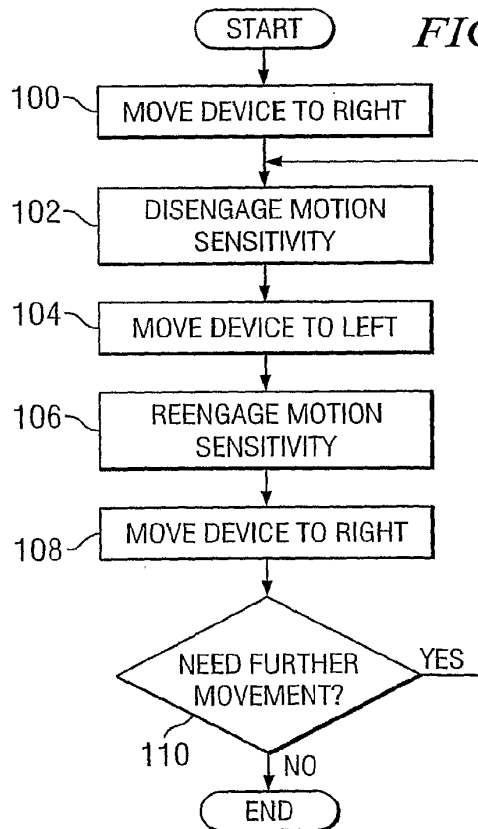


FIG. 9



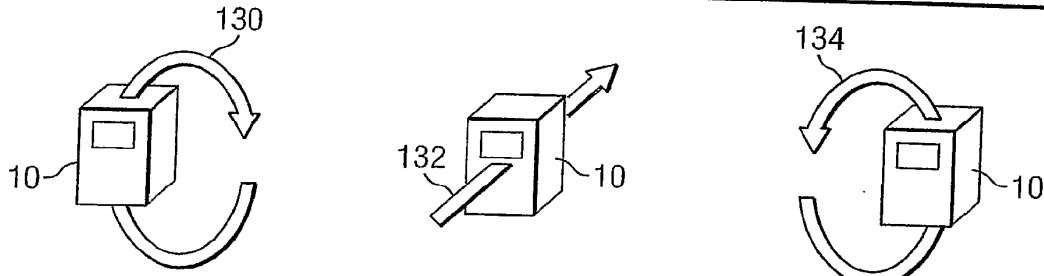
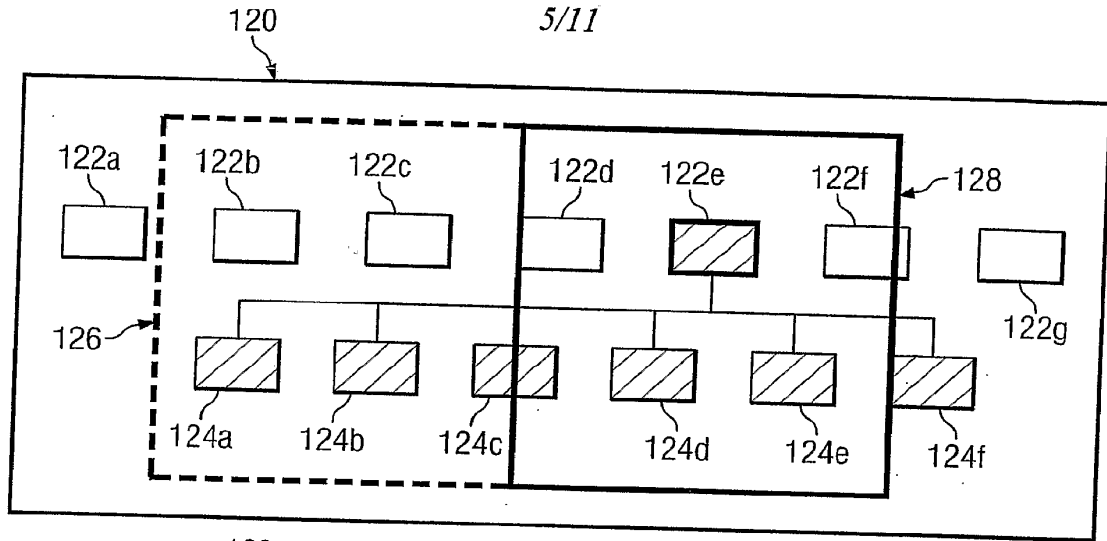


FIG. 10A

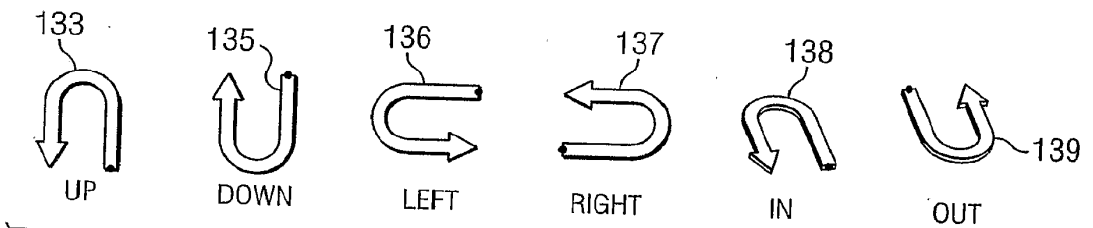


FIG. 10B

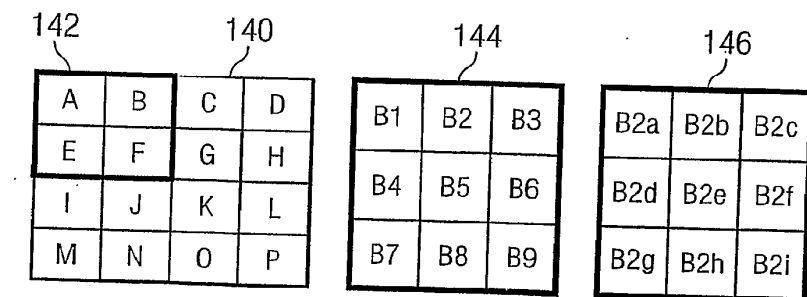


FIG. 11

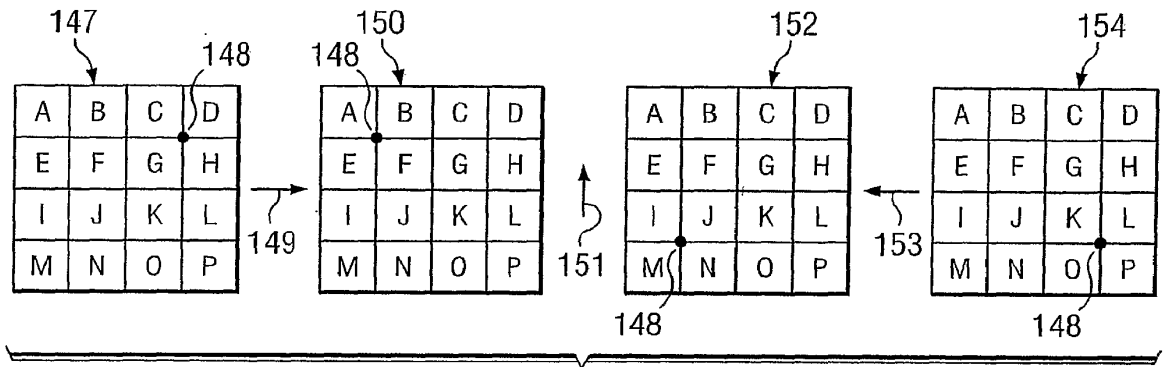
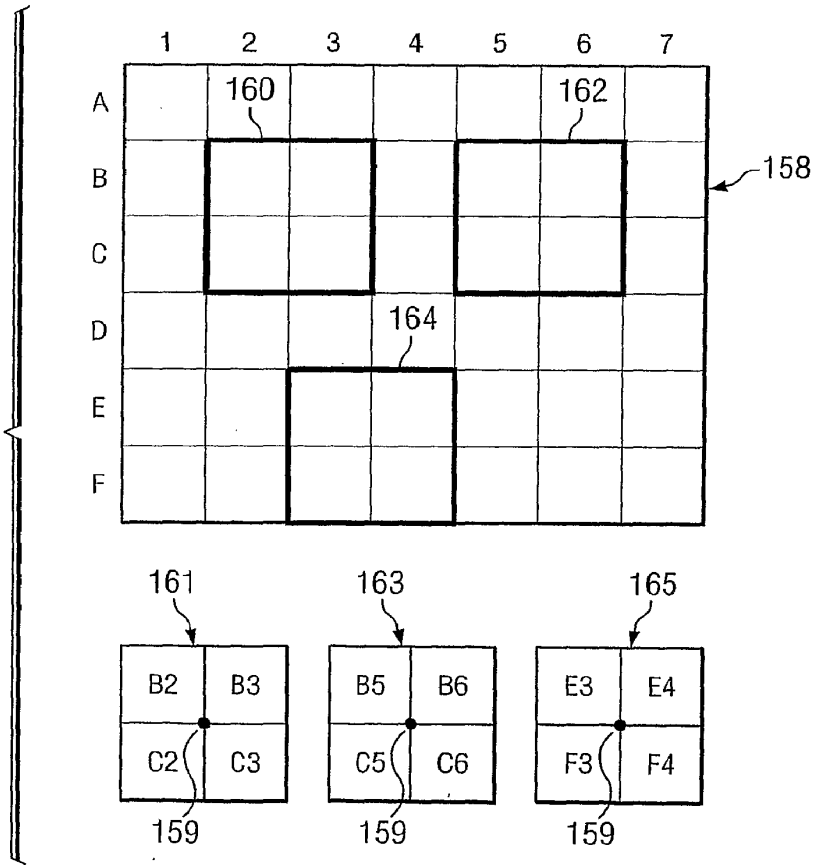


FIG. 12A

FIG. 12B



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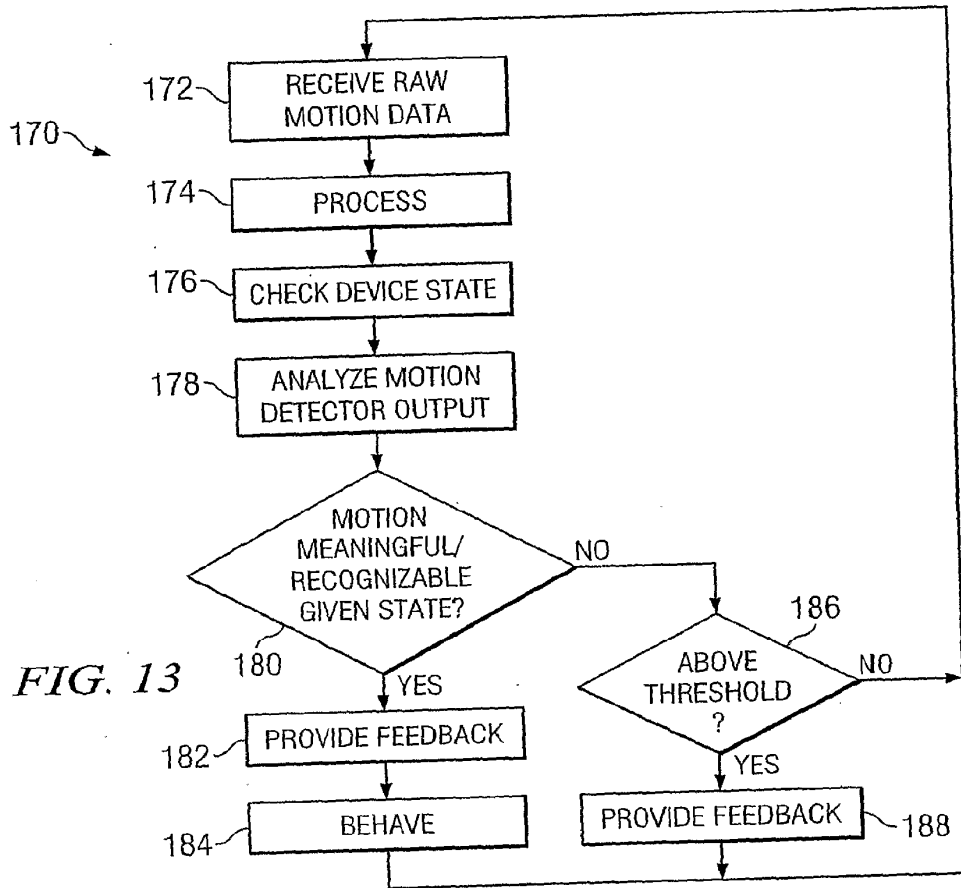


FIG. 13

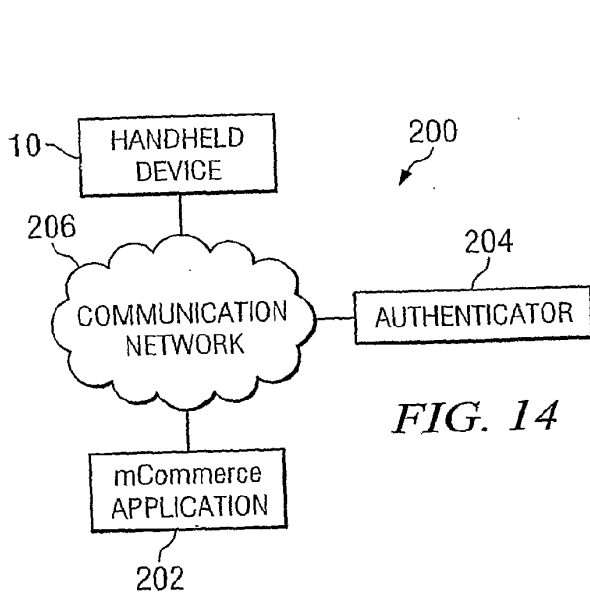


FIG. 14

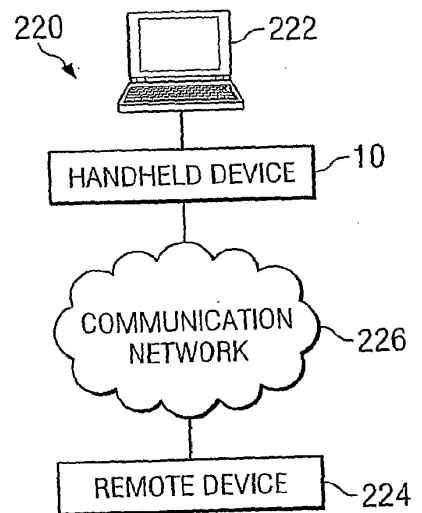


FIG. 15

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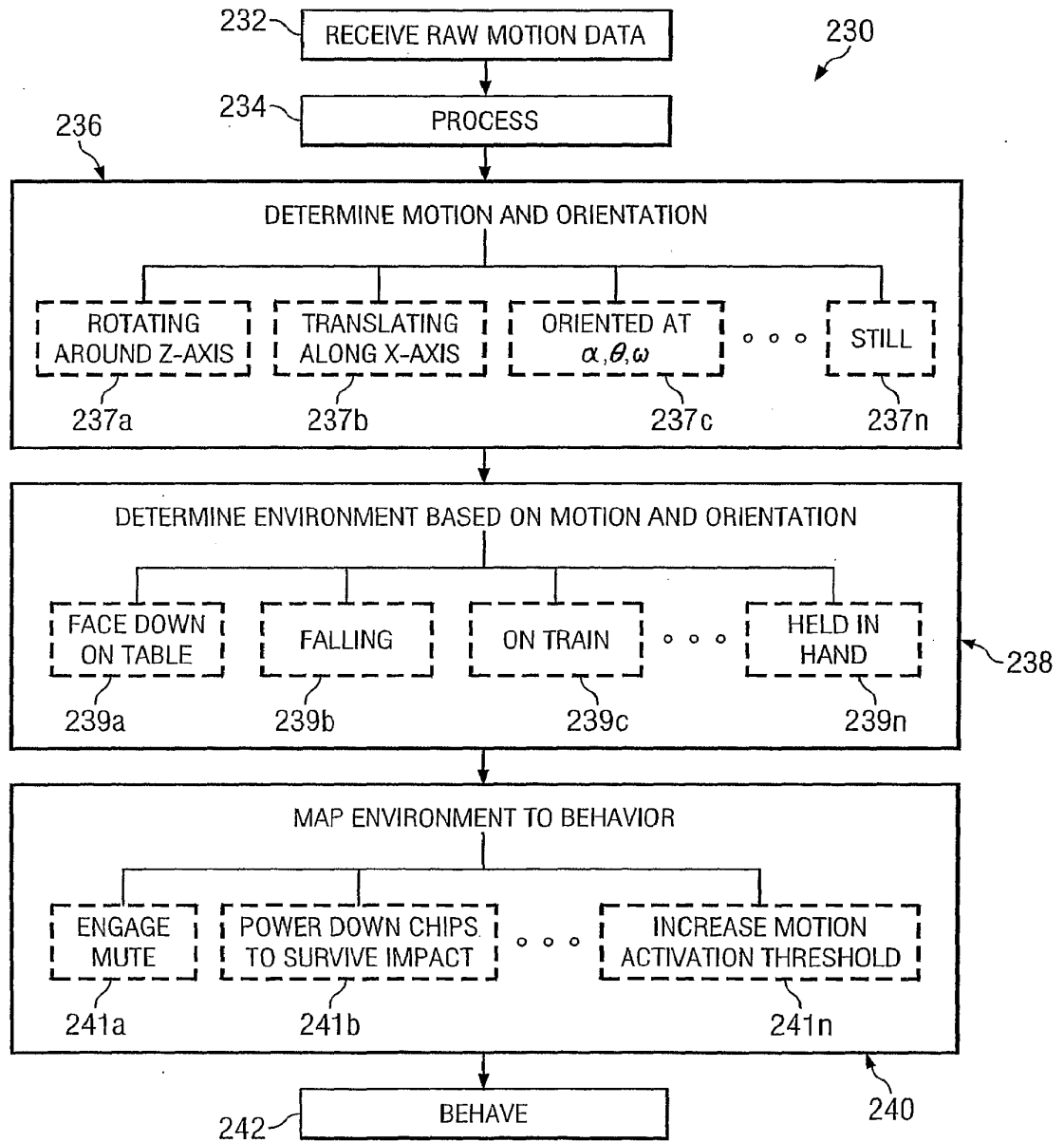


FIG. 16

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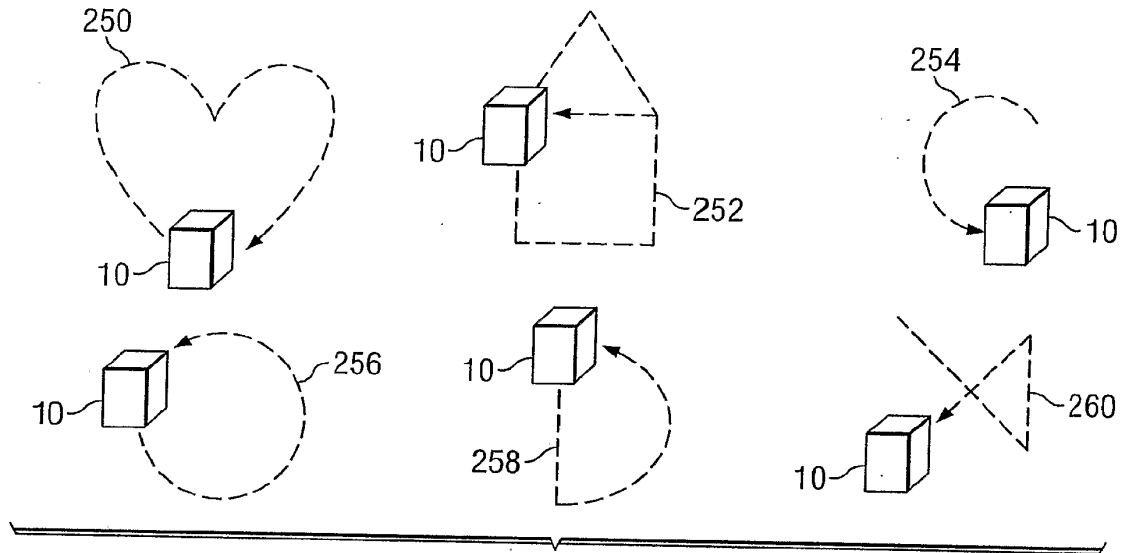


FIG. 17

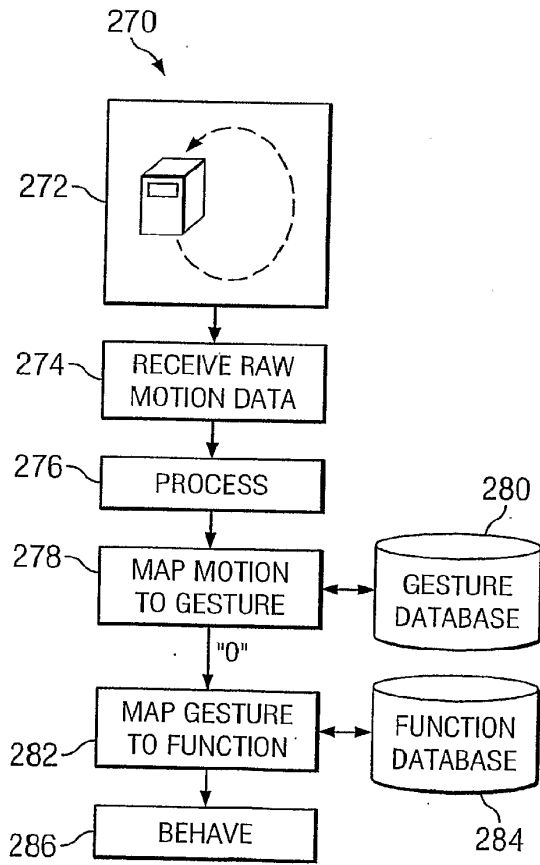


FIG. 18

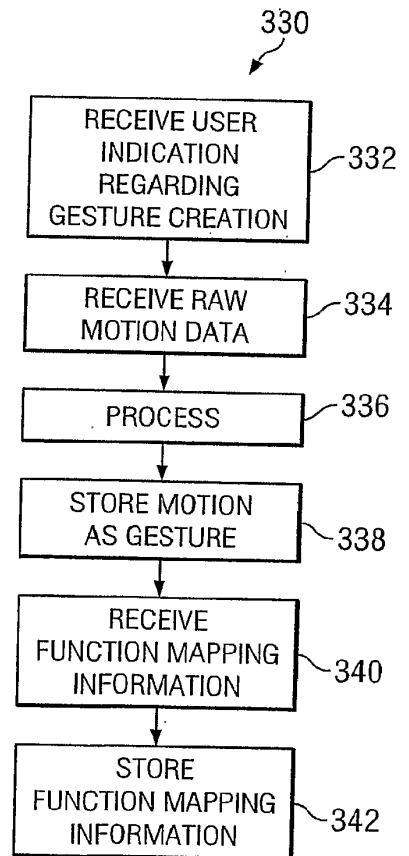
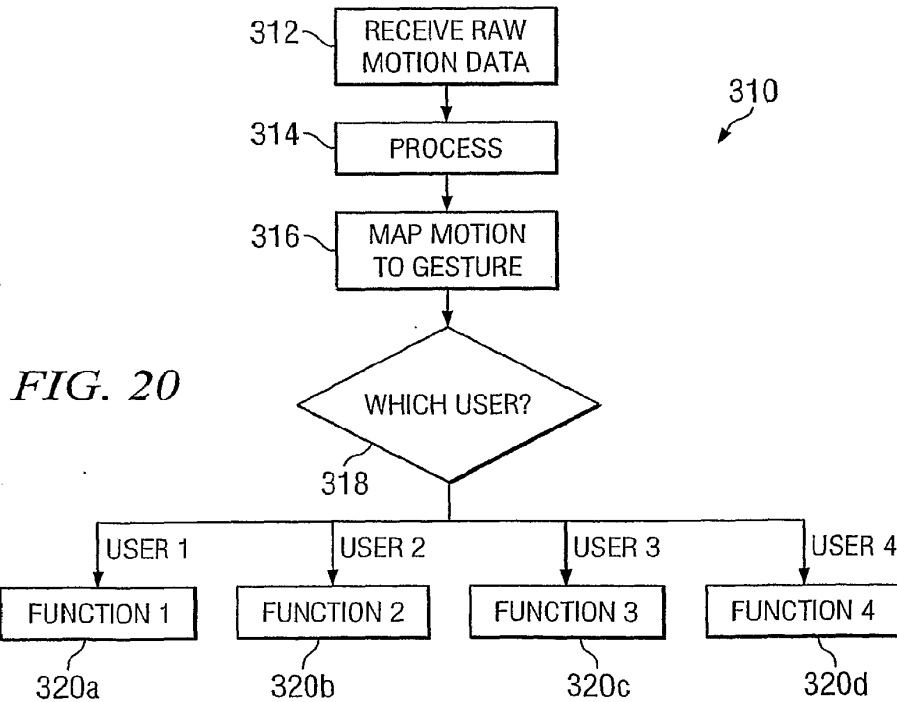
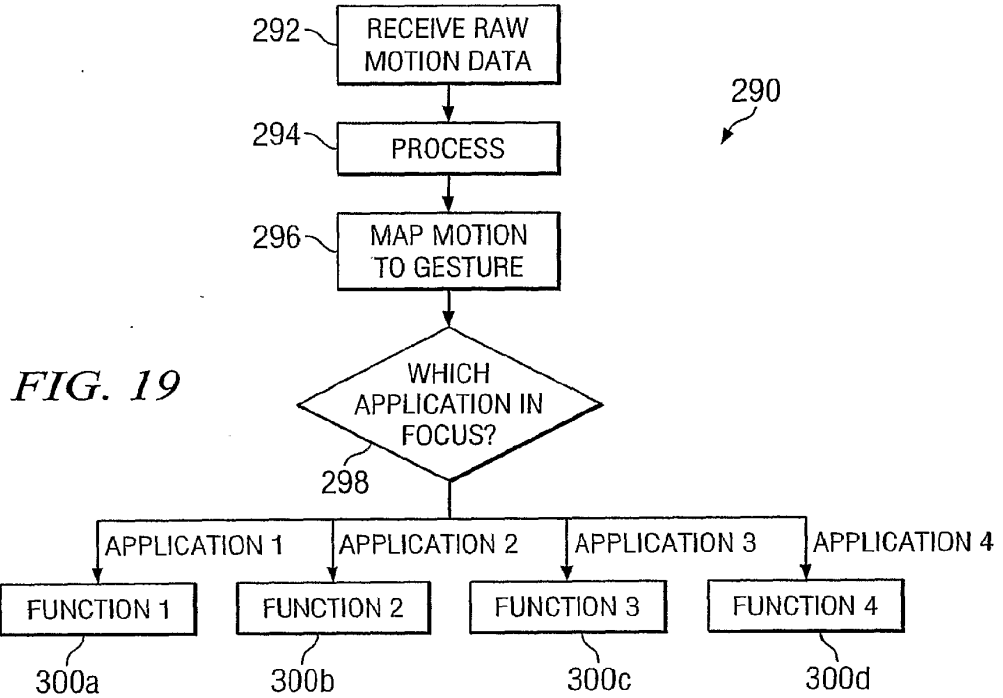


FIG. 21

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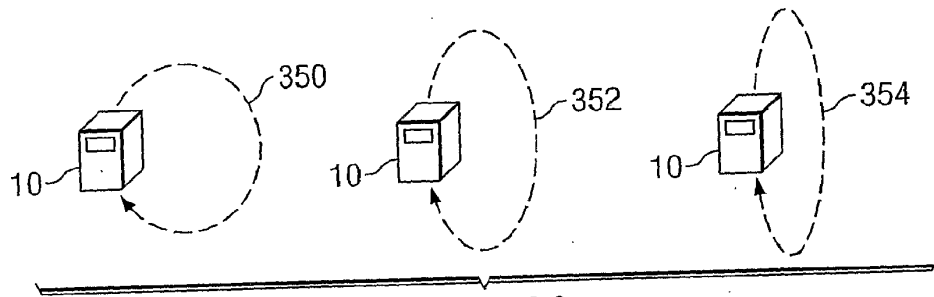


FIG. 22

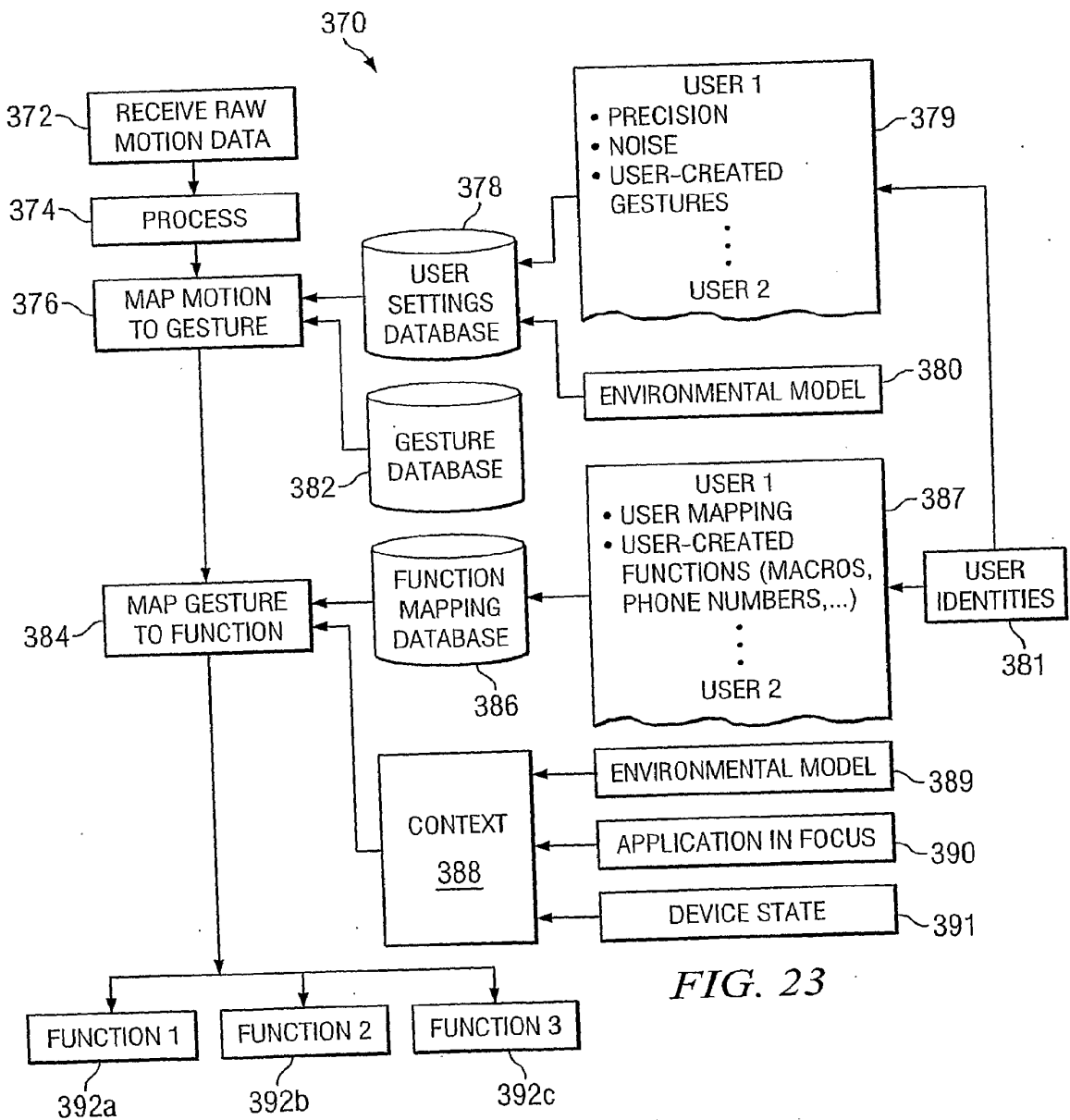


FIG. 23

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- (72) Inventors; and
(75) Inventors/Applicants (for US only): **REPONEN, Erika** [FI/FI]; Tampellan Esplanadi 6 D 15, FIN-33100 Tampere (FI). **KAUKO, Jarmo** [FI/FI]; Tuomiokirkonkatu 20 B 69, FIN-33100 Tampere (FI). **RONKAINEN, Sami** [FI/FI]; Parkkisenranta 2 as 6, FIN-90650 (FI). **HÄKKILÄ, Jonna** [FI/FI]; Utelantie 2, FIN-90450 Kempele (FI).
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(54) Title: METHOD AND MOBILE TERMINAL WITH USER INPUT BASED ON MOVEMENT OF THE TERMINAL DETECTED BY A SENSOR

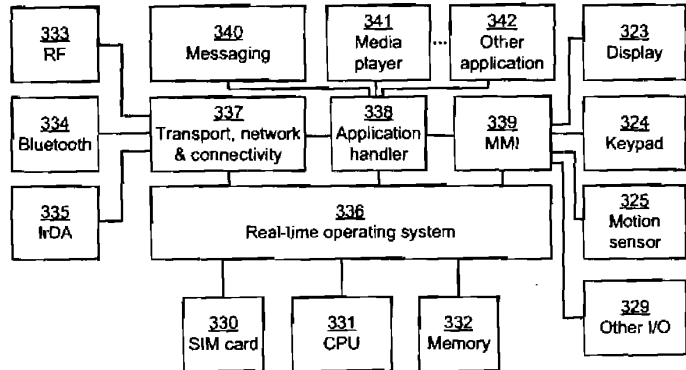


Fig 3

(57) Abstract: It is presented a method for a portable apparatus (200) comprising: detecting a movement of the portable apparatus, and determining that the movement is associated with a user input for retrieving a value of a status of the portable apparatus; determining a value of the status; and presenting the value to the user. The status can for example be battery level, signal strength, available memory, number of unread messages, etc. Corresponding portable apparatuses and computer program product are also presented.

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WO 2008/132540 A1

METHOD AND MOBILE TERMINAL WITH USER INPUT BASED ON MOVEMENT OF THE TERMINAL DETECTED BY A SENSOR

Field of the Invention

The present invention generally relates to portable apparatuses and more particularly to providing statuses of portable apparatus.

5 Background of the Invention

Mobile terminals, or mobile (cellular) telephones, for mobile telecommunications systems like GSM, UMTS, D-AMPS and CDMA2000 have been used for many years now. In the older days, mobile terminals were used almost exclusively for voice communication with other mobile terminals or stationary telephones. More recently, the use of modern terminals has
10 been broadened to include not just voice communication, but also various other services and applications such as www/wap browsing, video telephony, electronic messaging (e.g. SMS, MMS, email, instant messaging), digital image or video recording, FM radio, music playback, electronic games,
15 calendar/organizer/time planner, word processing, etc.

Being portable, there are a number of statuses of modern mobile terminals that vary over time. Such statuses can for example be battery level, mobile network signal strength, wireless local area network signal strength, available memory, number of unread messages etc.

20 One way to solve this is to always present on the display the most important statuses, such as the battery level and mobile network signal strength. However, this is not always available, for example when a screen saver has been activated, not is it particularly exciting or fun for the user.

25 Consequently, there is a need to provide an improved way of presenting statuses of the mobile terminal to the user.

Summary

In view of the above, an objective of the invention is to solve or at least reduce the problems discussed above.

30 Generally, the above objectives are achieved by the attached independent patent claims.

According to a first aspect of the present invention there has been provided a method for a portable apparatus comprising: detecting a movement of the portable apparatus, and determining that the movement is associated with a user input for retrieving a value of a status of the portable

apparatus; determining a value of the status; and presenting the value to the user. This allows the user to, simply by moving the portable apparatus according to a user input movement, effect the portable apparatus to present the desired status. There is therefore no need to touch the keypad, allowing
5 the user to get information about the status in situations where key presses may be difficult, such as when the user is wearing gloves, etc.

In the presenting, a plurality of indicators may be presented on a display of the portable apparatus, and the appearance of the plurality of indicators may indicate the value.

10 The presenting may comprise presentation of moving particles.

Icons may be displayed on the display and the presenting may comprise presentation of a subset of the particles proximate one of the icons and presented with an appearance representing a status of an application related to the icon. This allows for intuitive identification of the application
15 area indicated by the indicators.

In the presenting, the movement of the particles may be affected by the orientation of the portable apparatus. For example, the particles can appear to be affected by gravity this way.

In the presenting, the movement of the particles may be affected by a
20 time elapsed since a last detected movement of the portable apparatus and by an intensity of the last detected movement of the portable apparatus. In other words, effects initiated by movement can for example fade over time. Also, effects could be stronger if the last detected movement is stronger.

In the presenting, the value may be indicated by a characteristic of at
25 least some of the indicators, the characteristic selected from the group consisting of color, size, shape, movement behavior or any combination of these characteristics.

In the presenting, the number of indicators may be associated with the value. In other words, many indicators indicate a high value and fewer
30 indicators indicate a low value, or vice versa.

The indicators may be indicators selected from the group consisting of snowflakes, shining stardust, pearls, jewels, dust, flies, butterflies or any combination of these indicators.

In the detecting a movement, the user input may be associated with a
35 user input for retrieving values of a plurality of statuses of the portable apparatus; in the determining, values may be determined for all of the plurality of statuses; and in the presenting, the values may be presented to the user.

In other words, the value of several different statuses may efficiently be presented to the user simultaneously.

In the presenting, vibration pulses may be generated, the vibration pulses indicating the value.

5 The presenting may comprise generating vibration pulses at specific intervals, the duration of the intervals being indicative of the value.

The presenting may comprise generating vibration pulses with a specific duration, the duration being indicative of the value.

10 In the presenting, audio effects may be generated, the audio effects indicating the value.

The presenting may comprise generating audio effects at specific intervals, the duration of the intervals being indicative of the value.

The presenting may comprise generating audio effects with a specific duration, the duration being indicative of the value.

15 In the presenting, the audio effect may differ for different statuses.

In the detecting a movement, other movements of the portable apparatus may be associated with other user inputs, and each of these other user inputs may be used for retrieving other statuses of the portable apparatus.

20 The status may be a status selected from the group consisting of battery level, available memory, reception level for a mobile communication network, reception level for a wireless local area network, number of unread messages and number of missed calls.

25 A second aspect of the present invention is a portable apparatus comprising: a controller; a motion sensor capable of detecting a movement of the apparatus, wherein the controller is configured to determine if the movement is associated with a user input for retrieving a value of a status of the apparatus; and the controller is further configured to, when it is determined that the movement is associated with the user input, determine a value of the status and present the value to the user, as a response to the user input.

The portable apparatus may be an apparatus selected from the group consisting of a mobile communication terminal, a digital music player a pocket computer and a digital camera.

35 A third aspect of the present invention is a portable apparatus comprising: means for detecting a movement of the portable apparatus, and determining that the movement is associated with a user input for retrieving a

value of a status of the portable apparatus; means for determining a value of the status; and means for presenting the value to the user.

5 A fourth aspect of the present invention is a computer program product comprising software instructions that, when executed in a portable apparatus, performs the method according to the first aspect.

A fifth aspect of the present invention is a user interface comprising: a movement detector, and an output device, wherein the user interface is arranged to: detect a movement of the portable apparatus, and determine that the movement is associated with a user input for retrieving a value of a status
10 of the portable apparatus; and presenting a value of the status to the user.

Other objectives, features and advantages of the present invention will appear from the following detailed disclosure, from the attached dependent claims as well as from the drawings.

15 Generally, all terms used in the claims are to be interpreted according to their ordinary meaning in the technical field, unless explicitly defined otherwise herein. All references to "a/an/the [element, device, component, means, step, etc]" are to be interpreted openly as referring to at least one instance of the element, device, component, means, step, etc., unless explicitly stated otherwise. The steps of any method disclosed herein do not have to be
20 performed in the exact order disclosed, unless explicitly stated.

Brief Description of the Drawings

Embodiments of the present invention will now be described in more detail, reference being made to the enclosed drawings, in which:

25 Fig 1 is a schematic illustration of a cellular telecommunication system, as an example of an environment in which the present invention may be applied.

Fig 2 is a schematic front view illustrating a mobile terminal according to an embodiment of the present invention.

30 Fig 3 is a schematic block diagram representing an internal component, software and protocol structure of the mobile terminal shown in Fig 2.

Fig 4 is a flow chart illustrating a method for status check performed in the mobile terminal of Fig 2.

35 Figs 5a-d are schematic display views illustrating one embodiment of the mobile terminal of Fig 2.

Figs 6a-b are schematic diagrams illustrating how tactile and/or audio feedback can be generated in an embodiment of the mobile terminal of Fig 2.

Figs 7a-b are graphs illustrating how different statuses can be represented in tactile and/or audio signals in the mobile terminal of Fig 2.

5

Detailed Description of Embodiments

The present invention will now be described more fully hereinafter with reference to the accompanying drawings, in which certain embodiments of the invention are shown. This invention may, however, be embodied in many different forms and should not be construed as limited to the embodiments set forth herein; rather, these embodiments are provided by way of example so that this disclosure will be thorough and complete, and will fully convey the scope of the invention to those skilled in the art. Like numbers refer to like elements throughout.

10 Fig 1 illustrates an example of a cellular telecommunications system in which the invention may be applied. In the telecommunication system of Fig 1, various telecommunications services such as cellular voice calls, www/wap browsing, cellular video calls, data calls, facsimile transmissions, music transmissions, still image transmissions, video transmissions, electro-
20 nic message transmissions and electronic commerce may be performed between a mobile terminal 100 according to the present invention and other devices, such as another mobile terminal 106 or a stationary telephone 119. It is to be noted that for different embodiments of the mobile terminal 100 and in different situations, different ones of the telecommunications services referred
25 to above may or may not be available; the invention is not limited to any particular set of services in this respect.

The mobile terminals 100, 106 are connected to a mobile telecommunications network 110 through RF links 102, 108 via base stations 104, 109. The mobile telecommunications network 110 may be in compliance
30 with any commercially available mobile telecommunications standard, such as GSM, UMTS, D-AMPS, CDMA2000, FOMA and TD-SCDMA.

The mobile telecommunications network 110 is operatively connected to a wide area network 112, which may be Internet or a part thereof. An Internet server 115 has a data storage 114 and is connected to the wide area
35 network 112, as is an Internet client computer 116. The server 115 may host a www/wap server capable of serving www/wap content to the mobile terminal 100.

A public switched telephone network (PSTN) 118 is connected to the mobile telecommunications network 110 in a familiar manner. Various telephone terminals, including the stationary telephone 119, are connected to the PSTN 118.

5 The mobile terminal 100 is also capable of communicating locally via a local link 101 to one or more local devices 103. The local link can be any type of link with a limited range, such as Bluetooth, a Universal Serial Bus (USB) link, a Wireless Universal Serial Bus (WUSB) link, an IEEE 802.11 wireless local area network link, an RS-232 serial link, etc.

10 An embodiment 200 of the mobile terminal 100 is illustrated in more detail in Fig 2. The mobile terminal 200 comprises a speaker or earphone 222, a microphone 225, a display 223 and a set of keys 224 which may include a keypad 224a of common ITU-T type (alpha-numerical keypad representing characters "0"- "9", "*" and "#") and certain other keys such as
15 soft keys 224b, 224c and a joystick 226 or other type of navigational input device.

The internal component, software and protocol structure of the mobile terminal 200 will now be described with reference to Fig 3. The mobile terminal has a controller 331 which is responsible for the overall operation of
20 the mobile terminal and is preferably implemented by any commercially available CPU ("Central Processing Unit"), DSP ("Digital Signal Processor") or any other electronic programmable logic device. The controller 331 has associated electronic memory 332 such as RAM memory, ROM memory, EEPROM memory, flash memory, or any combination thereof. The memory
25 332 is used for various purposes by the controller 331, one of them being for storing data and program instructions for various software in the mobile terminal. The software includes a real-time operating system 336, drivers for a man-machine interface (MMI) 339, an application handler 338 as well as various applications. The applications can include a messaging application
30 340 for sending and receiving SMS, MMS or email, a media player application 341, as well as various other applications 342, such as applications for voice calling, video calling, web browsing, an instant messaging application, a phone book application, a calendar application, a control panel application, a camera application, one or more video games, a notepad application, etc.

35 The MMI 339 also includes one or more hardware controllers, which together with the MMI drivers cooperate with the display 323/223, keypad 324/224, motion sensor 325, such as an accelerometer, as well as various

other I/O devices 329 such as microphone, speaker, vibrator, ringtone generator, LED indicator, etc. As is commonly known, the user may operate the mobile terminal through the man-machine interface thus formed.

5 The software also includes various modules, protocol stacks, drivers, etc., which are commonly designated as 337 and which provide communication services (such as transport, network and connectivity) for an RF interface 333, and optionally a Bluetooth interface 334 and/or an IrDA interface 335 for local connectivity. The RF interface 333 comprises an internal or external antenna as well as appropriate radio circuitry for establishing and maintaining a wireless link to a base station (e.g. the link 102 and base station 104 in Fig 1). As is well known to a man skilled in the art, the radio circuitry comprises a series of analogue and digital electronic components, together forming a radio receiver and transmitter. These components include, i.a., band pass filters, amplifiers, mixers, local oscillators, low pass filters, AD/DA converters, etc.

15 The mobile terminal also has a SIM card 330 and an associated reader. As is commonly known, the SIM card 330 comprises a processor as well as local work and data memory.

20 Fig 4 is a flow chart illustrating a method for status check performed in the mobile terminal of Fig 2.

In a detect motion as user input to for status check step 450, it is detected that the user has moved the mobile terminal in a particular way. This can for example be a shake of the mobile terminal, a tap on the screen, a double tap on the screen, a circular motion of the apparatus, etc. As a person skilled in the art will realize, there is a large number of ways the mobile terminal can be moved to indicate that a status check is desired. The motion is detected by the motion sensor 325 (Fig 3). One motion can be used to check several statuses. Optionally, different movements can be used to check different statuses. Typical statuses that can be checked can be battery status, reception strength for mobile network, reception strength for wireless local area network, number of new messages, number or missed calls, etc.

30 In a determine value of status(es) step 452, the one or several statuses associated with the detected motion are determined. This information is typically available in the mobile terminal and is readily retrieved.

35 In a present value to user step 454, the status or statuses are presented to the user. As will described in more detail below, this

presentation can be visual on the display 223/323, audio, tactile, or any combination of these.

Figs 5a-d are schematic display views 560 illustrating one embodiment of the method of Fig 4. The display views are shown on the display 223/323.

5 Fig 5a shows a display view 560 before the status check has been initiated. As is customary, there are a number of icons 561 representing different applications or functions of the mobile terminal. Additionally, there is a separate reception level indicator 562 and a battery level indicator 563.

10 Fig 5b shows the display view 560 after the status check has been initiated. A large number of particles 564 are then shown on the display. The particles can be any designed as any visual particle; some examples are: snowflakes, shining stardust, pearls, jewels, dust, flies, and butterflies. The particles may vibrate or change color in their default behavior. Optionally, the particles fall to the bottom of the screen, or if there is a positional detector in
15 the mobile terminal, the particles may fall towards the ground, based on a signal from the positional detector.

Fig 5c shows the display view 560 when a status of an application is presented. The application represented by the icon 565 here has a status that is presented to the user. For example, the icon 565 may be an icon for the
20 messaging application and there are unread messages in the inbox. This status is indicated by particles 566 in the proximity of the messaging icon 565 being larger than the other particles 564. Optionally, if particles move around the screen, the particles grow bigger as they approach the messaging icon. The particles can change any other characteristic to indicate a status of an
25 icon or other user interface element. For example, the particles can change color, shape, movement speed, movement behavior, etc. As an example of movement behavior, the particles could fall into orbit around an icon when they are in proximity to indicate a particular status.

Fig 5d shows the display view 560 when a general status of the mobile
30 terminal is presented. In this example, the battery level is low, which can be seen on the battery indicator 568. Additionally, particles 567 in the proximity of the battery indicator grow larger.

It is to be noted that several statuses could be indicated at any one time. Fig 5e shows the display view 560 when a low battery level is indicated
35 with particles 567. Additionally, particles 566 in the proximity of the messaging icon 565 indicate that there are unread messages in the inbox. In one embodiment the particles 567 indicating low battery have one color, e.g.

red, and the particles 566 indicating a new message have another color, e.g. green.

The particles illustrated above could be generated through particle functionality of a graphics interface, e.g. a 3D graphics interface of the mobile terminal.

In one embodiment, some of the user interface elements affect the behavior of the particles, even if the state related to the user interface element is a normal state.

In one embodiment, the particles are snow flakes and are affected by gravity (virtual or real) as discussed above, and the particles are activated by shaking the mobile terminal. The combined effect of this is similar to a snow globe, where little snow flakes inside are agitated when shaken and slowly fall to the bottom of the snow globe.

Figs 6a-b are schematic diagrams illustrating how tactile and/or audio feedback can be generated in an embodiment of the method of Fig 4.

In Fig 6a, a ball 670 is shown within a confined space 672. This has a certain velocity and direction and will bounce 671 on the wall and continue until it bounces again etc. It is possible to generate a sound effect and/or a vibration corresponding to the times when the ball 670 bounces on the wall, optionally without showing this situation graphically on a display.

In Fig 6b, a relatively large number of balls 670 are present within the confined space 672, generating more bounces 671 per unit of time. Again, these bounces 671 can be represented with sound and/or vibration effects. The user will thus get a sensation that something is more full, compared to the situation in Fig 6a.

The situation illustrated by Figs 6a-b can thus be used to convey information to the user about the status of one or more applications. Optionally, several statuses can be multiplexed using different vibration patterns and/or sound effects for the different statuses, as is explained below.

Figs 7a-b are graphs illustrating how different statuses can be represented in tactile and/or audio signals. The horizontal axis represents time and the vertical axis represents vibration and/or audio signal level.

In Fig 7a, a first status is represented by pulses 782 and 783. The interval 786 between the pulses 782 and 783 is an indicator of the first status. Note the profile of the pulses 782 and 783, where each pulse consists of four equidistant vibrations/sounds of equal length.

In Fig 7b, a second status is represented by pulses 784 and 785, where the interval 787 between the pulses 784 and 785 indicate the value of the second status. Here the profile of the pulses 784 and 785 are different from the pulses 782 and 783 for the first status. As can be seen in the graph, the vibrations/sounds first increase and then decrease in length.

Consequently, the pulses 782 and 783 for the first status and the pulses 784 and 785 for the second status can be multiplexed, whereby the user still can sense the values of the individual statuses. If the pulses are kept sufficiently short and distinct, three or more statuses can be multiplexed. As can be readily understood by a person skilled in the art, many other pulse profiles than those shown here can be used without departing from the scope of the appended claims.

The tactile feedback can be created with vibration motor. Alternatively, a piezoelectric actuator can be used, whereby more control over different sensations is achieved, resulting in possibly even more different statuses which could be presented simultaneously.

Although the invention has above been described using an embodiment in a mobile terminal, the invention is applicable to any type portable apparatus, including portable mp3-players, cameras, pocket computers etc.

The invention has mainly been described above with reference to a few embodiments. However, as is readily appreciated by a person skilled in the art, other embodiments than the ones disclosed above are equally possible within the scope of the invention, as defined by the appended patent claims.

25

CLAIMS

1. A method for a portable apparatus comprising:
detecting a movement of said portable apparatus, and determining that
5 said movement is associated with a user input for retrieving a value of a
status of said portable apparatus;
determining a value of said status; and
presenting said value to said user.
- 10 2. The method according to claim 1, wherein in said presenting, a
plurality of indicators are presented on a display of said portable apparatus,
and the appearance of said plurality of indicators indicates said value.
3. The method according to claim 2, wherein said presenting
15 comprises presentation of moving particles.
4. The method according to claim 3, wherein icons are displayed on
said display and said presenting comprises presentation of a subset of said
particles proximate one of said icons and presented with an appearance
20 representing a status of an application related to said icon.
5. The method according to claim 3, wherein in said presenting, the
movement of said particles are affected by the orientation of said portable
apparatus.
25
6. The method according to claim 3, wherein in said presenting, the
movement of said particles are affected by a time elapsed since a last
detected movement of said portable apparatus and by an intensity of said last
detected movement of said portable apparatus.
30
7. The method according to claim 2, wherein in said presenting, said
value is indicated by a characteristic of at least some of said indicators, said
characteristic selected from the group consisting of color, size, shape,
movement behavior or any combination of these characteristics.
35
8. The method according to claim 2, wherein in said presenting, the
number of indicators are associated with said value.

- 5 9. The method according to claim 2, wherein said indicators are indicators selected from the group consisting of snowflakes, shining stardust, pearls, jewels, dust, flies, butterflies or any combination of these indicators.
- 10 10. The method according to claim 1, wherein
in said detecting a movement, said user input is associated with a user input for retrieving values of a plurality of statuses of said portable apparatus;
in said determining, values are determined for all of said plurality of statuses; and
in said presenting, said values are presented to said user.
- 15 11. The method according to claim 10, wherein in said presenting, vibration pulses are generated, said vibration pulses indicating said value.
- 20 12. The method according to claim 11, wherein said presenting comprises generating vibration pulses at specific intervals, the duration of said intervals being indicative of said value.
- 25 13. The method according to claim 11, wherein said presenting comprises generating vibration pulses with a specific duration, said duration being indicative of said value.
- 30 14. The method according to claim 10, wherein in said presenting, audio effects are generated, said audio effects indicating said value.
- 35 15. The method according to claim 14, wherein said presenting comprises generating audio effects at specific intervals, the duration of said intervals being indicative of said value.
16. The method according to claim 14, wherein said presenting comprises generating audio effects with a specific duration, said duration being indicative of said value.
17. The method according to claim 14, wherein in said presenting, said audio effect differs for different statuses.

18. The method according to claim 10, wherein in said detecting a movement, other movements of said portable apparatus are associated with other user inputs, and each of these other user inputs are used for retrieving other statuses of said portable apparatus.

5

19. The method according to claim 10, wherein said status is a status selected from the group consisting of battery level, available memory, reception level for a mobile communication network, reception level for a wireless local area network, number of unread messages and number of missed calls.

10

20. A portable apparatus comprising:

a controller;

a motion sensor capable of detecting a movement of said apparatus,

15

wherein said controller is configured to determine if said movement is associated with a user input for retrieving a value of a status of said apparatus; and

said controller is further configured to, when it is determined that said movement is associated with said user input, determine a value of said status and present said value to said user, as a response to said user input.

20

21. The portable apparatus according to claim 20, wherein

said controller is further configured to present a plurality of indicators

on a display of said portable apparatus, and the appearance of said plurality of indicators indicates said value.

25

22. The portable apparatus according to claim 20, wherein:

said user input is associated with a user input for retrieving values of a plurality of statuses of said portable apparatus;

30

said controller is configured to determine values for all of said plurality of statuses and present said values said user.

23. The portable apparatus according to claim 20, wherein said

portable apparatus is an apparatus selected from the group consisting of a mobile communication terminal, a digital music player a pocket computer and a digital camera.

35

14

24. A portable apparatus comprising:
means for detecting a movement of said portable apparatus, and
determining that said movement is associated with a user input for retrieving
a value of a status of said portable apparatus;

5 means for determining a value of said status; and
 means for presenting said value to said user.

25. A computer program product comprising software instructions that,
when executed in a portable apparatus, performs the method according to
10 any one of claims 1 to 19.

26. A user interface comprising:
a movement detector, and
an output device,
15 wherein said user interface is arranged to:
detect a movement of said portable apparatus, and determine that said
movement is associated with a user input for retrieving a value of a status of
said portable apparatus; and
presenting a value of said status to said user.
20

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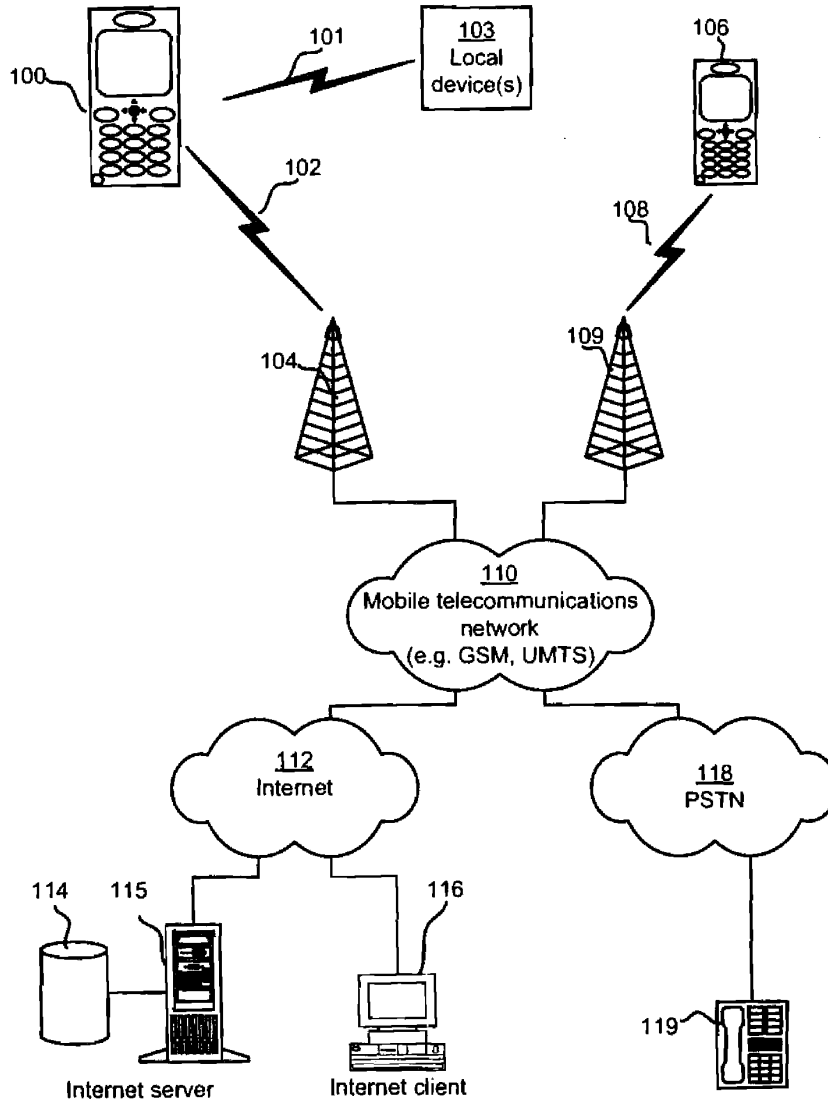


Fig 1

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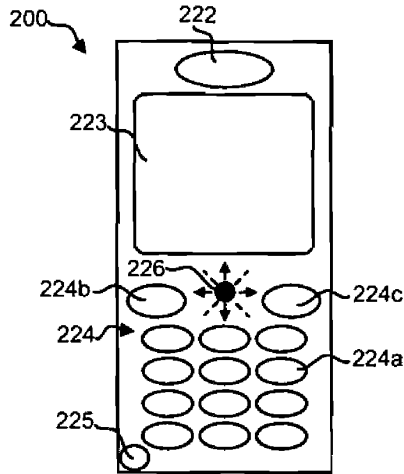


Fig 2

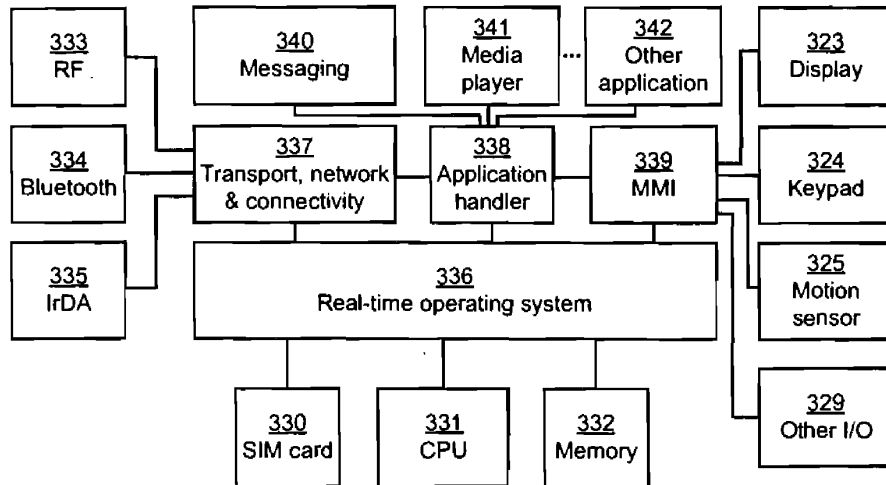


Fig 3

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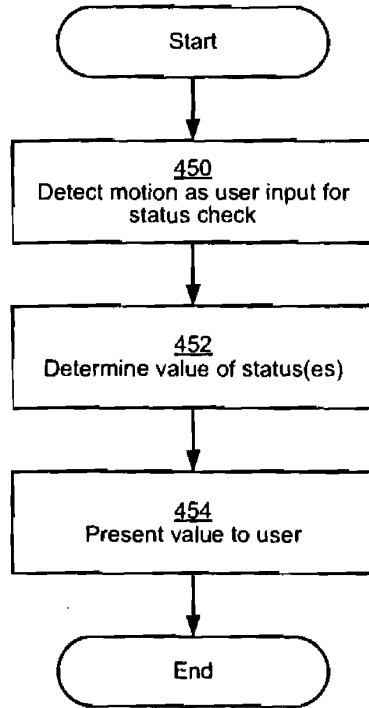


Fig 4

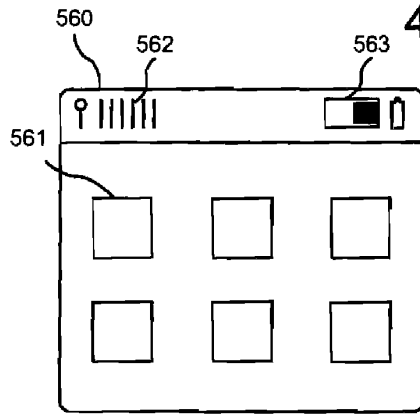


fig 5a

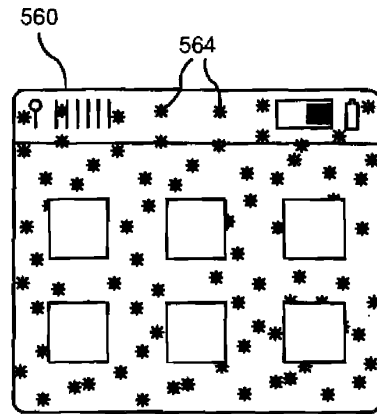


fig 5b

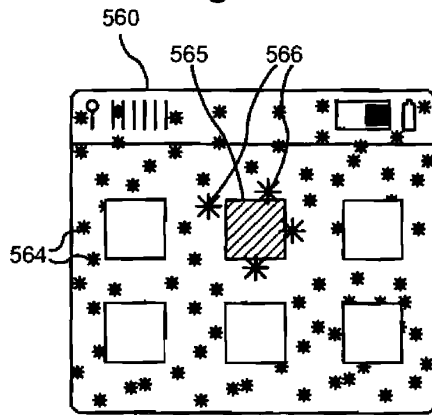


fig 5c

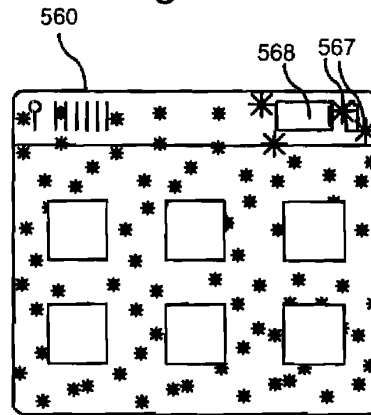


fig 5d

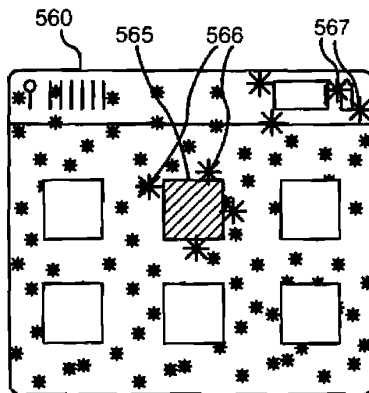


fig 5e

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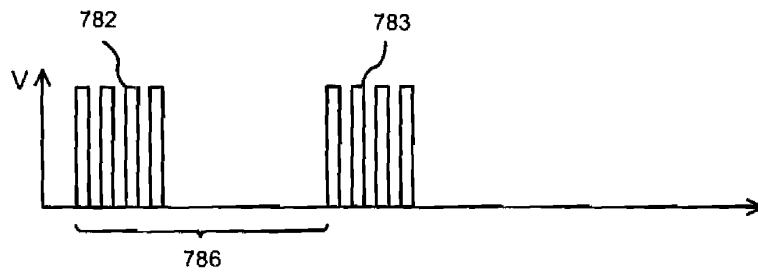
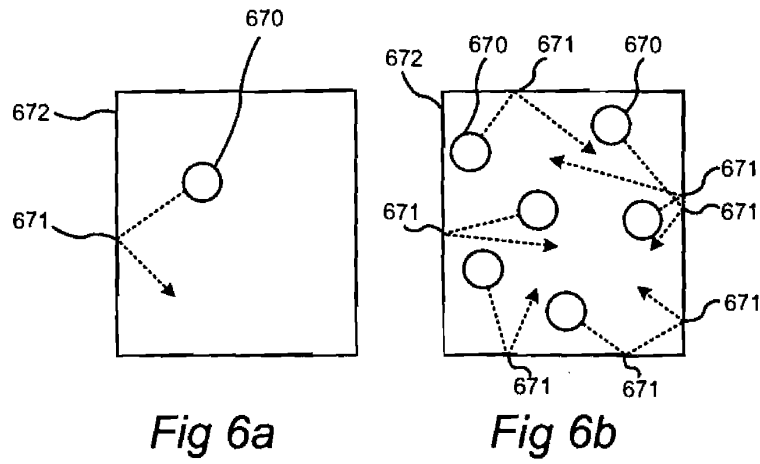


Fig 7a

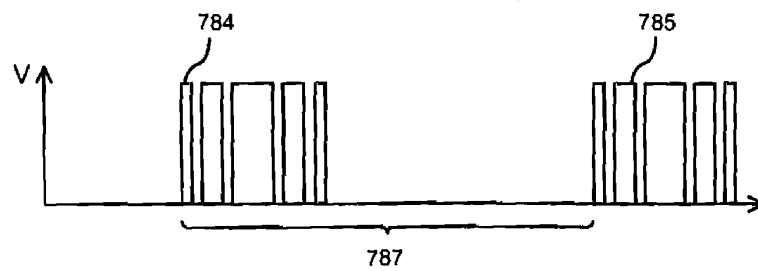


Fig 7b

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INTERNATIONAL SEARCH REPORT

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A. CLASSIFICATION OF SUBJECT MATTER INV. G06F1/16 HO4M1/725		
According to International Patent Classification (IPC) or to both national classification and IPC		
B. FIELDS SEARCHED Minimum documentation searched (classification system followed by classification symbols) HO4M G06F		
Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched		
Electronic data base consulted during the international search (name of data base and, where practical, search terms used) EPO-Internal		
C. DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	MOTOROLA: "HELLOMOTO - Manual of Motorola C139 wireless phone" MOTOROLA, [Online] 2005, pages 1-72, XPO02465839 Retrieved from the Internet: URL: http://www.motorola.com/Hellomoto/Master%20Lists/Product%20Manuals/Static%20Files/GB-EN/30294_1026_ENG.pdf [retrieved on 2008-01-22] page 22 pages 32,33 page 39 page 42 page 55	1-26
<p align="center">----- -/--</p>		
<input checked="" type="checkbox"/> Further documents are listed in the continuation of Box C. <input checked="" type="checkbox"/> See patent family annex.		
* Special categories of cited documents :		
A document defining the general state of the art which is not considered to be of particular relevance *E* earlier document but published on or after the international filing date *L* document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified) *O* document referring to an oral disclosure, use, exhibition or other means *P* document published prior to the international filing date but later than the priority date claimed *T* later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention *X* document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone *Y* document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art. *Z* document member of the same patent family		
Date of the actual completion of the international search: 23 January 2008		Date of mailing of the international search report: 11/02/2008
Name and mailing address of the ISA/ European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Tx. 31 651 epo nl, Fax: (+31-70) 340-3016		Authorized officer: Möll, Hans-Peter

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PCT/IB2007/001962

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
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Information on patent family members

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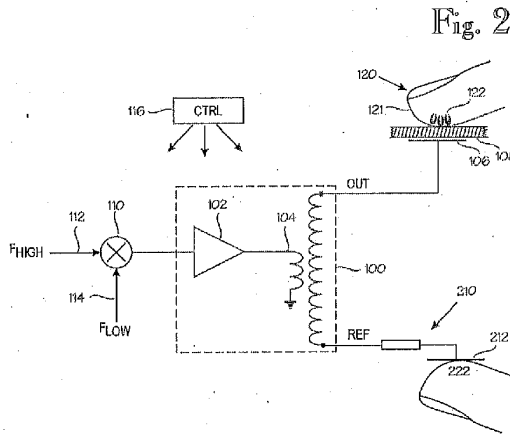
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- (71) Applicant (for all designated States except US): SENSEG OY [FI/FI]; Tekniikantie 21, FI-02150 Espoo (FI).
- (72) Inventors; and
- (75) Inventors/Applicants (for US only): MÄKINEN, Ville [FI/FI]; Metsänvartijantie 3 F, FI-02720 Espoo (FI). SU-VANTO, Petro [FI/FI]; Keilakuja 2 C 32, FI-01280 Vantaa (FI). LINJAMA, Jukka [FI/FI]; Tuurinniitynkujja 9, FI-02200 Espoo (FI).
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[Continued on next page]

(54) Title: METHOD AND APPARATUS FOR SENSORY STIMULATION



(57) Abstract: An apparatus for producing an electrosensory sensation to a body member (120). The apparatus comprises one or more conducting electrodes (106), each of which is provided with an insulator (108). When the body member (120) is proximate to the conducting electrode, the insulator prevents flow of direct current from the conducting electrode to the body member. A capacitive coupling over the insulator (108) is formed between the conducting electrode (106) and the body member (120). The conducting electrodes are driven by an electrical input which comprises a low-frequency component (114) in a frequency range between 10 Hz and 500 Hz. The capacitive coupling and electrical input are dimensioned to produce an electrosensory sensation. The apparatus is capable of producing the electrosensory sensation independently of any mechanical vibration of the one or more conducting electrodes (106) or insulators (108).

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Method and apparatus for sensory stimulation

Background of the invention

[0001] The present invention relates to an apparatus and method for sensory stimulation. The invention is particularly applicable for stimulating the sense of touch.

[0002] Manual input devices, such as joysticks and mice, are frequently complemented by means for providing tactile sensations such that the manual input devices provide tactile feedback to their users. There are hundreds of US patents for tactile feedback devices. In most or all of the prior art devices the tactile stimulation is generated by means of moving or vibrating mechanical members. A problem shared by most such devices is that such moving mechanical members tend to be bulky, unreliable and/or difficult to control.

Brief description of the invention

[0003] An object of the present invention is to provide a method and apparatus for alleviating at least one of the problems identified above.

[0004] The object of the invention is achieved by features which are disclosed in the attached independent claims. The dependent claims and the present patent specification disclosed additional specific embodiments and non-essential features of the invention.

[0005] The invention is based on the surprising discovery that subcutaneous Pacinian corpuscles can be stimulated by means of a capacitive electrical coupling and an appropriately dimensioned control voltage, either without any mechanical stimulation of the Pacinian corpuscles or as an additional stimulation separate from such mechanical stimulation. An appropriately dimensioned high voltage is used as the control voltage. In the present context a high voltage means such a voltage that direct galvanic contact must be prevented for reasons of safety and/or user comfort. This results in a capacitive coupling between the Pacinian corpuscles and the apparatus causing the stimulation, wherein one side of the capacitive coupling is formed by at least one galvanically isolated electrode connected to the stimulating apparatus, while the other side, in close proximity to the electrode, is formed by the body member, preferably a finger, of the stimulation target, such as the user of the apparatus, and more specifically the subcutaneous Pacinian corpuscles.

[0006] Without committing themselves to any particular theory, the inventors find it likely that the invention is based on a controlled formation of an electric

field between an active surface of the apparatus and the body member, such as a finger, approaching or touching it. The electric field tends to give rise to an opposite charge on the proximate finger. A local electric field and a capacitive coupling can be formed between the charges. The electric field directs a force on the charge of the finger tissue. By appropriately altering the electric field a force capable of moving the tissue may arise, whereby the sensory receptors sense such movement as vibration.

[0007] A benefit of the invention is independence from mechanical vibration and its associated problems in the prior art.

[0008] An aspect of the invention is an apparatus for generating an electro-sensory stimulus to at least one body member. The apparatus comprises one or more conducting electrodes each of which is provided with an insulator. When the body member is proximate to the conducting electrode, the insulator prevents flow of direct current from the conducting electrode to the body member. A capacitive coupling over the insulator is formed between the conducting electrode and the body member. The apparatus also comprises a high-voltage source for applying an electrical input to the one or more conducting electrodes, wherein the electrical input comprises a low-frequency component in a frequency range between 10 Hz and 1000 Hz. The capacitive coupling and electrical input are dimensioned to produce an electro-sensory sensation which is produced independently of any mechanical vibration of the one or more conducting electrodes or insulators.

[0009] Another aspect of the invention is a method for causing an electrosensory sensation to a body member. The method comprises providing one or more conducting electrodes. Each conducting electrode is provided with an insulator wherein, when the body member is proximate to the conducting electrode, the insulator prevents flow of direct current from the conducting electrode to the body member. A capacitive coupling over the insulator is formed between the conducting electrode and the body member. A high-voltage source is provided for applying an electrical input to the one or more conducting electrodes. The electrical input comprises a low-frequency component in a frequency range between 10 Hz and 1000 Hz, while the capacitive coupling and electrical input are dimensioned to produce an electrosensory sensation. The electrosensory sensation is produced independently of any mechanical vibration of the one or more conducting electrode(s) or insulator(s).

[0010] It is beneficial to vary the capacitive coupling such that the variation comprises one or more frequency components in a range wherein the Pacinian corpuscles exhibit their maximal sensitivity. This frequency range is roughly 10 to 1000 Hz and in most humans 100 to 500 Hz. The capacitive coupling can be varied by varying the control voltage and/or parameters of the capacitive coupling.

[0011] By way of example, the high-voltage charge applied to the electrode can have a voltage of at least 750, 1000, 1500 or 2000 V and at most 20, 50 or 100 kV (no-load measurements). In the present context, voltage values may refer to voltage in direct current or effective (RMS) voltages in alternating current. The high-voltage current applied may be direct current or alternating current. When alternating current is being used, the frequency of the current may be high, such as at least 1 kHz, 10 kHz, 20 kHz or 30 kHz and at most 100 kHz, 500 kHz tai 1 MHz, provided that the signal also exhibits a low-frequency component, for example such that high-frequency signal has an envelope whose frequency stimulates the desired sensory cells. The high-frequency alternating current can be modulated by means of a control signal having a low-frequency component, for example.

[0012] When high-voltage direct current is being used, the electrode may be embodied as a MEMS component (micro electromechanical system), which comprises a set of rotating, preferably individually controllable tiny electrodes. The strength of the capacitive coupling formed by the electrode can be adjusted by adjusting these tiny electrodes. In this case the strongest coupling is achieved when the tiny electrodes are oriented such that they collectively form a plane. In the inventive technique, by measuring the characteristics of the capacitive coupling, for example the capacitance of its variation, it may be possible to measure the distance of the body member from the surface of the apparatus, for example. Additionally, it may possible to detect separately the touching of the surface by the body member. The inventive technique may be further enhanced by power control functionality of the electric field being formed, for example. Utilization of some embodiments of the invention in the implementation of a proximity sensor may require a weaker electric field than what is required by causing the inventive sensory stimulus. Accordingly it may be beneficial to be able to vary the strength of the electric field depending on the currently needed functionality. Such variation may, for instance, involve strength-

ening the electric field such that a sense of touch or vibration is caused in the body member when it is brought sufficiently close to the electrode or insulator.

[0013] By way of example, the low-frequency component of the control signal being used in the inventive technique may be generated by modulating a high-
5 frequency alternating current. The modulation signal may be continuous or pulsed, for example. The duration of individual pulses may be 0.01, 0.5 or 4 ms and the pause between pulses can be at least 1, 10 or 100 ms.

[0014] The low-frequency component of the control signal may have a frequency of at least 10, 50 or 100 Hz and at most 300, 500 or 1000 Hz. In one
10 specific embodiment the control signal has an exemplary frequency of 120 Hz. In the inventive technique the alternating electric field, which causes the stimulus to be provided, may exhibit an intensity peak of at least 100 V/mm, 200 V/mm or 500 V/mm and at most 10 kV/mm, 30 kV/mm or 100 kV/mm. The field strength may be measured, for example, by means of a grounded electrode
15 with a surface area of eg 1 cm² positioned 0.05 to 5 mm, preferably about 1 mm from the surface of the insulated electrode.

[0015] By way of example, the electric field generated by the electrode can be controlled according to a processing logic being executed in a computer or
20 other electronic data processing apparatus. For example, the control logic can be used to control the variation frequency and/or intensity of the electric field generated by an individual electrode. Furthermore, the control logic can be used to pulse the varying electric field, for example. The control logic can also receive control information via a data network from a another apparatus, such as another computer or data processing apparatus.

[0016] An inventive apparatus for sensory stimulation comprises at least one
25 insulated electrode, wherein the apparatus is operable to apply a charge to the electrode such that the charge causes a stimulation of the Pacinian corpuscles. For humans this normally requires a voltage of at least 750 V. The apparatus further comprises means for varying the intensity of the charge-generated, capacitively-coupled electric field by utilizing a signal having a
30 component with a frequency of at least 10 Hz and at most 1000 Hz.

[0017] Some embodiments of the inventive apparatus can be implemented, when so desired, without mechanically moving parts, and such embodiments do not pose similar restrictions on the mechanical characteristics of the materials as do actuators based on mechanical movement of the surface. Accord-
35 ingly, some embodiments of the invention are applicable to a wide variety of

surfaces of different shapes. For instance, the surface shape of the electrode and/or insulator attached to it may be planar, rounded, spherical or concave. Likewise, the insulator material can be selected from a variety of materials having characteristics particularly suitable for the chosen application. As regards
5 mechanical characteristics, the surface material can be hard, soft, stiff, bending, transparent or flexible. The surface, as well as the material being used as the conductor, can also be transparent.

[0018] An individual electrode of the apparatus and/or the insulator attached to the electrode can have a surface area of 0.1, 1, 10 or 100 cm² or more. The
10 apparatus can comprise multiple insulated electrodes which can be arranged in an array forming an X-Y coordinate system. Each electrode of such a system can, when so desired, be controlled by a control logic according to some embodiments of the invention, for example. The electrodes can be fixedly mounted or movable.

[0019] The apparatus may comprise means for varying the variation frequency of the electric field, for example by modulating the high-voltage alternating current or by moving the electrodes of the MEMS device according to the control
15 signal.

[0020] The insulator to be arranged between the electrode of the apparatus and the body member can have a thickness of at least 0.01 mm, 0.05 mm, 0.1
20 mm or 0.5 mm and at most 10 mm, 20 mm or 50 mm. The insulator material can be selected according to the intended use and/or voltage to be used, for example.

[0021] In some embodiments the insulator comprises multiple layers. For instance, the inventors have discovered that the bulk of the insulator layer between the electrode and the body part approaching or touching it may comprise glass but glass is not optimal as the insulator's surface material. In the present context, optimal means an insulator material which best supports the creation of the electro-sensory sensation. A glass insulator works much better
25 if covered with a plastic film.

[0022] The inventive apparatus can be implemented such that its power consumption is low. For example, the power required to cause a sensory stimulus may be 1 mW, 5 mW or 10 mW or more. Power consumption can be measured on the basis of the electric power applied to the electrode when a human
30 touches the apparatus surface or when a capacitively grounded 50 pF capacitor is connected to the apparatus surface.

[0023] The apparatus may comprise means for measuring the capacitance of the capacitive coupling being formed. The apparatus may further comprise means for adjusting the characteristics of the electric field, such as intensity or variation frequency, based on the obtained measurement information.

5 [0024] The inventive apparatus for sensory stimulation can be integrated as a part of some other apparatus or system. For instance, a prior art touch display can be complemented by apparatuses according to some embodiments of the present invention. This way it is possible to provide a touch display which produces a sensation of touch even if the display is not physically touched. Control components of the feedback system can be combined, or they may be arranged to exchange information with one another. An advantageous embodiment of the presently disclosed method and apparatus is a control device based on touch or proximity, such as a touch display that produces a feedback which can be sensed via the sense of touch.

10 [0025] In some embodiments of the invention, the local charge/field can be controlled by means of capacitive grounding. In various embodiments of the invention, it is possible to take into account the fact that the dependence of the electric coupling on the insulated electrode, i.e., capacitance, depends on several factors. The capacitance value affects the potential difference between the finger and electrode if the apparatus or subject (such as human) is not grounded, and their ground potential is determined via stray capacitances. Prior art implementations ignore control and processing of the distribution of capacitances and voltages, and some embodiments of the present invention aim at alleviating this separate problem.

20 [0026] For example, the invention differs from prior art solutions in that no touching or mechanical movement or vibration is required to generate the stimulus. Accordingly, the invention provides advantages over solutions which are based on, say, stroking the finger over the electrodes and on locally varying friction caused by the electric field. Furthermore, the various embodiments of the invention support solutions which are based not only on alternating current but also on direct current. Yet further, the inventive solution can be provided with a functionality to detect proximity and touch, whereby the same component can be used for input and output functions. In addition, various embodiments of the invention may utilize thick insulators, for example, which are mechanically stronger than thin insulators. Moreover, it has been discovered in connection with several embodiments of the invention that it is benefi-

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cial to use particular variation frequencies for the electric field, as they will enable smaller energy consumption in the generation of the stimulus.

[0027] In one embodiment the electrical input also comprises a high-frequency component having a frequency which is higher than the frequency of the low-frequency component and lower than 500 kHz. This embodiment may also
5 comprise a modulator or other means for modulating the high-frequency component by the low-frequency component.

[0028] The electrical input to the one or more conducting electrodes has a peak-to-peak voltage of 750 to 100,000 Volts and the insulator should be dimensioned accordingly. In practical implementations with currently available
10 materials the insulator thickness is typically between 0.1 mm and 50 mm.

[0029] In order to convey time-variant information, as opposed to a steady-state sensation, the apparatus may comprise means for modulating the electrical input according to the time-variant information.

[0030] A simple but effective implementation of the invention comprises precisely one conducting electrode for each spatially distinct area of the body member. There may be more than one conducting electrode such that each conducting electrode stimulates a spatially distinct area of one or more body members. The apparatus may comprise an enclosure which contains the high-voltage source which is common to all the several conducting electrodes and wherein the enclosure also contains means for conveying the electrical input to zero or more of the several conducting electrodes simultaneously. The inventive apparatus and/or the one or more conducting electrodes may be positioned such that that the body member most likely to be affected is part of a
20 human hand. For example, five conducting electrodes under control of a common controller, may stimulate, at different times, zero to five fingertips in parallel. The five conducting electrodes thus convey five bits of information in parallel. The apparatus may be implemented as part of an input/output peripheral device connectable to a data processing equipment.

30 **Brief description of the drawings**

[0031] In the following the invention will be described in greater detail by means of specific embodiments with reference to the attached drawings, in which

Figure 1 illustrates the operating principle of a capacitive electro-sensory interface ("CEI");
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Figure 2 illustrates an embodiment of the CEI;

Figure 3 shows an enhanced embodiment with multiple independently-controllable electrodes;

Figure 4 shows a specific implementation of the embodiment shown in Figure 3;

5 Figure 5 is a graph which schematically illustrates the sensitivity of a test subject to sensations produced by the inventive capacitive electrosensory interface at various frequencies;

Figure 6 is a graph which further clarifies the operating principle of the CEI;

10 Figures 7A and 7B show an implementation of the CEI wherein the strength of the capacitive coupling is adjusted by electrode movement;

Figure 8 shows an implementation of the CEI wherein the charges of different electrodes have opposite signs;

Figure 9 shows an implementation of the CEI wherein a group of electrodes are organized in the form of a matrix;

15 Figure 10 illustrates distribution of an electric field-generating potential in capacitive couplings when the apparatus is grounded;

Figure 11 illustrates distribution of an electric field-generating potential in capacitive couplings when the apparatus is floating (not grounded);

20 Figure 12 illustrates distribution of an electric field-generating potential in capacitive couplings when the apparatus is floating and the user is sufficiently close to the apparatus and capacitively grounded to the ground (reference) potential of the apparatus;

Figure 13 shows an arrangement wherein capacitive couplings are utilized to detect touching; and

25 Figures 14 and 15 illustrate embodiments in which a single electrode and temporal variations in the intensity of the electro-sensory stimulus can be used to create illusions of a textured touch screen surface.

Detailed description of specific embodiments

30 **[0032]** Figures 1 through 15 relate to the operation and implementation of a capacitive electro-sensory interface ("CEI") which can be employed in the inventive touch screen interface.

[0033] Figure 1 illustrates the operating principle of the CEI. Reference numeral 100 denotes a high-voltage amplifier. The output of the high-voltage amplifier 100, denoted OUT, is coupled to an electrode 106 which is insulated against galvanic contact by an insulator 108 which comprises at least one insulation layer or member. Reference numeral 120 generally denotes a body

member to be stimulated, such as a human finger. Human skin, which is denoted by reference numeral 121, is a relatively good insulator when dry, but the CEI provides a relatively good capacitive coupling between the electrode 106 and the body member 120. The capacitive coupling is virtually independent from skin conditions, such as moisture. The inventors' hypothesis is that the capacitive coupling between the electrode 106 and the body member 120 generates a pulsating Coulomb force. The pulsating Coulomb force stimulates vibration-sensitive receptors, mainly those called Pacinian corpuscles which reside under the outermost layer of skin in the ipodermis 121. The Pacinian corpuscles are denoted by reference numeral 122. They are shown schematically and greatly magnified.

[0034] The high-voltage amplifier 100 is driven by an input signal IN which results in a substantial portion of the energy content of the resulting Coulomb forces to reside in a frequency range to which the Pacinian corpuscles 122 are sensitive. For humans this frequency range is between 10 Hz and 1000 Hz, preferably between 50 Hz and 500 Hz and optimally between 100 Hz and 300 Hz, such as about 240 Hz. The frequency response of the Pacinian corpuscles is further discussed in connection with Figures 5 and 6.

[0035] It should be understood that, while "tactile" is frequently defined as relating to a sensation of touch or pressure, the electrosensory interface according to the present CEI, when properly dimensioned, is capable of creating a sensation of vibration to a body member even when the body member 120 does not actually touch the insulator 108 overlaying the electrode 106. This means that unless the electrode 106 and/or insulator 108 are very rigid, the pulsating Coulomb forces between the electrode 106 and body member 120 (particularly the Pacinian corpuscles 122) may cause some slight mechanical vibration of the electrode 106 and/or insulator 108, but the method and apparatus according to the CEI are capable of producing the electrosensory sensation independently of such mechanical vibration.

[0036] The high-voltage amplifier and the capacitive coupling over the insulator 108 are dimensioned such that the Pacinian corpuscles or other mechanoreceptors are stimulated and an electrosensory sensation (a sensation of apparent vibration) is produced. For this, the high-voltage amplifier 100 must be capable of generating an output of several hundred volts or even several kilovolts. In practice, the alternating current driven into the body member 120 has

a very small magnitude and can be further reduced by using a low-frequency alternating current.

[0037] Figure 2 illustrates an apparatus which implements an illustrative embodiment of the present CEI. In this embodiment the high-voltage amplifier 100 is implemented as a current amplifier 102 followed by a high-voltage transformer 104. In the embodiment shown in Figure 2, the secondary winding of the high-voltage transformer 104 is in a more or less flying configuration with respect to the remainder of the apparatus. The amplifier 100, 102 is driven with a modulated signal whose components are denoted by 112 and 114. The output of the high-voltage amplifier 100 is coupled to an electrode 106 which is insulated against galvanic contact by the insulator 108. Reference numeral 120 generally denotes a member to be stimulated, such as a human finger. Human skin, which is denoted by reference numeral 121, is a relatively good insulator when dry, but the CEI provides a relatively good capacitive coupling between the electrode 106 and the electrically conductive tissue underneath the skin surface 121. Mechanoreceptors, such as the Pacinian corpuscles 122, reside in this conductive tissue. In Figures 1 and 2, the Pacinian corpuscles 122 are shown schematically and greatly magnified.

[0038] A benefit of the capacitive coupling between the electrode 106 and the electrically conductive tissue underneath the skin surface, which is known as the Corneus Layer and which contains the Pacinian corpuscles 122, is that the capacitive coupling eliminates high local current densities to finger tissue, which would result from contact that is conductive at direct current.

[0039] It is beneficial, although not strictly necessary, to provide a grounding connection which helps to bring the subject to be stimulated, such as the user of the apparatus, closer to a well-defined (non-floating) potential with respect to the high-voltage section of the apparatus. In the embodiment shown in Figure 2, the grounding connection, denoted by reference numeral 210, connects a reference point REF of the high-voltage section to a body part 222 which is different from the body part(s) 120 to be stimulated. In the embodiment shown in Figure 2, the reference point REF is at one end of the secondary winding of the transformer 104, while the drive voltage for the electrode(s) 206A, 206B, 206C is obtained from the opposite end of the secondary winding.

[0040] In an illustrative implementation, the apparatus is a hand-held device which comprises a touch display activated by finger(s) 120. The grounding connection 210 terminates at a grounding electrode 212. An illustrative imple-

mentation of the grounding electrode 212 is one or more ground plates which are arranged such that they are conveniently touched one hand 222 of the user while the apparatus is manipulated by the other hand. The ground plate(s) may be positioned on the same side of the apparatus with the touch display and next to the touch display, or it/they may be positioned on adjacent or opposite side(s) from the side which comprises the touch display, depending on ergonomic considerations, for example.

[0041] In real-world apparatuses, the coupling 210 between the reference point REF and the non-stimulated body part 222 may be electrically complex. In addition, hand-held apparatuses typically lack a solid reference potential with respect to the surroundings. Accordingly, the term "grounding connection" does not require a connection to a solid-earth ground. Instead the grounding connection means any connection which helps to decrease the potential difference between the reference potential of the apparatus and a second body member distinct from the body member(s) to be stimulated. This definition does not rule out any capacitive parallel or stray elements, so long as the grounding connection 210 helps bring the user of the apparatus, along with the non-stimulated body part 222, to a potential which is reasonably well defined with respect to the high-voltage section of the apparatus. A capacitive grounding connection will be discussed in connection with Figure 12. In the present context, the reasonably well-defined potential should be understood in view of the voltage OUT which drives the electrode(s) 206A, 206B, 206C. If the electrode drive voltage OUT is, say, 1000 V, a potential difference of, say, 100 V, between the user's body and the reference point REF may not be significant.

[0042] The non-capacitive coupling 210 between the reference point REF of the high-voltage section and the non-stimulated body part 222 greatly enhances the electro-sensory stimulus experienced by the stimulated body part 120. Conversely, an equivalent electro-sensory stimulus can be achieved with a much lower voltage and/or over a thicker insulator when the non-capacitive coupling 210 is being used.

[0043] The amplifier 100, 102 is driven with a high-frequency signal 112 which is modulated by a low-frequency signal 114 in a modulator 110. The frequency of the low-frequency signal 114 is such that the Pacinian corpuscles, which reside in the electrically conductive tissue underneath the skin surface, are responsive to that frequency. The frequency of the high-frequency signal 112 is preferably slightly above the hearing ability of humans, such as 18 to 25

kHz, more preferably between about 19 and 22 kHz. If the frequency of the signal 112 is within the audible range of humans, the apparatus and/or its drive circuit may produce distracting sounds. On the other hand, if the frequency of the signal 112 is far above the audible range of humans, the apparatus drives
5 more current into the member 120. A frequency of about 20 kHz is advantageous in the sense that components designed for audio circuits can generally be used, while the 20 kHz frequency is inaudible to most humans. Experiments carried out by the inventors suggest that such modulation is not essential for the CEI. Use of a high-frequency signal with low-frequency modulation, such
10 as the one schematically shown in Figure 2, as opposed to a system which relies on the low-frequency signal alone, provides the benefit that the relatively high alternating voltage (a few hundred volts or a few kilovolts) can be generated with a relatively small transformer 104.

[0044] Terms like frequency or kHz should not be understood such that the
15 high- or low-frequency signals 112, 114 are restricted to sinusoidal signals, and many other waveforms can be used, including square waves. The electrical components, such as the modulator 110, amplifier 102 and/or transformer 104 can be dimensioned such that harmonic overtones are suppressed. The inventors have discovered that pulses with durations of 4 ms (approximately
20 one half-cycle of the low-frequency signal) or longer can be readily detected and with a practical insulator thickness the peak-to-peak voltage in the electrode 106 needs to be at least about 750 V. Unloaded peak-to-peak voltage measured in the electrode 106 should be in the range of approximately 750 V - 100 kV. Near the lower limit of this voltage range, the insulator thickness may
25 be 0.05 - 1 mm, for example. As material technology and nanotechnology develop, even thinner durable insulating surfaces may become available. This may also permit a reduction of the voltages used.

[0045] The elements of Figures 1 and 2 described so far produce a steady-state electrosensory sensation as long as the body member, such as the finger
30 120, is in the vicinity of the electrode 106. In order to convey useful information, the electrosensory sensation must be modulated. In some simple embodiments, such modulation can be implemented by positioning the electrode 106 such that useful information is conveyed by the fact that the finger 120 can sense the presence of the electrode 106. For example, the electrode 106 can
35 be positioned over a switch, or in the vicinity of it, such that the switch can be detected without having to see it.

[0046] In other embodiments, such information-carrying modulation can be provided by electronically controlling one or more operating parameters of the inventive apparatus. The information-carrying modulation should not be confused with the modulation of the high-frequency signal 112 by the low-frequency signal 114, the purpose of which is to reduce the size of the transformer 104. In the schematic drawing shown in Figure 2, such information-carrying modulation is provided by controller 116, which controls one or more of the operating parameters of the inventive apparatus. For instance, the controller 116 may enable, disable or alter the frequency or amplitude of the high- or low-frequency signals 112, 114, the gain of the amplifier 102, or it may controllably enable or disable the power supply (not shown separately) or controllably break the circuit at any point.

[0047] Figure 3 shows an enhanced embodiment of the inventive apparatus with multiple independently-controllable electrodes. In Figure 3, elements with reference numerals less than 200 have been described in connection with Figures 1 and 2, and a repeated description is omitted. This embodiment comprises multiple independently-controllable electrodes 206A, 206B and 206C, of which three are shown but this number is purely arbitrary. Reference numeral 216 denotes an implementation of a controller which controls a switch matrix 217 which provides the high-voltage signal OUT to the electrodes 206A, 206B and 206C under control of the controller 216. The controller 216 may be responsive to commands from an external device, such as a data processing equipment (not shown separately).

[0048] A benefit of the embodiment shown in Figure 3 is that virtually all the drive circuitry, including the high-voltage amplifier 100, controller 216, and switch matrix 217, can be integrated into a common enclosure which is denoted by reference numeral 200. In this embodiment only the electrodes 206A, 206B and 206C and a single connecting wire for each electrode are outside the enclosure 200. As stated earlier, the electrodes need to be nothing more than simple conducting or semi-conducting plates covered by appropriate insulators. Therefore the enclosure 200 can be positioned in virtually any convenient position because the only elements external to it are very simple electrodes and connecting wires (and, in some implementations a power supply, not shown separately).

[0049] Some prior art systems provide direct stimulation of nerves via galvanic current conduction to the outermost layer of the skin. Because of the galvanic

current conduction, such systems require two electrodes to stimulate an area of skin. In contrast to such prior art systems, the embodiment described in connection with Figure 3 involves multiple electrodes 206A, 206B and 206C, but each electrode alone stimulates a distinct area of skin, or more precisely, the mechanoreceptors, including the Pacinian corpuscles underlying the outermost layers of skin. Therefore a configuration of n electrodes conveys n bits of information in parallel.

[0050] Figure 4 shows a specific implementation of the embodiment shown in Figure 3. In this implementation the switch matrix 217 comprises a bank of triacs 207A, 207B and 207C, but other types of semiconductor switches can be used, including semiconductor relays. Conventional electromechanical relays can be used as well. In this embodiment the switches (triacs) 207A, 207B and 207C are positioned logically after the transformer 104, ie, in the high-voltage circuitry. This implementation requires high-voltage switches (several hundred volts or several kilovolts) but it provides the benefit that the remainder of the circuitry, including the elements 100 through 114, can serve all of the electrodes 206A, 206B and 206C. As shown in Figure 4, the controller 216 may be connectable to a data processing equipment, an example of which is shown here as a personal computer PC.

[0051] Figure 5 is a graph which schematically illustrates the sensitivity of a randomly selected test subject to sensations produced by an apparatus substantially similar to the one shown in Figure 2. The x-axis of the graph shows frequency of the low-frequency signal (item 114 in Figure 2) multiplied by two, while the y-axis shows the amplitude required to detect an electrosensory stimulation. The amplitude scale is relative. The small dip at 75 Hz may be a measurement anomaly. The reason for placing the doubled low-frequency signal on the x-axis is that the Coulomb forces between the electrode 106 and the body member 120 have two intensity peaks for each cycle of a sinusoidal low-frequency signal, as will be schematically illustrated in connection with Figure 6.

[0052] The relative sensitivity at various frequencies is remarkably similar to the one published in section 2.3.1 (figure 2.2) of Reference document 1. Reference document 1 relates to vibrotactile (mechanical) stimulation of skin, but the similarity of the frequency response shown in Figure 5 to the one published in Reference 1 suggests that the present CEI operates such that the electrode 106 and the sensitive member 120 (see Figure 1) form a capacitor over the

insulator 108, and in that capacitor the oscillating Coulomb forces are converted to mechanical vibrations which are sensed by mechanoreceptors, including the Pacinian corpuscles. The inventors have also studied an alternative hypothesis wherein the Pacinian corpuscles are stimulated by current flowing through them, but this hypothesis does not explain the observations as well as the one which is based on Coulomb forces acting on the Pacinian corpuscles. However, the technical CEI described herein does not depend on the correctness of any particular hypothesis attempting to explain why the CEI operates the way it does.

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10 **[0053]** Figure 6 is a graph which further clarifies the operating principle of the CEI and the interpretation of frequencies in connection with the present CEI. Reference numeral 61 denotes the low-frequency input signal to the modulator 110 (shown as item 114 in Figure 2). Reference numeral 62 denotes the output of the modulator, ie, the high-frequency input signal as modulated by the low-frequency input signal.

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20 **[0054]** Reference numerals 63 and 64 denote the resulting Coulomb forces in the capacitive coupling between the electrode 106 and the body member 120 over the insulator 108. Because the two sides of the capacitive coupling have opposite charges, the Coulomb force between the two sides is always attractive and proportional to the square of the voltage. Reference numeral 63 denotes the actual Coulomb force while reference numeral 64 denotes its envelope. The envelope 64 is within the range of frequencies to which the Pacinian corpuscles are sensitive, but because the Coulomb force is always attractive, the envelope 64 has two peaks for each cycle of the modulator output signal 25 62, whereby a frequency-doubling effect is produced. Because the Coulomb force is proportional to the square of the voltage, any exemplary voltages disclosed herein should be interpreted as effective (RMS) values in case the voltages are not sinusoidal.

30 **[0055]** The statement that the two sides of the capacitive coupling have opposite charges whereby the Coulomb force is always attractive holds for a case in which the apparatus and the body member to be stimulated are at or near the same potential. High static charges can cause deviations from this ideal state of affairs, which is why some form of grounding connection between a reference potential of the high-voltage source and the body element other than the 35 one(s) to be stimulated is recommended, as the grounding connection helps to lower the potential differences between the apparatus and its user.

[0056] The CEI can be implemented as part of an input/output peripheral device which is connectable to a data processing equipment. In such a configuration the data processing equipment can provide prompting and/or feedback via electrically-controllable electrosensory sensation.

5 **[0057]** Figures 7A and 7B show implementations of the CEI wherein the strength of the capacitive coupling is adjusted by electrode movement. Generation of the electric field, and its variation as necessary, is effected via a set of electrodes 704 which comprises individual electrodes 703. The individual
10 electrodes 703 are preferably individually controllable, wherein the controlling of an electrode affects its orientation and/or protrusion. Figure 7A shows an implementation wherein a group of electrodes 703 are oriented, via the output signal from the controller 216, such that the electrodes 703 collectively form a plane under the insulator 702. In this situation the high-voltage current (DC or
15 AC) from the high-voltage amplifier 100 to the electrodes 703 generates an opposite-signed charge of sufficient strength to a body member (eg the finger 120) in close proximity to the apparatus. A capacitive coupling between the body member and the apparatus is formed over the insulator 702, which may give rise to a sensory stimulus.

[0058] Figure 7B shows the same apparatus shown in Figure 7A, but in this
20 case the strength of the capacitive coupling generated with the current from the high-voltage amplifier 100 is minimized by orienting the electrodes (now shown by reference numeral 714) such that they do not form a plane under the insulator 702. In some implementations of the present invention, the electric field alternating with a low frequency can be generated by alternating the state
25 of the apparatus between the two states shown in Figures 7A and 7B. The frequency of the state alternation can be in the order of several hundred, eg 200 to 300 full cycles per second.

[0059] Figure 8 shows an implementation of the CEI wherein the individual
30 electrodes 803 in the set of electrodes 804 may have charges of opposite signs. The charges of individual electrodes 803 may be adjusted and controlled via the controller 216. The individual electrodes 803 may be separated by insulator elements 806, so as to prevent sparking or shorting between the electrodes. The capacitive coupling between the CEI and the body member proximate to it may give rise to areas having charges with opposite signs 801.
35 Such opposing charges are mutually attractive to one another. Hence it is possible that Coulomb forces stimulating the Pacinian corpuscles may be gener-

ated not only between the CEI and the body member but between infinitesimal areas within the body member itself.

[0060] Figure 9 shows an implementation of the CEI wherein a group of individually controllable electrodes 910a through 910i are organized in the form of a matrix. Such a matrix can be integrated into a touch screen device, for example. Since the CEI described above does not require direct connection (touching) between the CEI and a body member of its user, the electrodes of the CEI apparatus can be positioned behind the touch screen, wherein "behind" means the side of the touch screen opposite to the side facing the user during normal operation. Alternatively, the electrodes can be very thin and/or transparent, whereby the electrodes can overlay the touch screen on the side normally facing the user. The electric charges, which are conducted from the high-voltage amplifier 100 to the electrodes 910a through 910i via the switch array 217, may all have similar signs or the charges conducted to different electrodes may have different signs, as illustrated in connection with Figure 8. For instance, the controller 216 may control the switches in the switch array individually, or certain groups may form commonly-controllable groups. The surface of an individual electrode and/or its associated insulator can be specified according to the intended range of operations or applications. The minimum practical area is about 0.01 cm^2 , while the practical maximum is roughly equal to the size of a human hand. It is expected that surface areas between 0.1 and 1 cm^2 will be found most usable in practice.

[0061] The matrix of electrodes 910a through 910i and the switch array 217 provide a spatial variation of the electro-sensory stimulation. In other words, the sensory stimulation provided to the user depends on the location of the user's body member, such as a finger, proximate to the CEI apparatus which is integrated to the inventive touch screen. The spatially varying sensory stimulation provides the user with an indication of the layout of the touch-sensitive areas of the touch screen interface.

[0062] In addition to the spatially varying sensory stimulation, the controller 216 may direct the switch array 217 to produce a temporally varying (time-dependent) electro-sensory stimulation, which can be used for a wide variety of useful effects. For instance, the temporally varying electro-sensory stimulation can be used to indicate a detected activation of a touch-sensitive area ("key press"). This embodiment address a common problem associated with prior art touch screen devices, namely the fact that a detection of a key press

produces no tactile feedback. Prior art application-level programs used via touch screen devices may provide visual or aural feedback, but such types of feedback exhibit the various problems described earlier. In addition, production of the visual or aural feedback from the application-level program causes a
5 burden on the programming and execution of those programs. In some implementations of the invention, an interface-level or driver-level program provides a tactile feedback from a detected activation of a touch-sensitive area by using the temporally and spatially variant electro-sensory stimulation, and such interface-level or driver-level programs can be used by any application-level programs. For example, the application-level programs can be coupled to the
10 inventive touch screen interface via an application programming interface ("API") whose set of available functions includes the feedback generation described above.

[0063] The temporally and spatially variant electro-sensory stimulation can
15 also be used to change the layout of the touch-sensitive areas "on the fly". In hindsight, this operation may be considered roughly analogous to changing the keyboard or keypad layout depending on the application program or user interface screen currently executed. However, when prior art touch screen devices change keyboard or keypad layout on the fly, the new layout must be some-
20 how indicated to the user, and this normally requires that the user sees the touch screen device.

[0064] Some embodiments of the inventive touch screen device eliminate the need to see the touch screen device, assuming that the layout of the touch-sensitive areas is sufficiently simple. For instance, up to about two dozen different "key legends" can be indicated to the user by providing different patterns
25 for the temporally and spatially variant electro-sensory stimulation. As used herein, the expression "key legend" refers to the fact that prior art touch screen devices, which produce no tactile feedback, normally produce visual cues, and these are commonly called "legends". In some embodiments of the present
30 invention, the function of the key legends can be provided via different patterns. For instance, the following patterns can be identified with one fingertip: pulses with low, medium or high repetition rate; sweeps to left, right, up or down, each with a few different repetition rates; rotations clockwise or anti-clockwise, each with a few different repetition rates.

[0065] From the above, it is evident that the inventive electro-sensory interface
35 can produce a large number of different touch-sensitive areas, each with a dis-

tinct "feel" (technically: a different pattern for the temporal and spatial variation of the electro-sensory stimulus). Hence the screen section of a conventional touch screen is not absolutely needed in connection with the present invention, and the term touch device interface should be interpreted as an interface device which, among other things, is suitable for applications commonly associated with touch screen devices, although the presence of the screen is not mandatory.

[0066] Moreover, the strength of the capacitive coupling between the inventive CEI and a body member of its user (or the capacitive coupling between an individual electrode or a group of electrodes and the user's body member) can be determined by direct or indirect measurements. This measurement information can be utilized in various ways. For instance, the strength of the capacitive coupling can indicate the body member's proximity to the electrode, or it can indicate touching the electrode by the body member. Such measurement functionality can be provided by a dedicated measurement unit (not shown) or it can be integrated into one of the blocks described earlier, such as the switch matrix 217. The switch matrix 217 (or the optional dedicated measurement unit) can send the measurement information to the controller 216 which can utilize it to vary the electric fields generated by the electrodes, by varying the voltage or frequency. In addition or alternatively the controller 216 may forward the measurement information, or some information processed from it, to a data processing equipment, such as the personal computer PC shown in Figure 4.

[0067] Yet further two or more inventive touch device interfaces can be interconnected via some communication network(s) and data processing equipment. In such an arrangement, the electro-sensory stimulation provided to the users of the touch screen devices may be based on some function of all users' contribution to the proximity to their respective devices. In one illustrative example, such an interconnection of two (or more) touch screen devices can provide their users with tactile feedback whose strength depends on the sum of the areas of hands touch the touch-sensitive areas. This technique simulates a handshake whose strength reflects the sum of hand pressure exerted by both (or all) users. In another illustrative example, a music teacher might "sense" how a remotely located student presses the keys of a simulated piano keyboard.

[0068] Figures 10 through 13 are equivalent circuits (theoretical models) which may be useful in dimensioning the parameters of the capacitive coupling. Fig-

ure 10 illustrates distribution of an electric field-generating potential in capacitive couplings when the apparatus is grounded. The underlying theory is omitted here, and it suffices to say that in the arrangement shown in Figure 10, the drive voltage e of an electrode is divided based on the ratio of capacitances C_1 and C_2 , wherein C_1 is the capacitance between the finger and the electrode and C_2 is the stray capacitance of the user. The electric field experienced by the finger is caused by voltage U_1 :

$$U_1 = \frac{C_2}{C_1 + C_2} e$$

[0069] This voltage is lower than the drive voltage e from the voltage source. In a general case the reference potential of the apparatus may be floating, as will be shown in Figure 11. This arrangement further decreases the electric field directed to the body member, such as finger.

[0070] For these reasons some embodiments of the invention aim at keeping the capacitance C_1 low in comparison to that of C_2 . At least capacitance C_1 should not be significantly higher than C_2 . Some embodiments aim at adjusting or controlling C_2 , for instance by coupling the reference potential of the apparatus back to the user, as shown in Figure 12.

[0071] Further analysis of the actual value of capacitance C_1 shows that it can be treated as a capacitance consisting of three series-coupled partial capacitances: C_1 of the insulator material, C_a of the air gap between insulator and finger, and C_s formed by the outmost skin layer that is electrically insulating the inner, conducting tissue from the environment. Each partial capacitance is given by:

$$C = \epsilon \frac{S}{d}$$

[0072] Herein, ϵ is the permittivity (dielectric constant) of the insulating material, S is the (effective) surface area and d is the distance between the surfaces of the capacitor. In a series arrangement of capacitances, the smallest one of the individual capacitances dominates the overall value of the total capacitance C_1 . When the body member does not touch the surface of the insulated electrode but only approaches it, the capacitive coupling is weak. Thus the value of C_1 is small and mainly determined by the air gap, C_a . When the body member touches the surface, the effective air gap is small (approximately the height ridges of the fingerprint profile on the skin surface). As capacitance is inversely proportional to the distance of the conducting surfaces forming the capacitor,

corresponding C_a obtains a high value, and the value of C_1 is determined by C_i and C_s . Thus the effectiveness of the electro-sensory stimulus generation can be enhanced by appropriate selection of insulator material, particularly in terms of thickness and dielectric properties. For instance, selecting a material with a relatively high dielectric constant for the insulator reduces the electric field in the material but increases the electric field strength in the air gap and skin.

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[0073] Furthermore, in applications where the surface is likely to be touched while the electro-sensory stimulation or response is given, the effectiveness of the electro-sensory stimulus generation can be enhanced by optimal selection of the material that will be touched by the body member. This is particularly significant in connection with insulators which are good volume insulators (insulators in the direction of the surface's normal) but less so in the direction along the surface.

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[0074] An insulator's insulation capability along the surface may be negatively affected by surface impurities or moisture which have a negative effect on the apparent strength of the sensation felt by the body member to be stimulated. For instance, glass is generally considered a good insulator, but its surface tends to collect a thin sheet of moisture from the air. If the electrode of the CEI is insulated with glass, the electro-sensory effect is felt in close proximity (when there is still an air gap between body member and the glass surface). However, when the glass surface is touched, even lightly, the electro-sensory tends to weaken or disappear altogether. Coating the outer insulating surface with a material having a low surface conductance remedies such problems. The inventors speculate that if the surface having some surface conductivity is touched, it is the conductive layer on the surface that experiences the coulomb force rather than the body member touching the surface. Instead the touching body member acts as a kind of grounding for the conductive surface layer, for example via the stray capacitance of the body.

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[0075] Instead of the measures described in connection with Figures 10 through 12, or in addition to such measures, stray capacitances can be controlled by arrangements in which several electrodes are used to generate potential differences among different areas of the touch screen surface. By way of example, this technique can be implemented by arranging the touch-sensitive surface of a hand-held device (eg the top side of the device) to a first potential, while the opposite side is arranged to a second potential, wherein the two different potentials can be the positive and negative poles of the de-

vice. Alternatively, a first surface area can be the electric ground (reference potential), while a second surface area is charged to a high potential.

[0076] Moreover, within the constraints imposed by the insulator layer(s), it is possible to form minuscule areas of different potentials, such as potentials with
5 opposite signs or widely different magnitudes, wherein the areas are small enough that the user's body member, such as finger, is simultaneously subjected to the electric fields from several areas with different potentials.

[0077] Figure 13 shows an embodiment in which the capacitive coupling is utilized to detect touching or approaching by the user's body member, such as
10 finger. A detected touching or approaching by the user's body member can be passed as an input to a data processing device. In the embodiment shown in Figure 13, the voltage source is floating. A floating voltage source can be implemented, via inductive or capacitive coupling and/or with break-before-make switches. A secondary winding of a transformer is an example of a simple yet
15 effective floating voltage source. By measuring the voltage U_4 , it is possible to detect a change in the value(s) of capacitance(s) C_1 and/or C_2 . Assuming that the floating voltage source is a secondary winding of a transformer, the change in capacitance(s) can be detected on the primary side as well, for example as a change in load impedance. Such a change in capacitance(s) serves as an
20 indication of a touching or approaching body member.

[0078] In one implementation, the apparatus is arranged to utilize such indication of the touching or approaching body member such that the apparatus uses a first (lower) voltage to detect the touching or approaching by the body member and a second (higher) voltage to provide feedback to the user. For instance, such feedback can indicate any of the following: the outline of the/each
25 touch-sensitive area, a detection of the touching or approaching body member by the apparatus, the significance of (the act to be initiated by) the touch-sensitive area, or any other information processed by the application program and which is potentially useful to the user.

[0079] Figure 14 schematically illustrates an embodiment in which a single electrode and temporal variations in the intensity of the electro-sensory stimulus can be used to create illusions of a textured touch screen surface. Reference numeral 1400 denotes a touch-sensitive screen which, for the purposes of describing the present embodiment, comprises three touch-sensitive areas
30 A_1 , A_2 and A_3 . The approaching or touching by the touch-sensitive areas A_1 , A_2 and A_3 of a user's finger 120 is detected by a controller 1406.

[0080] According to an embodiment of the invention, a conventional touch-sensitive screen 1400 can be complemented by an interface device according to the invention. Reference numeral 1404 denotes an electrode which is an implementation of the electrodes described in connection with previously-described embodiments, such as the electrode 106 described in connection with Figures 1 and 2. A supplemental insulator 1402 may be positioned between the touch-sensitive screen 1400 and the inventive electrode 1404, in case the touch-sensitive screen 1400 itself fails to provide sufficient insulation.

[0081] In addition to conventional touch-screen functionality, namely detection of approaching or touching by the touch-sensitive areas by the user's finger, the controller 1406 uses information of the position of the finger 120 to temporarily vary the intensity of the electro-sensory stimulation invoked by the electrode 1404 on the finger 120. Although the intensity of the electro-sensory stimulation is varied over time, time is not an independent variable in the present embodiment. Instead, timing of the temporal variations is a function of the position of the finger 120 relative to the touch-sensitive areas (here: A_1 , A_2 and A_3). Thus it is more accurate to say that the present embodiment is operable to cause variations in the intensity of the electro-sensory stimulation invoked by the electrode 1404 on the finger 120, wherein the variations are based on the position of the finger 120 relative to the touch-sensitive areas.

[0082] The bottom side of Figure 14 illustrates this functionality. The three touch-sensitive area A_1 , A_2 and A_3 are demarcated by respective x coordinate pairs $\{x_1, x_2\}$, $\{x_3, x_4\}$ and $\{x_5, x_7\}$. Processing in the y direction is analogous and a detailed description is omitted. The controller 1406 does not sense the presence of the finger, or senses the finger as inactive, as long as the finger is to the left of any of the touch-sensitive areas A_1 , A_2 and A_3 . In this example the controller 1406 responds by applying a low-intensity signal to the electrode 1404. As soon as the finger 120 crosses the x coordinate value x_1 , the controller 1406 detects the finger over the first touch-sensitive area A_1 and starts to apply a medium-intensity signal to the electrode 1404. Between the areas A_1 and A_2 (between x coordinates x_2 and x_3), the controller again applies a low-intensity signal to the electrode 1404. The second touch-sensitive area A_2 is processed similarly to the first touch-sensitive area A_1 , but the third touch-sensitive area A_3 is processed somewhat differently. As soon as the controller 1406 detects the finger 120 above or in close proximity to the area A_3 , it begins to apply the medium-intensity signal to the electrode 1404, similarly to areas A_1

and A₂. But the user decides to press the touch screen 1400 at a point x6 within the third area A₃. The controller 1406 detects the finger press (activation of the function assigned to the area A₃) and responds by applying a high-intensity signal to the electrode 1404.

5 [0083] Thus the embodiment shown in Figure 14 can provide the user with a tactile feedback which creates an illusion of a textures surface, although only a single electrode 1404 was used to create the electro-sensory stimulus. A residual problem is, however, that the user has to memorize the significance of the several touch-sensitive areas or obtain visual or aural information on their
10 significance.

[0084] Figure 15 shows a further enhanced embodiment from the one described in connection with Figure 14. The embodiment shown in Figure 15 uses different temporal variations of the intensity of the electro-sensory stimulus, wherein the different temporal variations provide the user with a tactile
15 feedback indicating the significance of the touch-sensitive areas.

[0085] The operation of the embodiment shown in Figure 14 differs from the one described in connection with Figure 14 in that the controller, here denoted by reference numeral 1506, applies different temporal variations to the intensity of the signal to the electrode 1404. In this example, the first touch-sensitive
20 area A₁ is processed similarly to the preceding embodiment, or in other words, the intensity of the electro-sensory stimulus depends only on the presence of the finger 120 in close proximity to the area A₁. But in close proximity to areas A₂ and A₃, the controller 1506 also applies temporal variations to the intensity of the electro-sensory stimulus. For example the significance (coarsely analogous with a displayed legend) of area A₂ is indicated by a pulsed electro-sensory stimulus at a first (low) repetition rate, while the significance of area A₃
25 is indicated by a pulsed electro-sensory stimulus at a second (higher) repetition rate. In an illustrative example, the three touch-sensitive areas A₁, A₂ and A₃ can invoke the three functions in a yes/no/cancel -type user interface, wherein the user can sense the positions of the user interface keys (here: the three touch-sensitive areas) and the indication of an accepted input only via
30 tactile feedback. In other words, the user needs no visual or aural information on the positions of the touch-sensitive areas or on the selected function. The embodiment described in connection with Figure 15 is particularly attractive in car navigators or the like, which should not require visual attention from their
35 users.

[0086] In the embodiments shown in Figures 14 and 15, when the user's finger 120 has selected the function assigned to area A_3 and the controller CTRL 1406, 1506 generates the high-intensity electro-sensory stimulus via the electrode 1404, the high-intensity stimulus is sensed via any of the areas A_1 , A_2 and A_3 . In other words, if one finger of the user presses the area A_3 , other finger(s) in close proximity to the other areas A_2 and/or A_3 will also sense the high-intensity stimulus. In cases where this is not desirable, the embodiments shown in Figures 14 and 15 can be combined with the multi-electrode embodiment disclosed in connection with Figure 9, such that the signal to each of several electrodes (shown in Figure 9 as items 910a through 910i) is controlled individually.

[0087] It is readily apparent to a person skilled in the art that, as the technology advances, the inventive concept can be implemented in various ways. The invention and its embodiments are not limited to the examples described above but may vary within the scope of the claims.

References

1. Gunther, Eric: "*Skinscape: A Tool for Composition in the Tactile Modality*" Master's thesis, Massachusetts Institute of Technology 2001, available on the internet address:
<http://mf.media.mit.edu/pubs/thesis/guntherMS.pdf>

Claims

1. An apparatus for producing an electrosensory sensation to at least one body member (120) to be stimulated, the apparatus comprising:

- 5 - one or more conducting electrodes (106), each conducting electrode being provided with an insulator (108) wherein, when the at least one body member (120) to be stimulated is proximate to the conducting electrode, the insulator prevents flow of direct current from the conducting electrode to the body member to be stimulated and a capacitive coupling over the insulator (108) is formed between the conducting electrode (106) and the at least one body member (120) to be stimulated;
- 10 - a high-voltage source (100, 102, 104) for applying an electrical input (OUT) to the one or more conducting electrodes, wherein the electrical input comprises a low-frequency component (114) in a frequency range between 10 Hz and 1000 Hz;
- 15 - wherein the capacitive coupling and electrical input are dimensioned to produce an electrosensory sensation; and
- 20 - whereby the electrosensory sensation is produced independently of any mechanical vibration of the one or more conducting electrodes (106) or insulators (108).

2. An apparatus according to claim 1, further comprising a grounding connection (210) between:

- 25 - a reference voltage (REF) of the high-voltage source (100, 102, 104) other than the electrical input (OUT) to the one or more conducting electrodes; and
- at least one grounding electrode (212) separate from the one or more conducting electrodes (106), wherein the grounding electrode (212) is positioned so as to be touched by a second body member (222) distinct from each of the at least one body member to be stimulated (120; 220A, 220B, 220C).

3. An apparatus according to any one of the preceding claims, wherein at least one of the one or more conducting electrodes is positioned such that that the at least one body member to be stimulated most likely to be affected is part of a human hand.

4. An apparatus according to any one of the preceding claims, wherein the apparatus comprises one conducting electrode for each spatially distinct area of the at least one body member to be stimulated (120; 220A, 220B, 220C).

5 5. An apparatus according to any one of the preceding claims, wherein the apparatus comprises one conducting electrode (206A, 206B, 206C) for each of several spatially distinct areas of the at least one body member to be stimulated (220A, 220B, 220C).

6. An apparatus according to any one of the preceding claims, 10 wherein the apparatus comprises means (116, 216) for conveying information via the electrosensory sensation by modulating the electrical input according to said information.

7. An apparatus according to any one of the preceding claims, further comprising an enclosure (200) which contains the high-voltage source 15 (100, 102, 104) which is common to all the several conducting electrodes (206A, 206B, 206C) and wherein the enclosure (200) also contains means (217) for conveying the electrical input (OUT) to zero or more of the several conducting electrodes simultaneously, under control of a common controller (216).

20 8. An apparatus according to claim 7, wherein the apparatus is part of an input/output peripheral device connectable to a data processing equipment.

9. An apparatus according to any one of the preceding claims, further comprising a surface (1400) arranged so as to be touched or approached 25 by the body member to be stimulated (120), wherein the surface has at least one touch-sensitive area (A1, A2, A3), each touch-sensitive area having a predetermined position (x1-x2; x3-x4; x5-x7);

wherein the apparatus comprises or is operatively connectable to means for assigning at least one function to the least one touch-sensitive area; 30 and

wherein the apparatus further comprises means (1406, 1506) for varying the intensity of the electro-sensory stimulus spatially and/or temporally based on a detected touching or approaching of the at least one touch-sensitive area (A1, A2, A3) by the body member to be stimulated (120);

whereby the interface device is able to produce a feedback to a user via the body member to be stimulated.

10. An apparatus according to claim 9, wherein said means (1406, 1506) for varying the intensity of the electro-sensory stimulus spatially and/or
5 temporally comprises means (1406, 1506) for varying the intensity of the electro-sensory stimulus temporally.

11. An apparatus according to claim 10, wherein:
said means for assigning at least one function are operable to dynamically change the at least one function assigned to the least one touch-sensitive area; and
10 the apparatus is operable to vary the feedback based on the function assigned to the least one touch-sensitive area.

12. An apparatus according to any one of the preceding claims, wherein the electrical input also comprises a high-frequency component (112)
15 having a frequency which is higher than the frequency of the low-frequency component (114) and lower than 500 kHz.

13. An apparatus according to any one of the preceding claims, comprising means (110) for modulating the high-frequency component (112) by the low-frequency component (114).

20 14. An apparatus according to any one of the preceding claims, wherein the electrical input to the one or more conducting electrodes (106) has a peak-to-peak voltage of 750 to 100,000 Volts.

15. An apparatus according to any one of the preceding claims, wherein the insulator has a thickness between 0.1 mm and 50 mm.

25 16. An apparatus according to any one of the preceding claims, wherein at least one insulator comprises a first layer and a second layer such that the first layer is closer to the conducting electrode than the second layer, and wherein the second layer has a lower surface conductivity than the first layer.

30 17. A method for causing an electrosensory sensation to at least one body member (120) to be stimulated, the method comprising:

- 5 - providing one or more conducting electrodes (106), each conducting electrode being provided with an insulator (108) wherein, when the at least one body member (120) to be stimulated is proximate to the conducting electrode, the insulator prevents flow of direct current from the conducting electrode to the body member to be stimulated and a capacitive coupling over the insulator (108) is formed between the conducting electrode (106) and the body member (120) to be stimulated;
- 10 - providing a high-voltage source (100, 102, 104) for applying an electrical input (OUT) to the one or more conducting electrodes, wherein the electrical input comprises a low-frequency component (114) in a frequency range between 10 Hz and 1000 Hz;
- wherein the capacitive coupling and electrical input are dimensioned to produce an electrosensory sensation; and
- 15 - whereby the electrosensory sensation is produced independently of any mechanical vibration of the one or more conducting electrodes (106) or insulators (108).

Fig. 1

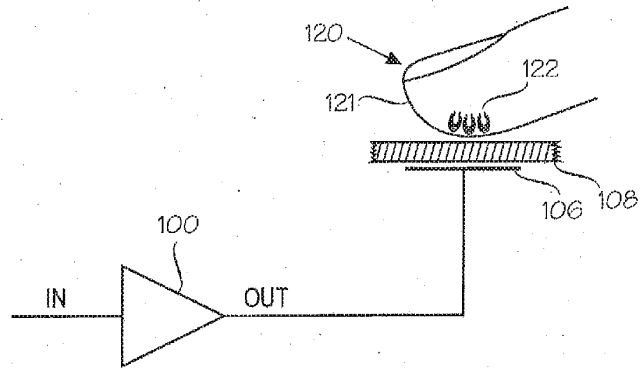


Fig. 2

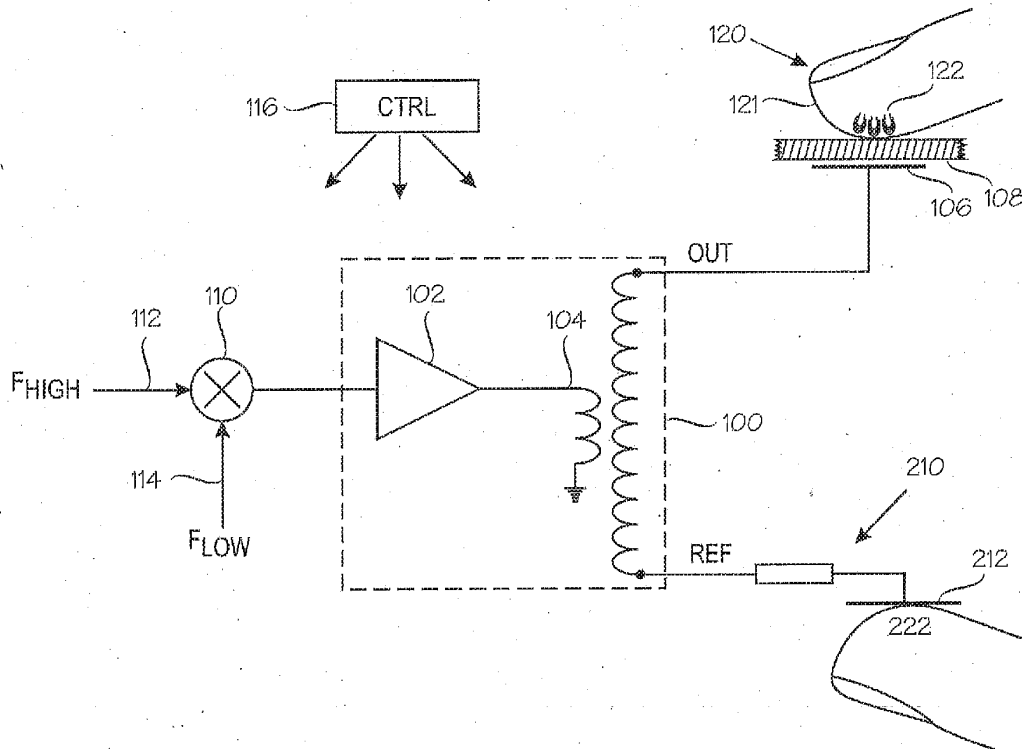


Fig. 3

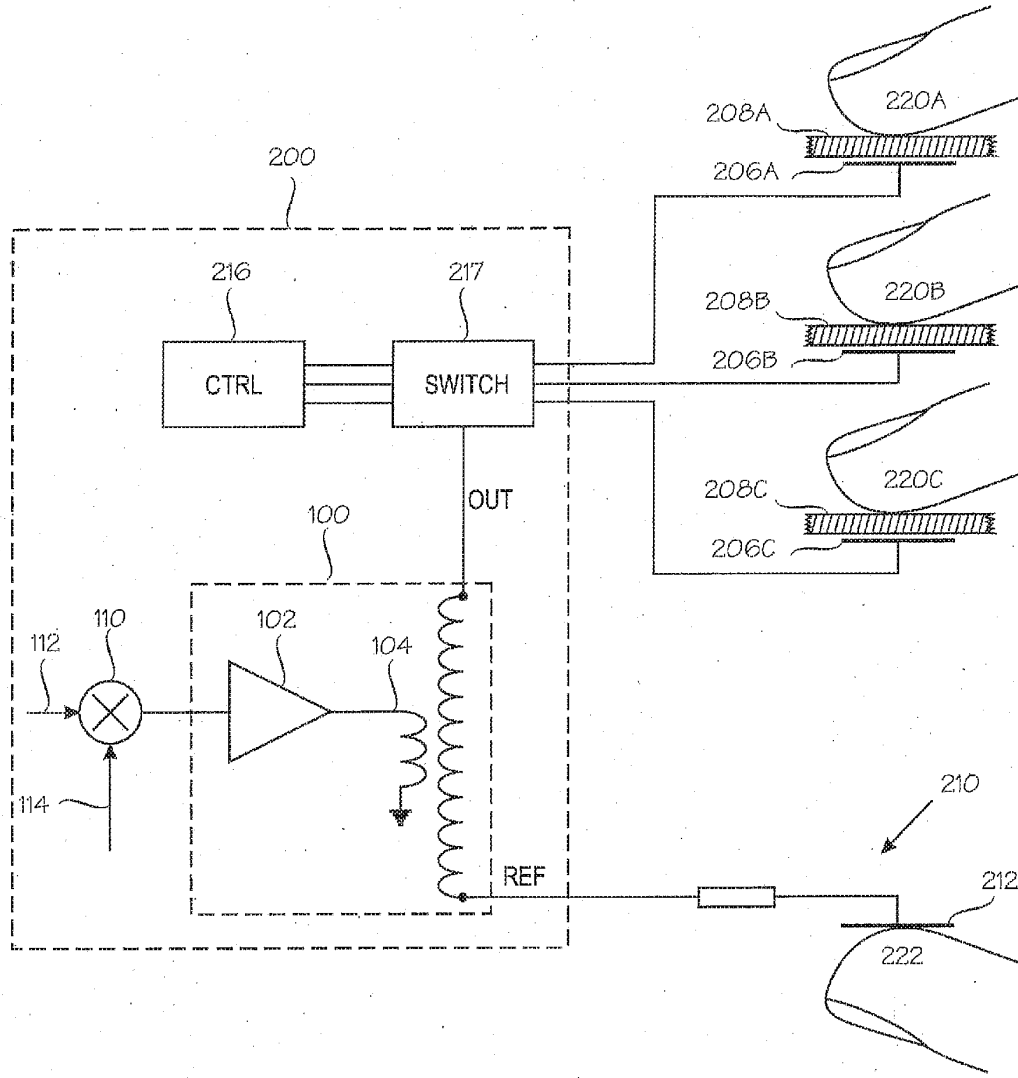


Fig. 4

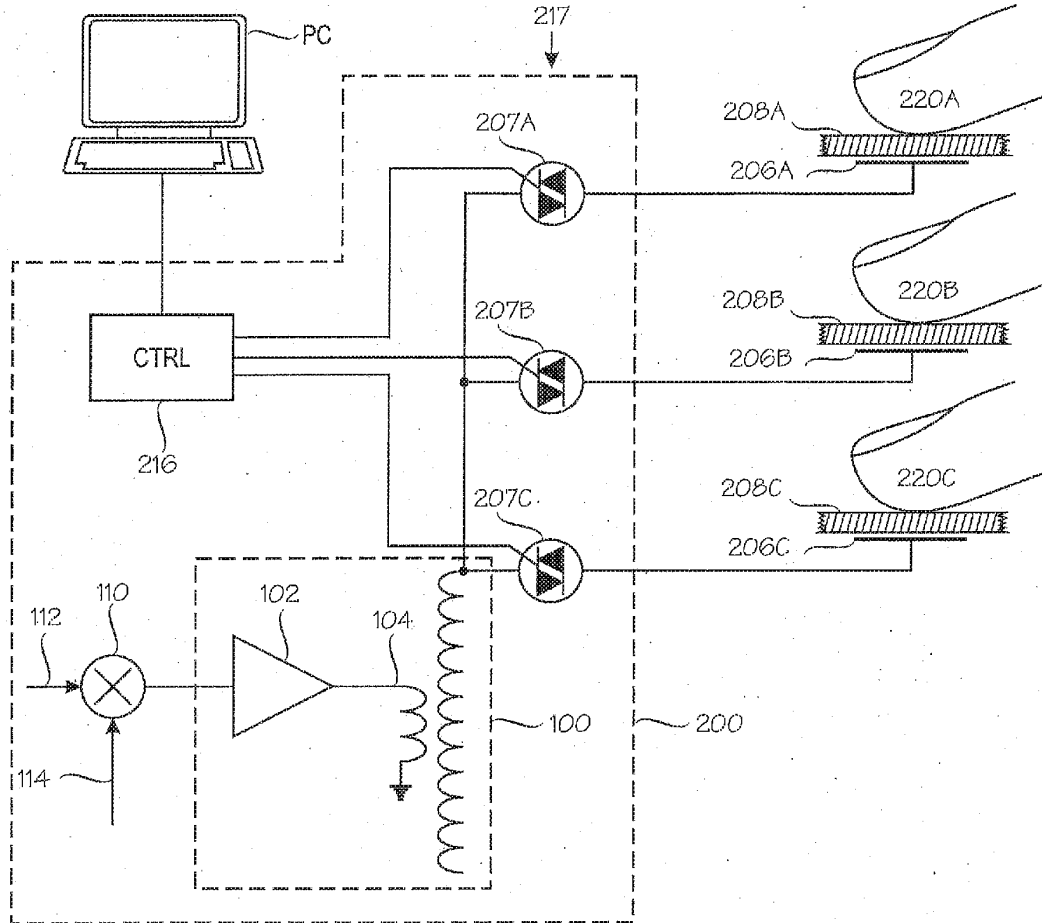


Fig. 5

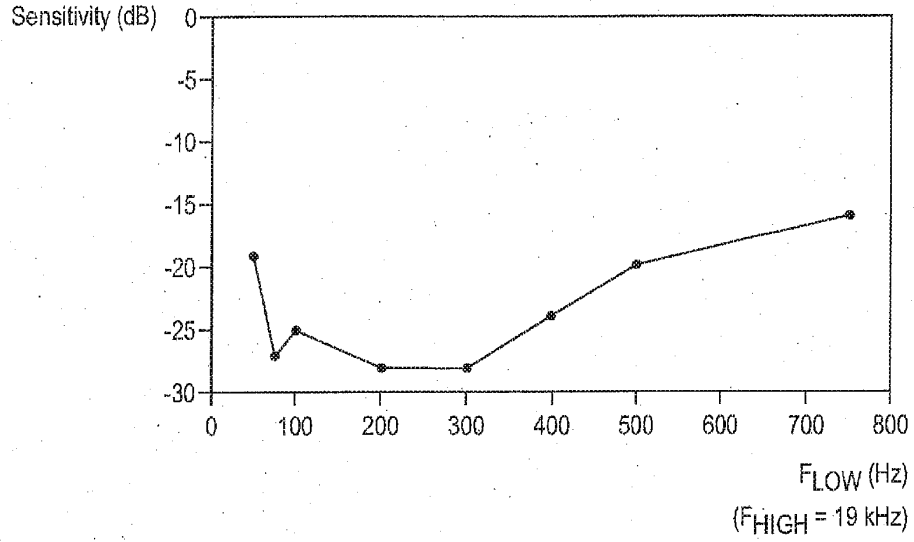
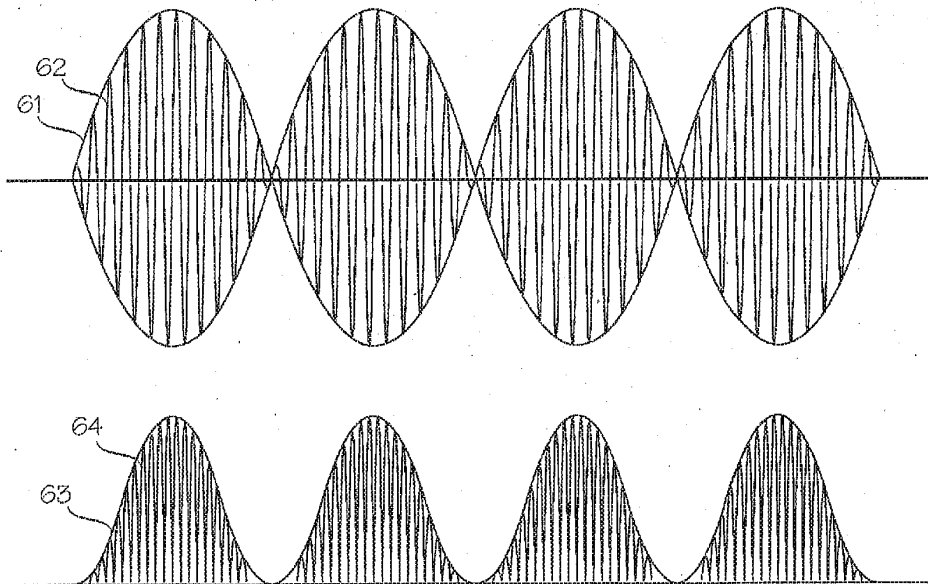


Fig. 6



5/8

Fig. 7A

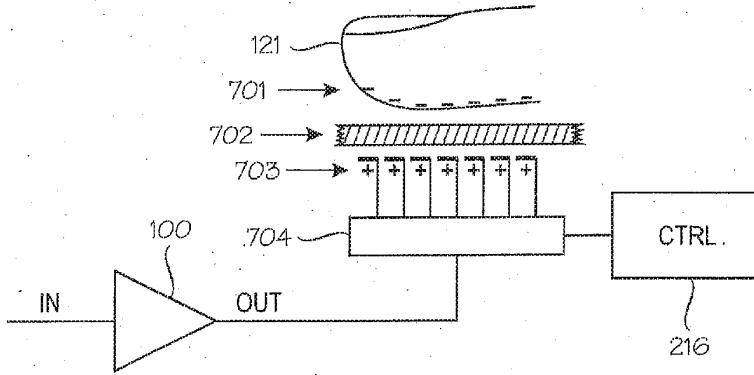


Fig. 7B

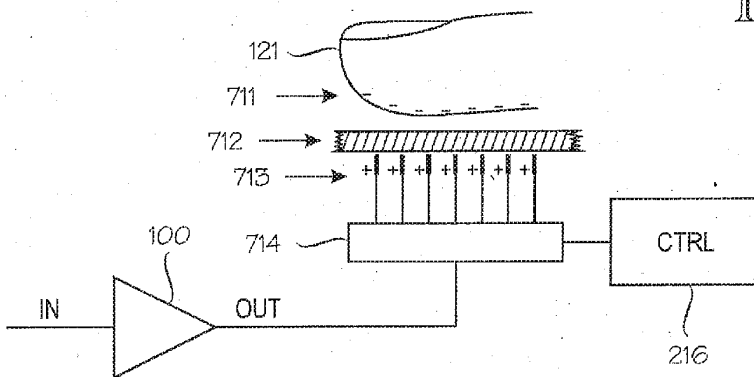


Fig. 8

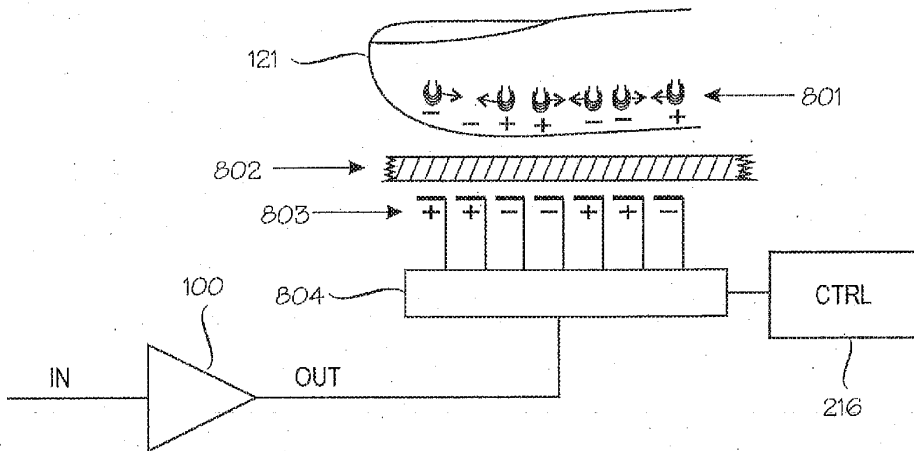


Fig. 9

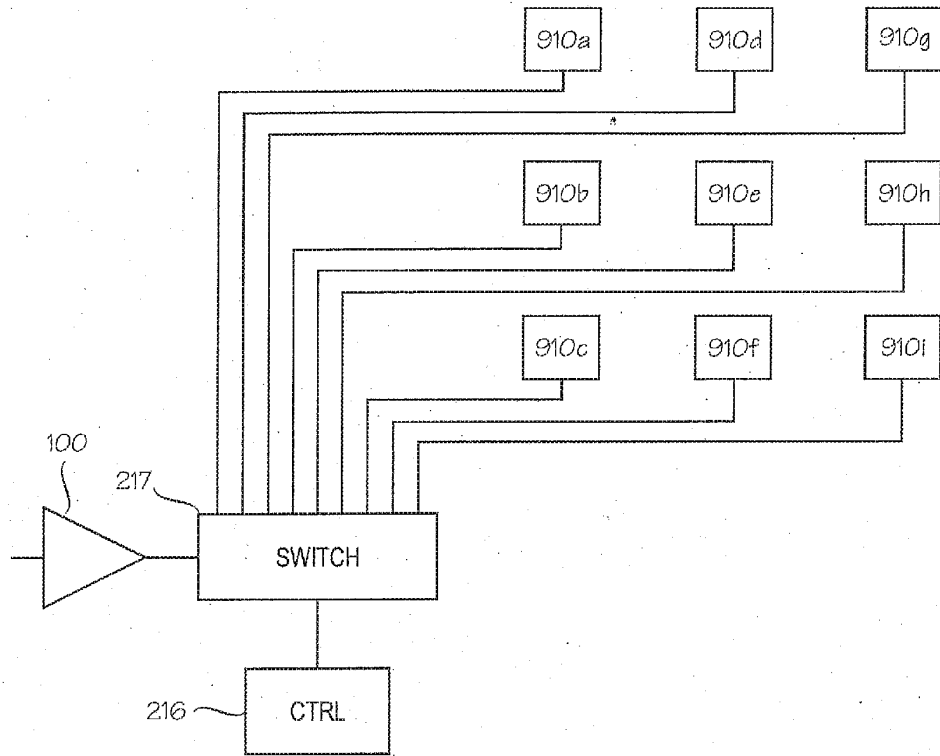


Fig. 10

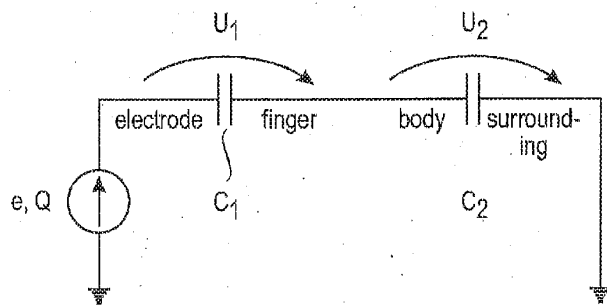


Fig. 11

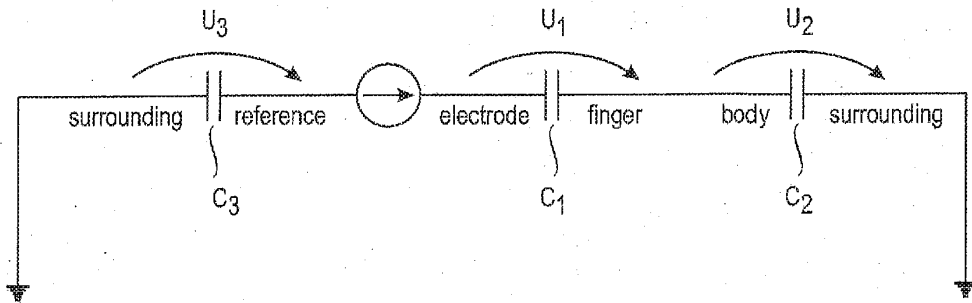


Fig. 12

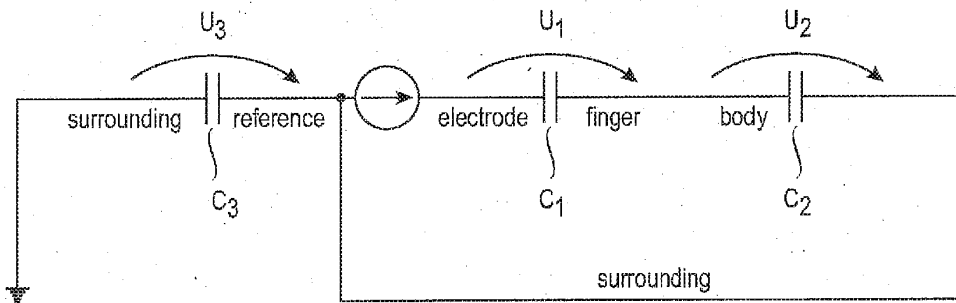


Fig. 13

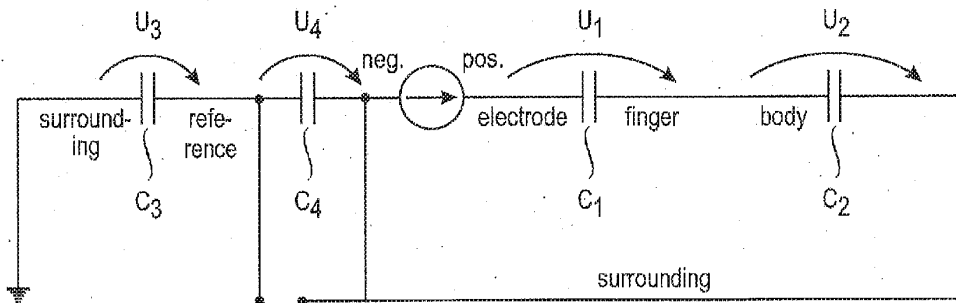


Fig. 14

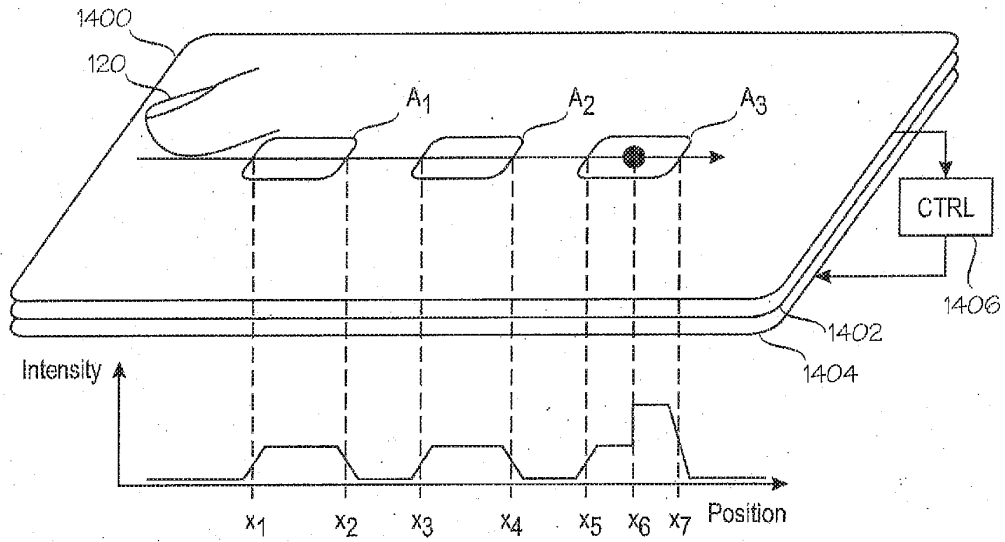
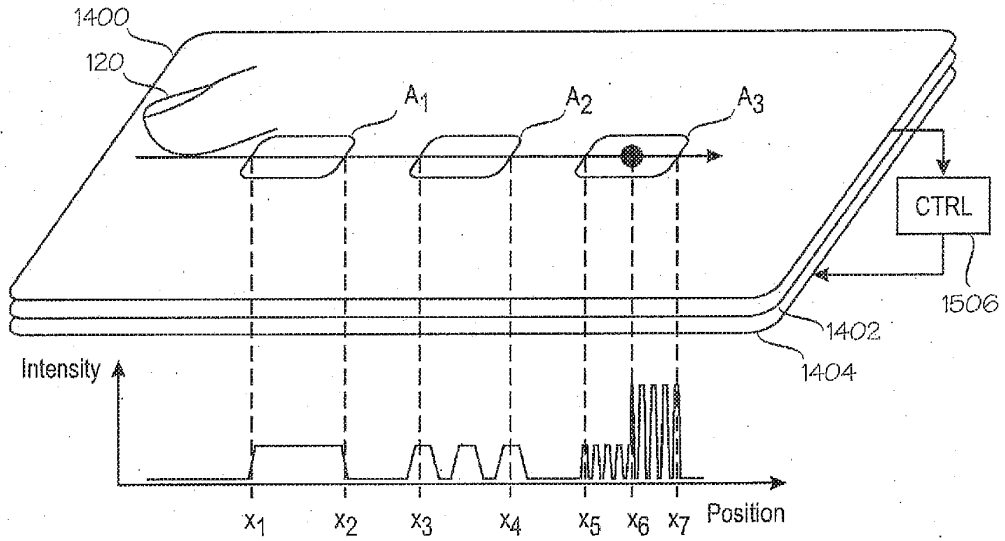


Fig. 15



INTERNATIONAL SEARCH REPORT

International application No.

PCT/FI2008/050514

A. CLASSIFICATION OF SUBJECT MATTER See extra sheet According to International Patent Classification (IPC) or to both national classification and IPC		
B. FIELDS SEARCHED Minimum documentation searched (classification system followed by classification symbols) IPC8: G06F, G09B, A61N Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched FI, SE, NO, DK Electronic data base consulted during the international search (name of data base and, where practicable, search terms used) EPO-Internal, WPI, XPIEE, XPI3E		
C. DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	KACZMAREK, K.A., et al., Polarity Effect in Electro vibration for Tactile Display; IEEE Transactions on Biomedical Engineering, Volume 53, Issue 10, Oct. 2006 Page(s): 2047-2054 <DOI: 10.1109/TBME.2006.881804> The whole document	1, 3-4, 7-10, and 17
X	YAMAMOTO, A., et al., Electrostatic tactile display with thin film slider and its application to tactile telepresentation systems; IEEE Transactions on Visualization and Computer Graphics, Volume 12, Issue 2, March-April 2006 Page(s): 168-177 <DOI: 10.1109/TVCG.2006.28> The whole document	1, 3-4, 7-10, and 17
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INTERNATIONAL SEARCH REPORT

International application No.

PCT/FI2008/050514

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	<p>AGARWAL, A.K., et al., A hybrid natural/artificial electrostatic actuator for tactile stimulation; 2nd Annual International IEEE-EMB Special Topic Conference on Microtechnologies in Medicine & Biology, 2-4 May 2002 Page(s): 341-345 <DOI: 10.1109/MMB.2002.1002343></p> <p>The whole document</p>	1, 3-4, 7-10, and 17
X	<p>BEEBE, D.J., et al., A polyimide-on-silicon electrostatic fingertip tactile display; Engineering in Medicine and Biology Society, 1995., IEEE 17th Annual Conference Volume 2, 20-23 Sept. 1995 Page(s): 1545-1546 vol.2 <DOI: 10.1109/IEMBS.1995.579819></p> <p>The whole document</p>	1, 3-4, 7-10, and 17
A	<p>KACZMAREK, K.A., et al., Electrotactile and vibrotactile displays for sensory substitution systems; IEEE Transactions on Biomedical Engineering, Volume 38, Issue 1, Jan. 1991 Page(s): 1-16 <DOI: 10.1109/10.68204></p> <p>The whole document</p>	1-17

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- (71) Applicant (for all designated States except US): NOKIA CORPORATION [FI/FI]; Keilalahdentie 4, FI-02150 Espoo (FI).
- (72) Inventor; and
(75) Inventor/Applicant (for US only): MÄENPÄÄ, Jani Christian [FI/FI]; Ulvilantie 29/9 A 147, FI-00350 Helsinki (FI).
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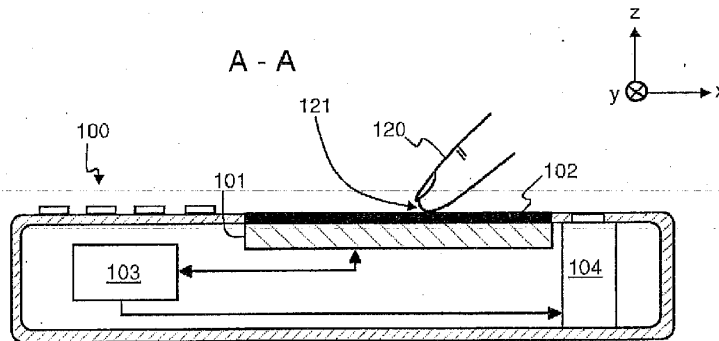


Fig. 1b

(57) Abstract: The invention relates to a user interface of an electronic device. The user interface comprises a touch sensitive display panel (101) and an actuator (104) that is arranged to generate a signal that is detectable for a human being. The actuator is arranged to alter a property of the signal as a response to a situation in which an external object (120) is slid on a surface (102) of the touch sensitive display panel. The property of the signal can be, for example, amplitude or frequency of mechanical vibration generated to a housing of the electronic device. The signal represents a feedback to a user of the electronic device and it makes the user interface more illustrative when the touch sensitive display panel is used for controlling a quantity having a continuous nature, e.g. volume of voice generated with a speaker element.

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A user interface

Field of the invention

The invention relates to a user interface of an electronic device. The invention further relates to a method and a computer program for controlling an electronic device.

Background

Electronic devices such as mobile communication terminals and palmtop computers are typically equipped with digital devices capable of supporting various services and application functions. As a consequence, designing user interfaces for electronic devices of the kind mentioned above presents unique challenges in view of limited size, a limited number of controls that can be accommodated on such devices, and a need for quick, simple, and intuitive device operation. Especially in conjunction with mobile devices the challenge related to a user interface is exacerbated because such devices are designed to be small, lightweight and easily portable. Consequently, mobile devices typically have limited display panels, keypads, keyboards and/or other input and output devices.

Touch sensitive display panels provide such advantages that a display screen and a keyboard can be integrated together and placing of press buttons of the keyboard can be made freely modifiable. Therefore, considerable savings in the size of a user interface can be achieved. A touch sensitive display panel is inherently suitable for implementing press keys and other control devices with the aid of which discrete control actions, such as pressing a press button, can be directed to an electronic device. On the other hand, using a touch sensitive display panel it is more challenging to implement a control device with the aid of which a quantity having a continuous and non-discrete nature could be adjusted. The quantity having a continuous and non-discrete nature can be, for example, strength of voice generated with a speaker element, brightness of an image shown on a display screen, or a gain of a microphone circuitry.

In a solution according to the prior art a user interface of an electronic device includes both a touch sensitive display panel and mechanical control devices. Display functionalities and at least part of control devices for discrete control actions are implemented with the aid of the touch sensitive display panel. Control actions

for adjusting quantities having a continuous nature are carried out using the mechanical control devices. A mechanical control device can be, for example, a mechanical slide or a rotatable knob. The mechanical control devices require room in the user interface, they are vulnerable to impurities, and their placing in the user interface cannot be altered according to different needs in different operational situations of the electronic device.

Summary

In accordance with a first aspect of the invention a novel user interface is provided. The user interface comprises:

- 10 - a touch sensitive display panel,
- a controller arranged to control an electronic device on the basis of a position of an external object on a surface of the touch sensitive display panel, and
- 15 - an actuator arranged to generate a signal that is detectable for a human being,

wherein the actuator is arranged to alter a property of said signal as a response to a situation in which the external object is slid on the surface of the touch sensitive display panel.

20 The signal that is detectable for a human being represents a feedback to a user of the user interface and it makes the user interface more illustrative when the touch sensitive display panel is used for controlling an electronic device by sliding a finger or some other object on the touch sensitive display panel. In a user interface according to an embodiment of the invention a sliding control device and/or a rotatable control device for controlling quantities having a continuous nature are implemented with the aid of the touch sensitive display panel. The signal that is detectable for a human being can be used for giving to the user a conception of an instantaneous value or strength of the quantity that is being adjusted with the sliding control device or the rotatable control device.

30 In accordance with a second aspect of the invention a novel method that can be used for controlling an electronic device is provided. The method comprises:

- controlling an electronic device on the basis of a position of an external object on a surface of a touch sensitive display panel,

- generating a signal that is detectable for a human being, and
- altering a property of said signal as a response to a situation in which the external object is slid on the surface of the touch sensitive display panel.

In accordance with a third aspect of the invention a novel electronic device is provided. The electronic device comprises:

- a touch sensitive display panel,
- a controller arranged to control an electronic device on the basis of a position of an external object on a surface of the touch sensitive display panel, and
- an actuator arranged to generate a signal that is detectable for a human being,

wherein the actuator is arranged to alter a property of said signal as a response to a situation in which the external object is slid on the surface of the touch sensitive display panel.

The electronic device can be, for example, a mobile communication terminal, a palmtop computer, a portable play station, or a measurement instrument such as an oscilloscope. The electronic device can also be a combination of a mobile communication terminal, a palmtop computer, and a portable play station. The electronic device can also be, for example, a domestic appliance or an apparatus for industrial use. A domestic appliance can be e.g. a dishwasher or a washing machine. The apparatus for industrial use can be e.g. a part of control room equipment.

In accordance with a fourth aspect of the invention a novel computer program is provided for making a processor unit to control an electronic device that includes:

- a touch sensitive display panel, and
- an actuator arranged to generate a signal that is detectable for a human being.

The computer program comprises computer executable instructions for making the processor unit:

- to control the electronic device on the basis of a position of an external object on a surface of the touch sensitive display panel, and
 - to alter a property of said signal as a response to a situation in which the external object is slid on the surface of the touch sensitive display panel.
- 5 A computer readable medium can be encoded with the above-mentioned computer executable instructions.

In accordance with a fifth aspect of the invention a novel interface module is provided. The interface module comprises:

- a touch sensitive display panel,
- 10 - a controller capable of controlling an electronic device on the basis of a position of an external object on a surface of the touch sensitive display panel, and
- an actuator arranged to generate a signal that is detectable for a human being,

- 15 wherein the actuator is arranged to alter a property of said signal as a response to a situation in which the external object is slid on the surface of the touch sensitive display panel.

A number of embodiments of the invention are described in accompanied dependent claims.

- 20 Various embodiments of the invention both as to constructions and to methods of operation, together with additional objects and advantages thereof, will be best understood from the following description of specific embodiments when read in connection with the accompanying drawings.

- 25 The embodiments of the invention presented in this document are not to be interpreted to pose limitations to the applicability of the appended claims. The verb "to comprise" is used in this document as an open limitation that does not exclude the existence of also unrecited features. The features recited in depending claims are mutually freely combinable unless otherwise explicitly stated.

Brief description of the figures

The embodiments of the invention that are presented in the sense of examples and their advantages are explained in greater detail below with reference to the accompanying drawings, in which:

5 figures 1a and 1b show an electronic device comprising a user interface according to an embodiment of the invention,

figures 2a and 2b show an electronic device according to an embodiment of the invention,

10 figure 3 is a flow chart of a method according to an embodiment of the invention, and

figure 4 shows an interface module according to an embodiment of the invention.

Description of the embodiments

15 A user interface according to an embodiment of the invention comprises: (i) a touch sensitive display panel, (ii) means for controlling an electronic device on the basis of a position of an external object on a surface of the touch sensitive display panel, (iii) means for generating a signal that is detectable for a human being, and (iv) means for altering a property of said signal as a response to a situation in which the external object is slid on the surface of the touch sensitive display panel.

20 Figure 1a shows an electronic device 100 comprising a user interface according to an embodiment of the invention. Figure 1b shows the A-A section view of the electronic device. The user interface of the electronic device comprises a touch sensitive display panel 101 and a controller 103 that is arranged to control the electronic device on the basis of a position of an external object 120 on a surface 102 of the touch sensitive display panel 101. The position of the external object can expressed, for example, with the x- and y-coordinates of a spot 121 where the external object touches the touch sensitive display panel. In the exemplifying situation shown in figures 1a and 1b the external object 120 is a finger of a user of the electronic device 100. The external object 120 could as well be e.g. a pen or a stylus. The user interface comprises an actuator 104 that is arranged to generate a signal that is detectable for a human being, i.e. for the user of the electronic device. The actuator is arranged to alter a property of the signal that can be detected by the user when the external object 120 is slid on the surface 102 of the touch sensitive

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display panel. The user interface of the electronic device can comprise also a mechanical keyboard 110 and/or other control devices for exchanging information between the electronic device and the user. In the exemplifying situation shown in figures 1a and 1b a sliding control device 111 for controlling a quantity having a continuous nature is implemented with the aid of the touch sensitive display panel 101. The quantity that can be adjusted with the sliding control device can be, for example, strength of voice generated with a speaker element, background brightness of the touch sensitive display panel, or a gain of a microphone circuitry. The above-mentioned quantity can be increased by sliding the external object in the direction of an arrow 112 on the surface of the touch sensitive display panel. The above-mentioned quantity can be decreased by sliding the external object in the direction of an arrow 112' on the surface of the touch sensitive display panel.

In a user interface according to an embodiment of the invention the actuator 104 is a vibration generator. The vibration generator can be, for example, an electromechanical vibration generator or a piezo-electric vibration generator. The controller 103 is arranged to alter amplitude of mechanical vibration produced with the vibration generator as a response to the situation in which the external object is slid on the surface of the touch sensitive display panel. The amplitude is increased preferably when the external object is slid in the direction of the arrow 112 and the amplitude is decreased preferably when external object is slid in the direction of the arrow 112'. Therefore, the user of the electronic device gets feedback from the electronic device via his/her sense of touch. In a user interface according to another embodiment of the invention, the controller 103 is arranged to alter frequency of mechanical vibration produced with the vibration generator as a response to the situation in which the external object is slid on the surface of the touch sensitive display panel.

In a user interface according to an embodiment of the invention a part 104' of the touch sensitive display panel 101 is used as the actuator that is arranged to generate a signal that is detectable for a human being, i.e. for the user of the electronic device. The controller 103 is arranged to alter intensity of light shown on the part 104' of the touch sensitive display panel as a response to the situation in which the external object is slid on the surface of the touch sensitive display panel.

In a user interface according to an embodiment of the invention the actuator 104 is an oscillator capable of generating voice. The controller 103 is arranged to alter amplitude of the voice produced with the oscillator as a response to the situation in which the external object is slid on the surface of the touch sensitive display panel.

In a user interface according to another embodiment of the invention, the controller 103 is arranged to alter frequency of the voice produced with the oscillator as a response to the situation in which the external object is slid on the surface of the touch sensitive display panel.

- 5 In a user interface according to an embodiment of the invention the actuator 104 is a light source. The controller 103 is arranged to alter intensity of light produced with the light source as a response to the situation in which the external object is slid on the surface of the touch sensitive display panel. In a user interface according to another embodiment of the invention, the controller 103 is arranged to alter
10 color of light produced with the light source as a response to the situation in which the external object is slid on the surface of the touch sensitive display panel.

- In a user interface according to an embodiment of the invention the actuator 104 is arranged to alter the property of the signal generated by it as a response to a situation in which the external object is slid along a pre-determined path on the surface of the touch sensitive display panel. The pre-determined path can be defined
15 e.g. by a displayed symbol of a control device 111. The pre-determined path can be a linear path in which case a sliding control device is implemented with the aid of the touch sensitive display surface as shown in figure 1b. As an alternative, the pre-determined path can be a circular path in which case a rotatable control device
20 is implemented with the aid of the touch sensitive display surface.

- It is also possible that the control device is arranged to alter the property of the signal that is detectable for a human being as a response to a situation in which the external object is slid in a pre-determined direction, e.g. in the x-direction, on the surface of the touch sensitive display panel. In this case, the electronic device
25 can be controlled by sweeping the surface of the touch sensitive display panel starting from an arbitrary point of the touch sensitive display panel. The direction and the length of the sweep can be used for determining the effect of a control action.

- An electronic device according to an embodiment of the invention comprises: (i) a
30 touch sensitive display panel, (ii) means for controlling the electronic device on the basis of a position of an external object on a surface of the touch sensitive display panel, (iii) means for generating a signal that is detectable for a human being, and (iv) means for altering a property of said signal as a response to a situation in which the external object is slid on the surface of the touch sensitive display panel.

Figure 2a shows an electronic device 200 according to an embodiment of the invention. Figure 2b shows the A-A section view of the electronic device. The electronic device can be a mobile communication terminal, a palmtop computer, a portable play station, or a combination of them. The electronic device comprises a touch sensitive display panel 201 and a controller 203 that is arranged to control the electronic device on the basis of a position of an external object 220 on a surface 202 of the touch sensitive display panel 201. The position of the external object can be expressed, for example, with the x- and y-coordinates of a spot in which the external object touches the touch sensitive display panel. In the exemplifying situation shown in figures 2a and 2b the external object 220 is a finger of a user of the electronic device 200. The electronic device comprises an actuator 204 that is arranged to generate a signal that is detectable for a human being, i.e. for the user of the electronic device. The actuator is arranged to alter a property of the signal that can be detected by the user as a response to a situation in which the external object 220 is slid on the surface 202 of the touch sensitive display panel. In the exemplifying situation shown in figures 2a and 2b a rotatable control device 211 for controlling a quantity having a continuous nature is implemented with the aid of the touch sensitive display panel 201. The quantity that can be adjusted with the rotatable control device 211 can be, for example, strength of voice generated with a speaker element 205, background brightness of the touch sensitive display panel 201, or amplitude of an electrical signal produced with a microphone 206. The above-mentioned quantity can be increased by sliding the external object along a circular path clockwise according to an arrow 212 on the surface of the touch sensitive display panel. The above-mentioned quantity can be decreased by sliding the external object along the circular path counter-clockwise according to the arrow 212 on the surface of the touch sensitive display panel.

In an electronic device according to an embodiment of the invention the actuator 204 is a vibration generator. The controller 203 is arranged to alter amplitude of mechanical vibration produced with the vibration generator as a response to the situation in which the external object is slid on the surface of the touch sensitive display panel. In an electronic device according to another embodiment of the invention the controller 203 is arranged to alter frequency of the mechanical vibration produced with the vibration generator as a response to the situation in which the external object is slid on the surface of the touch sensitive display panel.

In an electronic device according to an embodiment of the invention the actuator 204 is arranged to alter the property of the signal generated with it as a response to a

situation in which the external object is slid along a pre-determined path on the surface of the touch sensitive display panel. The pre-determined path can be a circular path in which case a rotatable control device is implemented with the aid of the touch sensitive display surface as shown in figure 2b. As an alternative, the
5 pre-determined path can be a linear path in which case a sliding control device is implemented with the aid of the touch sensitive display surface.

In an electronic device according an embodiment of the invention the controller 203 is arranged to control, on the basis of the position of the external object on the surface of the touch sensitive display panel, a gain of an amplifier circuitry 207
10 coupled to the speaker element 205.

In an electronic device according an embodiment of the invention the controller 203 is arranged to control, on the basis of the position of the external object on the surface of the touch sensitive display panel, a gain of an amplifier circuitry 208 coupled to the microphone 206.

15 It should be noted that an electronic device according to an embodiment of the invention is not necessarily a portable electronic device. An electronic device according to an embodiment of the invention can be as well, for example, a domestic appliance or fixed industrial equipment.

20 Figure 3 is a flow chart of a method according to an embodiment of the invention for controlling an electronic device. Phase 301 comprises controlling the electronic device on the basis of a position of an external object on a surface of a touch sensitive display panel. Phase 302 comprises generating a signal that is detectable for a human being. Phase 303 comprises altering a property of said signal as a response to a situation in which the external object is slid on the surface of the touch
25 sensitive display panel. The external object can be e.g. a finger of a user of the electronic device, a pen, or a stylus.

In a method according to an embodiment of the invention the detectable signal is mechanical vibration generated to the housing of the electronic device and amplitude of the mechanical vibration is altered as a response to the situation in which
30 the external object is slid on the surface of the touch sensitive display panel. The mechanical vibration can be generated, for example, with an electromechanical vibration generator or a piezo-electric vibration generator.

In a method according to an embodiment of the invention the detectable signal is mechanical vibration generated to the housing of the electronic device and fre-

quency of said mechanical vibration is altered as a response to the situation in which the external object is slid on the surface of the touch sensitive display panel.

In a method according to an embodiment of the invention the detectable signal is voice and amplitude of the voice is altered as a response to the situation in which the external object is slid on the surface of the touch sensitive display panel.

In a method according to an embodiment of the invention the detectable signal is voice and frequency of the voice is altered as a response to the situation in which the external object is slid on the surface of the touch sensitive display panel.

In a method according to an embodiment of the invention the detectable is light and intensity of the light is altered as a response to the situation in which the external object is slid on the surface of the touch sensitive display.

In a method according to an embodiment of the invention the detectable signal is light and color of the light is altered as a response to the situation in which the external object is slid on the surface of the touch sensitive display.

In a method according to an embodiment of the invention the property of the detectable signal is altered as a response to a situation in which the external object is slid along a pre-determined path on the surface of the touch sensitive display panel. The pre-determined path can be, for example, a linear path on the surface of the touch sensitive display panel or a circular path on the surface of the touch sensitive display panel.

Figure 4 shows an interface module 400 according to an embodiment of the invention. The interface module can be used as a building block of an electronic device that can be e.g. a mobile phone, a domestic appliance, or industrial equipment. The interface module comprises a touch sensitive display panel 401 and a controller 403 that is capable of controlling an electronic device on the basis of a position of an external object on a surface of the touch sensitive display panel 401. The position of the external object can be expressed, for example, with the x- and y-coordinates of a spot in which the external object touches the touch sensitive display panel. The interface module comprises an actuator 404 that is arranged to generate a signal that is detectable for a human being. The actuator is arranged to alter a property of the detectable signal as a response to a situation in which the external object is slid on the surface of the touch sensitive display panel. The interface module comprises connector pads 450 via which electrical signals can be conducted to/from the interface module. The interface module can be used, for

example, for implementing a control device with the aid of which a quantity having a continuous nature can be controlled and tactile, audio, and/or visual feedback depending on the type of the actuator 404 can be given to a user of the control device.

- 5 In an interface module according to an embodiment of the invention the actuator 404 is arranged to alter the property of the signal generated by it as a response to a situation in which the external object is slid along a pre-determined path on the surface of the touch sensitive display panel. The pre-determined path can be, for example, a linear path on the surface of the touch sensitive display panel or a circular path on the surface of the touch sensitive display panel.
- 10

A computer program according to an embodiment of the invention comprises software modules for making a processor unit to control an electronic device that includes:

- a touch sensitive display panel, and
- 15 - an actuator arranged to generate a signal that is detectable for a human being.

The software modules comprise computer executable instructions for making the processor unit:

- 20 - to control the electronic device on the basis of a position of an external object on a surface of the touch sensitive display panel, and
- to alter a property of said signal as a response to a situation in which the external object is slid on the surface of the touch sensitive display panel.

The processor unit in which the computer program can be executed can be e.g. the controller 203 of the electronic device 200 shown in figures 2a and 2b.

- 25 The software modules can be, for example, sub-routines and/or functions.

- In a computer program according to an embodiment of the invention the computer executable instructions are capable of making the processor unit to alter the property of the detectable signal as a response to a situation in which the external object is slid along a pre-determined path on the surface of the touch sensitive display panel. The pre-determined path can be, for example, a linear path on the sur-
- 30

face of the touch sensitive display panel or a circular path on the surface of the touch sensitive display panel.

A computer program according to an embodiment of the invention can be stored in a computer readable medium. The computer readable medium can be, for example,
5 p, an optical compact disk or an electronic memory device like a RAM (random access memory) or a ROM (read only memory).

While there have been shown and described and pointed out fundamental novel features of the invention as applied to embodiments thereof, it will be understood that various omissions and substitutions and changes in the form and details of the
10 devices and methods described may be made by those skilled in the art without departing from the spirit of the invention. For example, it is expressly intended that all combinations of those elements and/or method steps which perform substantially the same function in substantially the same way to achieve the same results are within the scope of the invention. Moreover, it should be recognized that struc-
15 tures and/or elements and/or method steps shown and/or described in connection with any disclosed form or embodiment of the invention may be incorporated in any other disclosed or described or suggested form or embodiment as a general matter of design choice. The specific examples provided in the description given above should not be construed as limiting. Therefore, the invention is not limited
20 merely to the embodiments described above, many variants being possible without departing from the scope of the inventive idea.

What is claimed is:

1. A user interface comprising:

- a touch sensitive display panel,
- 5 - a controller arranged to control an electronic device on the basis of a position of an external object on a surface of the touch sensitive display panel, and
- an actuator arranged to generate a signal that is detectable for a human being,

10 wherein the actuator is arranged to alter a property of said signal as a response to a situation in which the external object is slid on the surface of the touch sensitive display panel.

15 2. A user interface according to claim 1, wherein the actuator is a vibration generator that is arranged to alter amplitude of mechanical vibration produced with the vibration generator as a response to the situation in which the external object is slid on the surface of the touch sensitive display panel.

3. A user interface according to claim 1, wherein the actuator is a vibration generator that is arranged to alter frequency of mechanical vibration produced with the vibration generator as a response to the situation in which the external object is slid on the surface of the touch sensitive display panel.

20 4. A user interface according to claim 1, wherein the actuator is an oscillator that is arranged to alter amplitude of voice produced with the oscillator as a response to the situation in which the external object is slid on the surface of the touch sensitive display panel.

25 5. A user interface according to claim 1, wherein the actuator is an oscillator that is arranged to alter frequency of voice produced with the oscillator as a response to the situation in which the external object is slid on the surface of the touch sensitive display panel.

30 6. A user interface according to claim 1, wherein the actuator is a light source that is arranged to alter intensity of light produced with the light source as a response to the situation in which the external object is slid on the surface of the touch sensitive display panel.

7. A user interface according to claim 1, wherein the actuator is a light source that is arranged to alter color of light produced with the light source as a response to the situation in which the external object is slid on the surface of the touch sensitive display panel.
- 5 8. A user interface according to claim 1, wherein the actuator is arranged to alter the property of said signal as a response to a situation in which the external object is slid along a pre-determined path on the surface of the touch sensitive display panel.
9. A user interface according to claim 8, wherein the pre-determined path is one
10 of the following: a linear path on the surface of the touch sensitive display panel and a circular path on the surface of the touch sensitive display panel.
10. A user interface according to claim 2 or 3, wherein the vibration generator is one of the following: an electromechanical vibration generator and a piezo-electric vibration generator.
- 15 11. A method comprising:
- controlling an electronic device on the basis of a position of an external object on a surface of a touch sensitive display panel,
 - generating a signal that is detectable for a human being, and
 - altering a property of said signal as a response to a situation in which the
20 external object is slid on the surface of the touch sensitive display panel.
12. A method according to claim 11, wherein said signal is mechanical vibration and amplitude of said mechanical vibration is altered as a response to the situation in which the external object is slid on the surface of the touch sensitive display panel.
- 25 13. A method according to claim 11, wherein said signal is mechanical vibration and frequency of said mechanical vibration is altered as a response to the situation in which the external object is slid on the surface of the touch sensitive display panel.
14. A method according to claim 11, wherein said signal is voice and amplitude
30 of said voice is altered as a response to the situation in which the external object is slid on the surface of the touch sensitive display panel.

15. A method according to claim 11, wherein said signal is voice and frequency of said voice is altered as a response to the situation in which the external object is slid on the surface of the touch sensitive display panel.
16. A method according to claim 11, wherein said signal is light and intensity of
5 said light is altered as a response to the situation in which the external object is slid on the surface of the touch sensitive display.
17. A method according to claim 11, wherein said signal is light and color of said light is altered as a response to the situation in which the external object is slid on the surface of the touch sensitive display.
- 10 18. A method according to claim 11, wherein the property of said signal is altered as a response to a situation in which the external object is slid along a pre-determined path on the surface of the touch sensitive display panel.
19. A method according to claim 11, wherein the pre-determined path is one of
15 the following: a linear path on the surface of the touch sensitive display panel and a circular path on the surface of the touch sensitive display panel.
20. A method according to claim 12 or 13, wherein the mechanical vibration is generated with one of the following: an electromechanical vibration generator and a piezo-electric vibration generator.
21. An electronic device comprising:
- 20 - a touch sensitive display panel,
- a controller arranged to control an electronic device on the basis of a position of an external object on a surface of the touch sensitive display panel, and
- an actuator arranged to generate a signal that is detectable for a human being,
25 ing,
- wherein the actuator is arranged to alter a property of said signal as a response to a situation in which the external object is slid on the surface of the touch sensitive display panel.
22. An electronic device according to claim 21, wherein the actuator is a vibration
30 generator that is arranged to alter amplitude of mechanical vibration produced with

the vibration generator as a response to the situation in which the external object is slid on the surface of the touch sensitive display panel.

23. An electronic device according to claim 21, wherein the actuator is a vibration generator that is arranged to alter frequency of mechanical vibration produced with the vibration generator as a response to the situation in which the external object is slid on the surface of the touch sensitive display panel.

24. An electronic device according to claim 21, wherein the actuator is arranged to alter the property of said signal as a response to a situation in which the external object is slid along a pre-determined path on the surface of the touch sensitive display panel.

25. An electronic device according to claim 24, wherein the pre-determined path is one of the following: a linear path on the surface of the touch sensitive display panel and a circular path on the surface of the touch sensitive display panel.

26. An electronic device according to claim 21, wherein the controller is arranged to control a gain of an amplifier circuitry coupled to a speaker element on the basis of the position of the external object on the surface of the touch sensitive display panel.

27. An electronic device according to claim 21, wherein the controller is arranged to control a gain of an amplifier circuitry coupled to a microphone on the basis of the position of the external object on the surface of the touch sensitive display panel.

28. An electronic device according to claim 21, wherein the electronic device is at least one of the following: a mobile communication terminal, a palmtop computer, and a portable play station.

29. A computer readable medium storing a computer program for making a processor unit to control an electronic device that includes:

- a touch sensitive display panel, and
- an actuator arranged to generate a signal that is detectable for a human being,

the computer program comprising computer executable instructions for making the processor unit:

- to control the electronic device on the basis of a position of an external object on a surface of the touch sensitive display panel, and
- to alter a property of said signal as a response to a situation in which the external object is slid on the surface of the touch sensitive display panel.

5 30. A computer readable medium according to claim 29, wherein the computer executable instructions are capable of making the processor unit to alter the property of said signal as a response to a situation in which the external object is slid along a pre-determined path on the surface of the touch sensitive display panel.

31. An interface module comprising:

- 10
- a touch sensitive display panel,
 - a controller capable of controlling an electronic device on the basis of a position of an external object on a surface of the touch sensitive display panel, and
 - 15 - an actuator arranged to generate a signal that is detectable for a human being,

wherein the actuator is arranged to alter a property of said signal as a response to a situation in which the external object is slid on the surface of the touch sensitive display panel.

20 32. An interface module according to claim 31, wherein the actuator is arranged to alter the property of said signal as a response to a situation in which the external object is slid along a pre-determined path on the surface of the touch sensitive display panel.

33. A user interface comprising:

- 25
- a touch sensitive display panel,
 - means for controlling an electronic device on the basis of a position of an external object on a surface of the touch sensitive display panel,
 - means for generating a signal that is detectable for a human being, and

- means for altering a property of said signal as a response to a situation in which the external object is slid on the surface of the touch sensitive display panel.

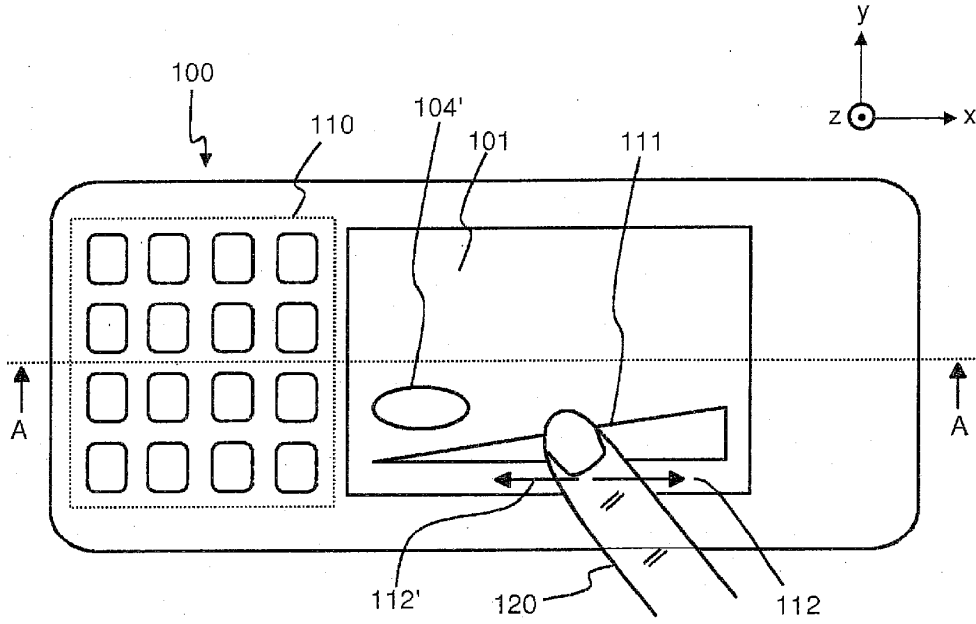


Fig. 1a

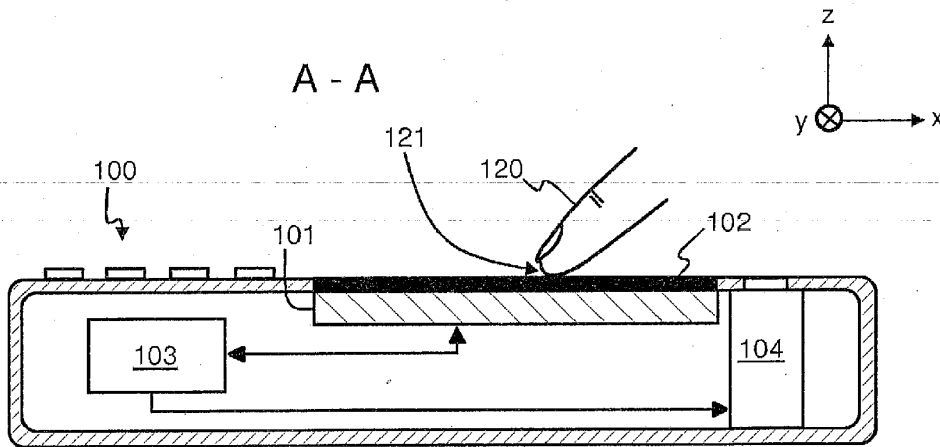


Fig. 1b

2 / 4

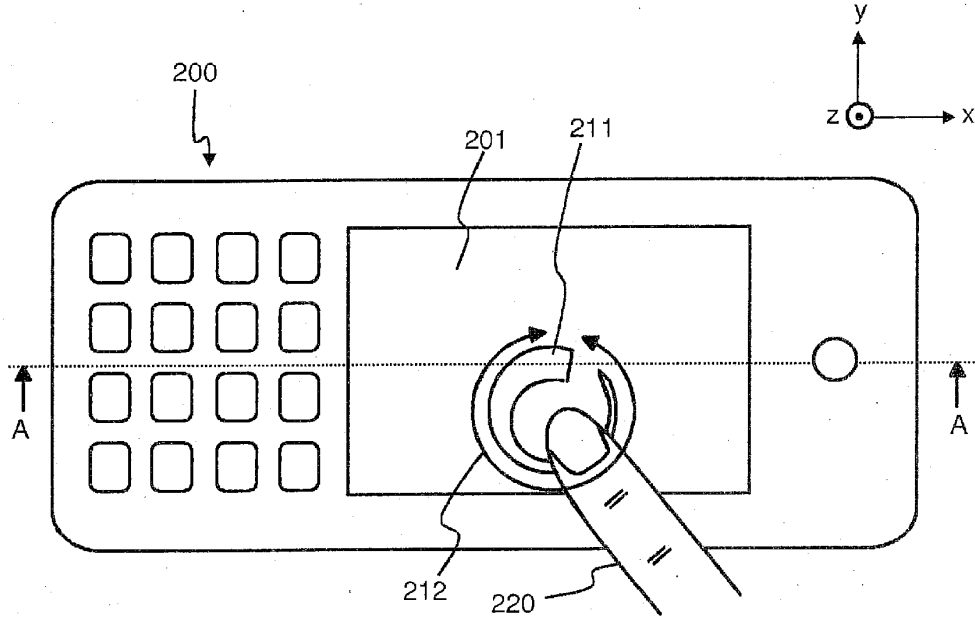


Fig. 2a

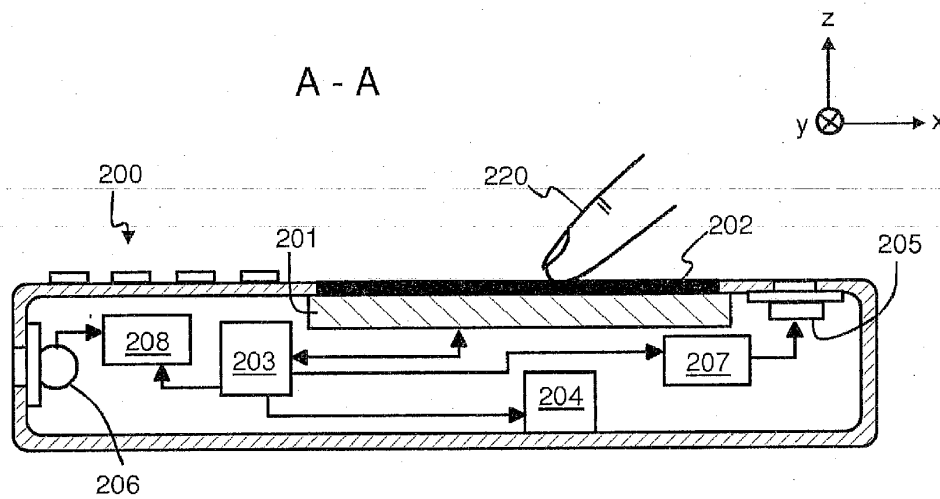


Fig. 2b

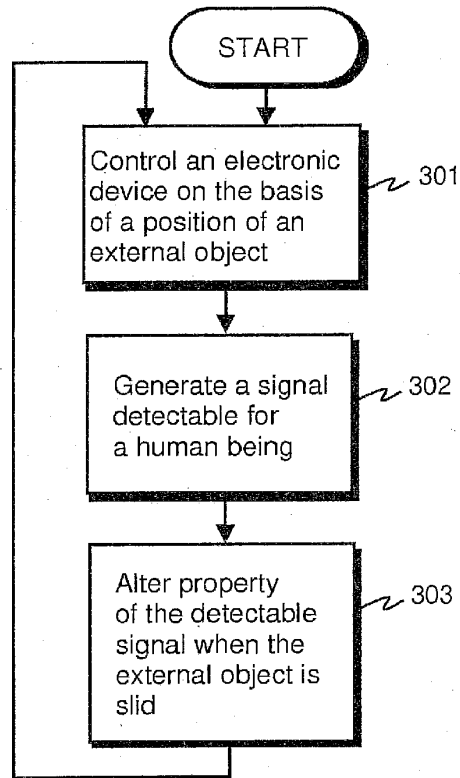


Fig. 3

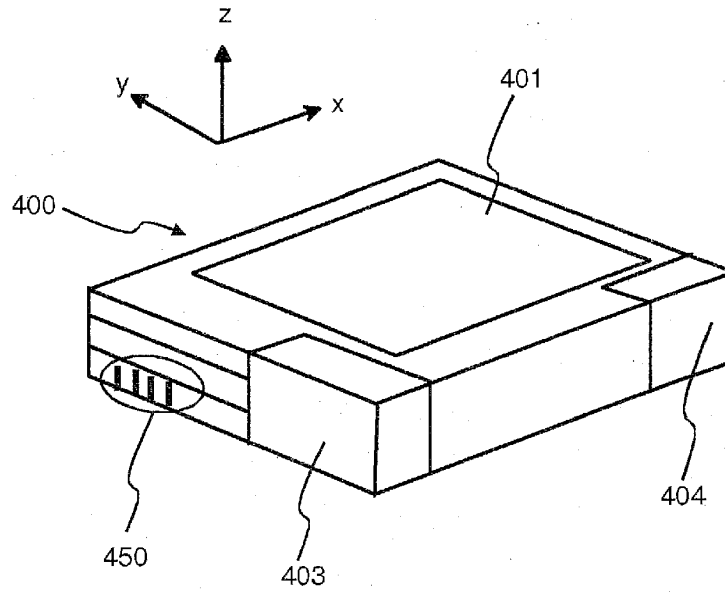


Fig. 4

INTERNATIONAL SEARCH REPORT

International application No.

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A. CLASSIFICATION OF SUBJECT MATTER		
See extra sheet		
According to International Patent Classification (IPC) or to both national classification and IPC		
B. FIELDS SEARCHED		
Minimum documentation searched (classification system followed by classification symbols)		
IPC: G06F, G09G, H01H, H03K		
Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched		
FI, SE, NO, DK		
Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)		
EPO-Internal, WPI, ACM Digital Library		
C. DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 2007/0222765 A1 (NYSSONEN, T.) 27 September 2007 (27.09.2007), figures 2a, 2b, 2c, 3a, 3b, 3c, 5a, 5b, claims 1-26, [0002], [0005]-[0016], [0042]-[0053], [0057]-[0058], [0062]	1-33
A	US 2002/0008691 A1 (HANAJIMA, M. et al.) 24 January 2002 (24.01.2002), figure 6, claims 1-7, [0010]-[0018], [0052]-[0059]	1-33
A	US 2007/0276525 A1 (ZADESKY, S. P. et al.) 29 November 2007 (29.11.2007), figure 1, claims 1-30, [0014], [0015]-[0022], [0059]-[0061]	1-33
A	EP 1731993 A1 (TAKASHIMA, K. et al.) 13 December 2006 (13.12.2006), figures 5, 13A, 13B, 13C, claims 1-12, [0006]-[0012], [0038]-[0039], [0089]-[0092]	1-33
A	US 2006/0007182 A1 (SATO, T. et al.) 12 January 2006 (12.01.2006), figure 4, claims 1-8, [0005]-[0019], [0038]-[0039], [0073]-[0074]	1-33
<input type="checkbox"/> Further documents are listed in the continuation of Box C. <input checked="" type="checkbox"/> See patent family annex.		
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Date of the actual completion of the international search		Date of mailing of the international search report
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Information on patent family members

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PCT/FI2008/050713

Patent document cited in search report	Publication date	Patent family members(s)	Publication date
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Information on patent family members

International application No.
PCT/FI2008/050713

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- (72) Inventors; and
- (75) Inventors/Applicants (for US only): PIKKUJAMSA, Kalle [FI/FI]; Piilikuja 8, FIN-90420 Oulu (FI). LINJAMA, Jukka [FI/FI]; Tuurinnitynkuja 9, FIN-02200 Espoo (FI). JUHA, Kela [FI/FI]; Kuivasrannantie 19 B 16, FIN-90540 Oulu (FI). PANU, Korpipää [FI/FI]; Kuivasrannantie 65 A2, FIN-90540 Oulu (FI). SANNA, Kallio [FI/FI]; Tuulikintie 6 D 227, FIN-90570 Oulu (FI).

TAPANI, Rantakokko [FI/FI]; Kuusikkotie 3, FIN-90460 Oulunsalo (FI).

(74) Agent: HARD, John, Martin; Nordic Patent Service ApS, Pilestræde 58, DK-1112 Copenhagen K (DK).

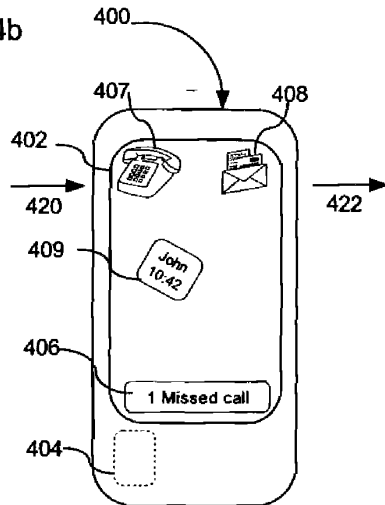
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(54) Title: IMPROVED USER INTERFACE HAVING REALISTIC PHYSICAL EFFECTS

Fig 4b



(57) Abstract: A user interface module comprising a display and a motion detector arranged to detect a motion. The module is arranged to display an emulated movement of a graphical representation of a first object on the display according to a motion detected by the motion detector. The first object comprises a physical characteristic and said user interface module further comprises a controller module arranged to generate said emulated movement based on said physical characteristic.

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IMPROVED USER INTERFACE HAVING REALISTIC PHYSICAL EFFECTS

The present application relates to a device and a method for providing quick access to information stored on or accessible through a device, and in particular to a device and a method for providing quick access to data stored on or accessible through a device by using tap commands.

10 BACKGROUND OF THE INVENTION

More and more electronic devices such as mobile phones, MP3 players, Personal Digital Assistants (PDAs) are becoming smaller and smaller while having more and more information stored and/or accessible through them. Users are relying on these devices and becoming all the more dependant on them. Due to the devices' complexity they can sometimes be difficult for a user to learn and understand. There is a plethora of functionalities, features, applications and shortcuts available through a wide variety of user inputs such as touch input, key pad input, stylus input and recently also sensor based input such as tap input or tilting movement input using accelerometers. The sheer amount of possibilities can thus become bewildering to a user and increase the effort required to learn and understand the device significantly.

The environments in which these devices are used are also becoming more and more hectic with higher demands on fast access and multitasking, and not only in a professional environment but also in private and social environments. For example a user should be able to read a book, while holding a grocery bag in a rattling subway train and

still be able to access the information stored in the device for the device to live up to the many requirements posed upon it by a user buying and using the device. This requires that the device is simple to learn and intuitive to use.

DISCLOSURE OF THE INVENTION

On this background, it is an object of the present application to provide a device and a method that overcomes or at least reduces the drawbacks indicated above by providing user interface, a device and a method that is easy to learn and understand and intuitive to use.

This objective is achieved by providing a user interface module comprising a display and a motion detector arranged to detect a motion, said module being arranged to display an emulated movement of a graphical representation of a first object on said display according to a motion detected by said motion detector.

By controlling a user interface with movements a there through any objects a user interface that is simple to use is achieved.

In one embodiment the first object comprises a physical characteristic and said user interface module further comprises a controller module arranged to generate said emulated movement based on said physical characteristic.

Through having a physical model and basing the movements on this model and thereby on physical characteristics of the objects the object's behaviour becomes more intuitive

and easy to understand by a user thereby rendering the user interface easy to learn and use.

In one embodiment the physical characteristic is a mass
5 for emulating inertia of said object, in one embodiment
the physical characteristic is a velocity vector and in
one embodiment the physical characteristic is an extent.
This enables realistic dynamic behaviour to be modelled
on physical laws.

10

In one embodiment the display has a display area and the
graphical representation of said object is smaller than
the display area. This enables an overview of more than
one object and a visual indication of the object's
15 movement and interaction with other objects displayed on
the same display and the resulting emulated behaviour.
This further increases the intuitive association between
a physical motion with a resulting action.

20 In one embodiment the physical characteristics comprise a
spring coefficient and a damping coefficient and wherein
said generation of said emulated movement is based on a
damped spring dynamic.

25 In one embodiment the generation of said emulated
movement comprises determining an updated position from
an original position depending on said physical
characteristics and said motion detected by the motion
detector and wherein said displaying of said emulated
30 movement comprises displaying said object at said updated
position.

In one embodiment the user interface is further arranged
to display graphical representations of at least one

additional object, wherein said at least one additional object has physical characteristics and said generation of said emulated movement of said first object is further based on said physical characteristics of said at least
5 one additional object. In a user interface with more than one object a co-relation or dependency between data entities can be established thus making the user interface more versatile.

10 In one embodiment the first object and/or said at least one additional object has a data value wherein said user interface module is further arranged to display said data value as part of said graphical representation of said object. This makes it easy to display information to a
15 user.

In one embodiment the user interface is further arranged to execute a function associated with a movement pattern and wherein said controller module is arranged to execute
20 said function on said object upon detection of said movement pattern. This makes the control and activation of operations or functions easy to initiate as no precise movement, like hitting a specific key, is required and the user interface is further intuitive as the function
25 is visibly connected to an object.

In one embodiment the movement pattern corresponds to a throwing movement and said movement function is a delete operation and in one embodiment the movement pattern
30 corresponds to an upwards movement and said movement function is an open operation.

In one embodiment an object has an associated function. Directly associating a function with an object makes it

further intuitive to execute the function and does not clutter the display area with functional labels.

In one embodiment a movement pattern corresponds to an emulated collision between one object having a data value and one object having an associated object function, and wherein said user interface is arranged to execute said function on said data value upon detection of said emulated collision. Causing a collision or forcing to objects to touch provides a mental image of how to execute a function that correlates function and data value in a simple and easy to learn and remember manner.

In one embodiment the function is any taken from the group comprising: a delete operation, a call operation, a send message operation, a postpone operation, an open operation and a read out operation.

In one embodiment the object is an area object. In one embodiment the additional object is static.

In one embodiment the display and the motion detector are arranged in the one and same housing which further increases the intuitive connection or coupling between the motions and the realistically modelled resulting movements and associated actions.

The objectives above are also achieved by providing a device having a module as above. In one embodiment the device is a mobile terminal.

The objectives above are also achieved by providing a method for controlling a user interface comprising a display, a motion detector and at least one object, said

method comprising detecting a motion, emulating a movement for said at least one object according to said motion, wherein an updated position is determined, and displaying said at least one object at said updated position, wherein the movement emulation is based on a physical characteristic of said object. This provides for a dynamic method for controlling a user interface that is easy to control and intuitive to learn yet versatile and expandable.

10

In one embodiment the method further comprises determining whether a collision between a first and a second object is caused by said emulated movement and emulating said movement accordingly. The collision concept simulates or models co-dependencies between objects in a way that is easy to control and intuitive to use, learn and understand.

In one embodiment an object has an associated function corresponding to a movement pattern and said method further comprises determining whether said detected motion completes said movement pattern and if so execute said function. This associates an object with a functionality in a realistic and intuitive manner.

25

In one embodiment the movement pattern is a collision.

In one embodiment the at least one object has a data value and said method further comprises executing said associated function on said data value upon a completed movement pattern. This provides a manner in which a data is related to a function in a very intuitive manner.

In one embodiment the execution of said associated function comprises generating an additional object.

According to another aspect of this application the objectives above are achieved by providing a user interface module comprising motion detector means for detecting a motion, and display means for displaying an emulated movement of a graphical representation of a first object according to a motion detected by said motion detector means.

In one embodiment the first object comprises a physical characteristic and said user interface module further comprises controller means for generating said emulated movement based on said physical characteristic.

In one embodiment the first object and/or at least one additional object has a data value wherein said user interface module further comprises display means for displaying said data value as part of said graphical representation.

In one embodiment the user interface further comprises means for executing a function associated with a movement pattern on said object upon detection of said movement pattern.

A user interface such as this has the same benefits as explained for the user interface and method above.

According to another aspect of this application the objectives above are achieved by providing a computer readable medium including at least computer program code for controlling a user interface comprising a display,

motion detector and at least one object, said computer readable medium comprising software code for receiving a motion through said motion detector, software code for emulating a movement for said at least one object, and
5 software code for displaying said movement of said at least one object.

In one embodiment the computer readable medium further comprises software code for determining whether said
10 motion completes a movement pattern and if so for executing an associated function corresponding to said movement pattern.

This enables a device to benefit from the advantages as
15 described above and also later in the detailed description by executing the software code.

In one aspect the objectives are achieved by a device incorporating and implementing a computer readable medium
20 according to above.

Further objects, features, advantages and properties of device, method and computer readable medium according to the present application will become apparent from the
25 detailed description.

BRIEF DESCRIPTION OF THE DRAWINGS

In the following detailed portion of the present
30 description, the teachings of the present application will be explained in more detail with reference to the example embodiments shown in the drawings, in which:

Fig. 1 is an overview of a telecommunications system in which a device according to the present application is used according to an embodiment,

Fig. 2 is a plane front view of a device according to an embodiment,

Fig. 3 is a block diagram illustrating the general architecture of a device of Fig. 1 in accordance with the present application,

Fig. 4 a, b, c, d, e, f, g, h and i are plane front views of a device according to an embodiment,

Fig. 5 is a schematic view of a model used in an embodiment,

Fig. 6 a and b are flow charts describing a method each according to an embodiment,

Fig. 7 is a schematic view of a model used in an embodiment, and

Fig. 8 is a plane front view of a device according to an embodiment.

20 DETAILED DESCRIPTION OF PREFERRED EMBODIMENTS

In the following detailed description, the device, the method and the software product according to the teachings for this application in the form of a cellular/mobile phone will be described by the embodiments. It should be noted that although only a mobile phone is described the teachings of this application can also be used in any electronic device such as in portable electronic devices such as laptops, PDAs, mobile communication terminals, electronic books and notepads and other electronic devices offering access to information.

FIG. 1 illustrates an example of a cellular telecommunications system in which the teachings of the present application may be applied. In the telecommunication system of FIG. 1, various
5 telecommunications services such as cellular voice calls, www/wap browsing, cellular video calls, data calls, facsimile transmissions, music transmissions, still image transmissions, video transmissions, electronic message transmissions and electronic commerce may be performed
10 between a mobile terminal 100 according to the teachings of the present application and other devices, such as another mobile terminal 106 or a stationary telephone 132. It is to be noted that for different embodiments of the mobile terminal 100 and in different situations,
15 different ones of the telecommunications services referred to above may or may not be available; the teachings of the present application are not limited to any particular set of services in this respect.

20 The mobile terminals 100, 106 are connected to a mobile telecommunications network 110 through RF links 102, 108 via base stations 104, 109. The mobile telecommunications network 110 may be in compliance with any commercially available mobile telecommunications standard, such as
25 GSM, UMTS, D-AMPS, CDMA2000, FOMA and TD-SCDMA.

The mobile telecommunications network 110 is operatively connected to a wide area network 120, which may be Internet or a part thereof. An Internet server 122 has a
30 data storage 124 and is connected to the wide area network 120, as is an Internet client computer 126. The server 122 may host a www/wap server capable of serving www/wap content to the mobile terminal 100.

A public switched telephone network (PSTN) 130 is connected to the mobile telecommunications network 110 in a familiar manner. Various telephone terminals, including the stationary telephone 132, are connected to the PSTN
5 130.

The mobile terminal 100 is also capable of communicating locally via a local link 101 to one or more local devices 103. The local link can be any type of link with a
10 limited range, such as Bluetooth, a Universal Serial Bus (USB) link, a Wireless Universal Serial Bus (WUSB) link, an IEEE 802.11 wireless local area network link, an RS-232 serial link, etc. The local devices 103 can for example be various sensors that can communicate
15 measurement values to the mobile terminal 100 over the local link 101.

An embodiment 200 of the mobile terminal 100 is illustrated in more detail in FIG. 2. The mobile terminal
20 200 comprises a speaker or earphone 202, a microphone 205, a main or first display 203 and a set of keys 204 which may include a keypad 204a of common ITU-T type (alpha-numerical keypad representing characters "0"- "9", "*" and "#") and certain other keys such as soft keys
25 204b, 204c and a joystick 211 or other type of navigational input device. The mobile phone may also comprise an extra display, a secondary display arranged on the backside of the mobile phone 200 (shown in figure 4).

30 In the following a display will be referred to as being inactive when it or the display image on it is not visible to a user and it is not used to display any information or other data. A skilled person will realize that the display can still be functioning although at

using less power than when it is active, i.e. the displayed image is visible to a user.

The internal component, software and protocol structure of the mobile terminal 200 will now be described with reference to FIG. 3. The mobile terminal has a controller 300 which is responsible for the overall operation of the mobile terminal and may be implemented by any commercially available CPU ("Central Processing Unit"), DSP ("Digital Signal Processor") or any other electronic programmable logic device. The controller 300 has associated electronic memory 302 such as RAM memory, ROM memory, EEPROM memory, flash memory, or any combination thereof. The memory 302 is used for various purposes by the controller 300, one of them being for storing data used by and program instructions for various software in the mobile terminal. The software includes a real-time operating system 320, drivers for a man-machine interface (MMI) 334, an application handler 332 as well as various applications. The applications can include a calendar application 350, a notepad application 360, as well as various other applications 370, such as applications for voice calling, video calling, sending and receiving Short Message Service (SMS) messages, Multimedia Message Service (MMS) messages or email, web browsing, an instant messaging application, a phone book application, a calendar application, a control panel application, a camera application, one or more video games, a notepad application, etc.

The MMI 334 also includes one or more hardware controllers, which together with the MMI drivers cooperate with the first display 336/203, the secondary display 340, the keypad 338/204 and a movement sensor or

detector 342 as well as various other I/O devices such as microphone, speaker, vibrator, ringtone generator, LED indicator, etc. As is known to a man skilled in the art the movement detector 342 can be implemented with for
5 example an acceleration sensor or an other sensor capable of detecting a motion. Examples of such sensors are micro-electromechanical systems (MEMS), nano-electromechanical systems (NANS), piezo acceleration sensors, vibration sensors, laser accelerometers,
10 resonance accelerometers, strain gauge accelerometers, capacitive spring Mass based accelerometers, electromechanical accelerometers, optical accelerometers or gyroscopes. As is commonly known, the user may operate the mobile terminal through the man-machine interface
15 thus formed.

The software also includes various modules, protocol stacks, drivers, etc., which are commonly designated as 330 and which provide communication services (such as
20 transport, network and connectivity) for an RF interface 306, and optionally a Bluetooth interface 308 and/or an IrDA interface 310 for local connectivity. The RF interface 306 comprises an internal or external antenna as well as appropriate radio circuitry for establishing
25 and maintaining a wireless link to a base station (e.g. the link 102 and base station 104 in FIG. 1). As is well known to a man skilled in the art, the radio circuitry comprises a series of analogue and digital electronic components, together forming a radio receiver and
30 transmitter. These components include, band pass filters, amplifiers, mixers, local oscillators, low pass filters, AD/DA converters, etc.

The mobile terminal also has a SIM card 304 and an associated reader. As is commonly known, the SIM card 304 comprises a processor as well as local work and data memory.

5

Figure 4 show a device in the form of a mobile phone 400 according to the present application. The mobile phone 400 has a user interface enabling a user to interact with the device through a display 402 and some input. This
10 input can either be a keypad 204, as in figure 2, or a movement sensor 404 such as an accelerometer. The keypad can have physical keys, soft keys, virtual keys or any combination of these depending on design choices. A combination of movement sensors and keys is also
15 plausible and highly beneficial. In the following description focus will only be given to the motion detector 402, but it should be understood that the teachings herein work equally well with any combination of a motion detector and keys as above.

20

A motion detector 404 (342 in fig 3) is arranged in the mobile phone 400. The motion detector is shown in dashed lines as it is part of the internal circuitry of the mobile phone and not is visible as disclosed above. Upon
25 detection of a motion or a movement pattern a detection signal is generated and processed by the controller (300 in fig 3) of the mobile phone 400. It should be understood that the motion detector 404 could comprise both a sensor for detecting the physical movement and a
30 controller for differentiating between different physical movements and movement patterns, which controller could be the same as the controller 300 of the mobile phone 400.

It should be noted that as the display 402 and the motion detector 404 are arranged in the same housing of a device, in this embodiment a mobile phone 400, the user interface may respond to physical forces which the device
5 is subjected to and it may serve as part of a multimodal feedback.

As is commonly known the display 402 is used to relay information to a user and enable him to interact with the
10 mobile phone 400. The information is relayed by being displayed on the display 402. Traditionally this information is displayed statically. As motion control of a mobile phone is in its very nature dynamic it can be confusing to a user to relate the dynamical control
15 movements to the static functions and behaviour of the mobile phone 400.

To overcome this, a dynamic model, with user interface elements or objects, is used to create a dynamic
20 relationship between objects that are used to relay information. The objects 406, 407 and 408 can have different traits or characteristics which will be discussed in more details below. Three examples of characteristics are a data value, an associated function
25 and if the object is movable or not. An object with a data value is usually used to display this data value. An object with an associated function is used to inform the user that the function is available and if effected to initiate or execute the function. Non-movable objects can
30 be used for interacting with a movable object and to put some movement restraints on the graphical representation of the user interface.

To further increase the understanding of the connection between the physical motion and the resulting emulated movement of an object a physically realistic behaviour is needed. If the resulting emulated movement is not realistic it will be confusing and bewildering to a user.

The dynamic model is based on that all objects have some physical characteristics and that they are affected by the motions detected through a motion sensor in the same way as a normal, physical object would be affected having the same characteristics.

The physical characteristics can be a mass and a physical extent. The mass will emulate inertia in the object determining how quickly it accelerates and rotates as well as how it behaves upon collision with other objects. The physical extent defines the object's borders and is used to determine whether an object collides with another or not.

Some objects are without mass and have no borders this makes them purely graphical and they can accelerate and move at any speed and they do not collide, they merely overlap. Such objects can be used to model information entities for which no function is to be taken such as labels or time notifications. Labels for softkeys should not be movable except as explained with reference to fig 7a as they should be kept close to the associated softkey.

Other possible characteristics are friction, elasticity (surface elasticity and volume elasticity).

To realistically model all physical aspects of moving objects and their interaction with each other the dynamic model makes use of: physics modelling, friction modelling, multi-object collision modelling, collision
5 detection based feedback, centre of mass modelling and other techniques used to model dynamic movement. In an embodiment algorithms were used to model Rigid body dynamics, such as linear momentum, angular momentum and torque, simulation methods for motions using a Lagrange
10 multiplier velocity based model and a contact and friction model based on the Dantzig LCP solver.

As is known to a man skilled in the art optimisation problems are can be investigated using Lagrange's method
15 of multipliers which is a method for finding the extrema of a function of several variables subject to one or more constraints; it is the basic tool in nonlinear constrained optimization. It reduces finding stationary points of a constrained function in n variables with k
20 constraints to finding stationary points of an unconstrained function in n+k variables.

As is also known to a person skilled in the art The Dantzig LCP solver solves friction modelling problems by
25 applying Linear Complimentary Programming, LCP as introduced by George Dantzig.

This dynamic model requires heavy computing power and an optimization is used for low resource devices such as a
30 mobile phone. The optimization is based on replacing floating point presentations with fixed-points presentations in calculations to be made by the controller 300. This can be done by performing the replacement from floating-point to fixed-point directly

as in table 1 in which Q denotes the mantissa of the fixed point operation and ">>" which entity that is to be replaced. For fast calculations values of 16 or 32 for Q are used. Other values are also possible as will be clear to a skilled person depending on the controller used for the replacement. A direct replacement saves time as no further procedural calls are necessary.

Figure 5 show a dynamic model 500 for a user interface, UI, having a controller 510. The controller 510 is arranged to create and control one or more objects 540. These objects 540 have some characteristics that are common to all objects and these are their position and their extent. These characteristics are necessary to generate a graphical representation of an object. Some objects have no representation but the position and the extent of the object is still needed to determine its interaction with other objects. Such objects are from hereafter called area objects. Other characteristics are shown in table 2 along with their purposes. The model 500 also has a motion detector 520 from which information is provided to the controller 300 regarding motions the device is subjected to and forces applied to it. The motion detector 520 can be implemented through an acceleration sensor. An integrator can be used to integrate the acceleration detected and from this generate a movement or motion. These motions can be a movement pattern through which a user controls one or more objects. The modelling of the motion of the objects has been discussed and explained above.

In one embodiment a collision detector 530 is also used in the model 500. The collision detector 520 could be made part of the controller 510, but in this description

it is described as a separate entity to better illustrate its functionality. If two objects are active, for example one stationary and one dynamic, and a motion is detected the collision detector will start monitoring if any of
5 the objects' positions and extent overlap. A simplified formula for a collision is:

$$\begin{aligned} \text{pos A} + \text{EXTENT A} &\subseteq \text{pos B} + \text{EXTENT B} \text{ OR} \\ \text{pos B} + \text{EXTENT B} &\subseteq \text{pos A} + \text{EXTENT A} \Rightarrow \text{COLLISION} \end{aligned}$$

10

where pos is a position that is uniformly added to the extent of an object.

The formula is to be understood as if any part of object
15 A overlaps with any part of object B then there is a collision.

The objects can be either stationary, which can be modelled as having an infinite mass, dynamic, having a
20 finite mass or purely graphical, having a mass of 0. A purely graphical object will be able to travel at any speed and overlap other objects and are used for informative purposes such as labelling.

25 For dynamic objects an emulated motion is determined between updates of a display. The emulated motion is a function of the current position, current velocity, mass or inertia, the body's orientation, friction of object's surface or surface of surrounding and the force and there
30 from derived applied acceleration subjected to the object. An updated position is calculated from the current position using the known characteristic values and the modelling techniques described herein. The position, velocity and angular velocity can be expressed

by vectors and the orientation can be expressed as a 3x3 rotation matrix.

Characteristics such as mass can also be expressed as a
5 matrix. For mass a constant can be used to describe the total mass. A centre vector to express the centre of mass seen from a reference point and an inertia matrix describing how the mass is distributed.

10 An object can have a data value assigned to it. These data values can be used to notify the user of certain events or they can have other meaning.

An object 540 can additionally or alternatively have one
15 or more functions associated with it. As such an objected is activated the corresponding function is executed. Examples of such functions are: OPEN, DELETE, CLOSE or POSTPONE. A function can also be designed to work on one or more data values, either being carried by the object
20 itself or by another object. If a collision between a data value object and a function object takes place the function is executed using the data value as a parameter. As can be seen in figure 5b when a function object 540A and a data object 540B collides as a result the function
25 is executed on the data.

If an object carries more than one function, the function to be executed can depend upon the object collided with and also on the data carried by the object collided with.

30

For the special objects referred to as area objects explained above a collision occurs when another object enters the area, or in other words, the areas extent overlaps with another objects extent. Area objects can be

used as function carrying objects. An example of such an object is a delete zone modelled through an area object having the associated function DELETE.

- 5 An object's position might be so that as the graphical representation is shown on a display the object may be partially or completely missing from the display, i.e. it is not visible as it is outside the displayed area.
- 10 It should be understood that in this model a collision can be regarded as a movement pattern and a function is to be executed as a certain movement pattern is detected. The movement pattern can then be a controlled movement or a collision. Collisions are thus assumed to be controlled
- 15 by a user for initiating a certain action. It should also be understood that a motion can be part of a movement pattern (possibly the only part of the movement pattern) and the movement pattern is completed by said motion which causes any corresponding action or function to be
- 20 taken or executed.

For example, by having an object area virtually positioned in the top of the screen and assigned the function DELETE another object can easily be deleted by

25 throwing it upwards or turning the phone upside down and allowing the object to fall out of the user interface and thereby be deleted. To safeguard against accidental deletion the area object can be assigned a friction which would slow down any object coming over it and thus

30 prevent unwanted execution of the assigned operation, in this case deletion.

A function could also be activated if the carrying object is subjected to a movement pattern, i.e. a sequence of or

a single controlled movement that is specific in its nature. Examples can be throwing away (signified by strong acceleration over a period of time), hoisting (signified by a strong upward acceleration followed by a downward acceleration) or a tap (signified by a short pulse or shock).

To safeguard against accidental execution of functions resulting from random collisions and movement patterns a confirmation object can be created and displayed prompting the user to confirm whether the action is deliberate or not. A tap to the device, thereby inducing a slight shock which is detected by the motion detector will execute the function. Alternatively a double tap can be used to accept the action and a single tap to reject or cancel it.

In one embodiment a tactile feedback is generated by the collision detector as soon as a collision is detected. Such a tactile feedback can be in the form of a vibration. For some purposes it is also possible to give a small electric shock. Naturally, also visible and audible feedbacks are possible either alone or in any combination. If two objects collide one type of vibration can be generated and if an object collides with a wall object another type of vibration can be generated. Thus a user can differentiate between different events taking place on the screen and be able to control the device even with out looking. Especially if the user interface is equipped with a text to speech or other voice coder so that information can be read out loud to the user.

To illustrate with an example: a device receives an incoming message and the user is alerted with an audible

signal. As the user is partly occupied with another task, but still wants to see what the message is the user can quickly take out the phone, perform an open action, which can be a hoisting motion that will open the object with the message notification as will be described below. The user knows that in the left hand side of the display there is an area for reading the message out loud and leans or tilts the phone to the left side. Due to other factors influencing the motion (such as if the user is riding a train) the object slightly misses the read out loud area and a vibration followed by a screeching sound is emitted from the device informing the user that the object is about to travel through an area associated with a delete operation. The user reacts to the feedback and changes the movement to be more clearly to the left side and as the object collides with the message read area another softer vibration and a pleasant sound is emitted as a feedback. The user is informed that the action is correct, or at least it does not have irrevocable consequences, and to finish it of exaggerates the motion so as to make sure the action is undertaken and area's function to run a text through a text to speech coder is executed on the object's data value, being the text of the message, and the message is read out loud while the object is in the area. To silence the read out, the user simply moves the object out of the area again by controlling the motion of the device. Thus an incoming message can be opened, read and even paused by simple hand gestures that are easy to learn, intuitive to use and without requiring much attention by a user.

In one embodiment a device is subjected to a keylock function and while the keylock function is active only notifying actions will be accepted. For example, if a

keylock is activated and there are missed calls, only actions to show the missed calls will be accepted. Any action to delete or call back will be ignored or cancelled by the keylock function. Thus if the motion
5 triggering an action is by coincidence the status of the device will be the same when the user directs his attention to it as it was before the actions were taken.

Returning to figure 4 an embodiment is shown of a user
10 interface in a device 400 using the models above making the user interface more intuitive to use with a motion sensor 404. The device is as stated above a mobile phone 400 and it has a display 402. In fig 4a three objects are displayed on the display 402. They are all stationary
15 which can be modelled by giving them an infinite mass or by simply setting a flag stating that they are stationary. The first object 406 is in the shape of a box with a text indicating or notifying a user that there are 2 Missed Calls. If the user wants to see what the missed
20 calls are, but is currently unavailable or unwilling to reach some control keys (not shown) he simply makes an upward movement 420 imitating a movement pattern for hoisting the box up in the air and down again. This triggers the motion detector 404 to send a signal
25 carrying details describing the movement, such as speed vectors to the controller 300. The controller determines that an open operation has been initiated and executes this. The open operation creates another fourth object 409 and makes it float up from inside the box. This
30 fourth object 409 is a dynamic object and its motion is being emulated whereby the direction is dependant on the original motion detected by the sensor and the speed dependant on the object's 409 mass and the force applied to the mobile phone 400. As can be seen in figure 4b, the

object 409 has a data value which is displayed on the object 409 indicating that a contact "John" had called at 10:42. The user notices this but chooses not to take action at this point and decides to delete the notification. The user performs a movement pattern
5 simulating a throwing movement 422 that is detected by the motion detector 404 and a signal is sent to the controller 300 that determines that a delete action has been taken and initiates the delete action on the object
10 409. The object's 409 emulated movement will be displayed as it is being hurdled to the side of the phone in the direction in which the throwing motion was made and the object 409 disappears from the display 402 as seen in figure 4c. The movement pattern of throwing away the
15 object thereby causes a function to delete the object 409. As the object's 409 graphical representation has left the display 402 the display is now as in fig 4d with the three original objects. The first object 406 now has a data value notifying one missed call and a repeated
20 hoisting movement 420 makes a fifth object 411 to float or fly up from the missed call box object 406. This fifth object also has a data value which is displayed notifying that a contact "Jane" made a call at 9:34 as is shown in fig 4e. The user now has four options. He can choose to
25 delete as he did with the previous notification or he can steer or control the movement of the object 411 through the motion detector 404 by controlling the movement of the device 400 to collide with any of the stationary objects displayed. The three stationary objects are the
30 missing call box object 406, now indicating that there are no missing calls, a phone call object 407 and a send message object 408. The two objects, phone call 407 and send message 408, have functions associated with them which functions are clear from the appearance of the

graphical representation of the object. Upon collision with such an object the associated function will be initiated. The first object 406 also has an associated function which is to store any object colliding with it.

5 The user chooses to call the contact by controlling or steering, through a motion or movement pattern 424, the fifth object 411 to collide with the Phone call object 407. As the two objects 407 and 411 collide in fig 4f the collision is detected in the controller and the

10 associated function of the phone call object 407 is executed on the data value associated with the fifth object 411. As the user has chosen not to save the notification object 411, the missed call box object 406 is deleted.

15

Alternatively the delete operation initiated by the throwing motion 422 in figure 4b and c can be determined as a collision between the object 409 and a side wall of the display 402 modelled to have no surface so no

20 collision occurs and where the emulated movement clearly brings the object outside the display 402. The side wall can be modelled as an area object.

Alternatively, if both notifying objects 409 and 411 were

25 in the air at the same time and the both collided with the phone symbol 407 a conference call could be initiated to both of them. Thus a function can also be set to operate on more than one data value.

30 Other notifications that could be displayed are status reports of incoming calls, missed calls, received messages (SMSes, MMSes, emails etc), download status or a special message fetched by a specially adapted

application for example arranged to show cartoons according to preset parameters.

Alternatively, functions can be assigned to areas of the display 402 as can be seen in fig 4g. These areas can be modelled as stationary objects having a non-reflective border i.e. capable of overlapping. In fig 4g two operations are assigned to the walls and these operations are CALL and DELETE. The operations can be marked with indications 411 and 412. As previously described a user can open the missed call box 406 by a hoisting movement 420 upon which the call notification 409 flies up, see fig 4h. To delete it the user controls the object 409 through a movement pattern 426 to collide with the area marked DELETE 411 as shown in fig 4i.

Further examples of functions and corresponding movement patters are listed in table 3.

In one embodiment a collision is not necessary to initiate an action. An object that has a data value can also have an associated function with a corresponding movement pattern. In the example above the object 409 could have the associated function of calling the contact with a corresponding movement pattern of a shaking movement. If a user wanted to call the contact displayed he would simply shake the phone and the controller would execute the associated function of calling on the data value being the contact.

Another example is when a downloaded item has been fully downloaded a download box appears. A user can open the item by hoisting it and if the item is a media file a

shaking movement would execute a media player to play the downloaded media file.

Most commonly, the more advanced the motion or movement
5 pattern is the safer it is to assume that it has been
done on purpose thus safe guarding from coincidental
movements. However, a more advanced or complicated motion
is more difficult for a user to achieve. Which movement
patterns and what combinations that are to be used depend
10 on usability aspects for the phone whether it is a heavy
duty model or a fashion model etc as well as the intended
user group and a combination of these and other factors.

Figure 6a show a method according to the teachings of the
15 present application. In a first step 610 a notification
is displayed. As a motion is detected in an event 615 the
motion is determined to be a movement pattern
corresponding to an OPEN command and an object carrying
the data for the notification is created. Its movement is
20 emulated in step 620 and the object is displayed in step
630. If other objects are present their movements are
also emulated in step 620 and the display is updated with
the new positions in step 630. As further motions are
detected in event 625, the movements are emulated and the
25 positions are updated in step 640. In step 650 it is
determined whether any collisions between two objects
have taken place. If there are no collisions the objects
are displayed in the updated positions in step 630. If
there is a collision the associated function is
30 determined in step 660 and executed on the data carried
by the object in step 670. As the function is executed
the method can return to step 630 of displaying the
objects as indicated by the dashed line. Or, the method

can terminate depending on the number of remaining objects and the nature of the function.

Figure 6b show a method according to the teachings of the present application. In a first step 601 a motion is detected by a controller 300 through a motion detector 404. In the next step 602 a movement for an object 409 is emulated and a check is made if a movement pattern has been completed in step 603. A movement pattern can in this method be any of a collision or other movement patterns. In step 604 it is checked if an object has an associated function which will then be executed in step 605. A movement pattern does not need to be a collision but can for an object having both a data value and a function be a specific movement pattern corresponding to the function. An example of this has been given above with reference to figure 4 such as when a user has downloaded a media file and plays it by shaking the device.

20

Figure 7a show a model 700 used to emulate an object's physical behaviour and movement in one axel. To correctly emulate a three dimensional movement one model would be needed for each axel in all requiring three models. This model is used for objects having a fixed point in the user interface thus creating a dynamic behaviour also for stationary objects.

The model 700 is based on a damped spring and an object 702 is connected by a spring 704 and a damper 706 to a fixed position 708. According to Hooke's law the spring has a spring constant k and the force F_s exerted on the string equals the displacement vector x multiplied by this string constant, $F_s=kx$. In real life the spring

constant is not always constant but varies a little bit with the displacement and a better word would therefore be the spring coefficient. The damper 706 is also subjected to a force F_d which equals a damping coefficient c multiplied with a velocity v of an object 702 attached to the damper 706 in the negative, $F_d = -cv$. These two relationships in combination with Newton's second law of motion, stating that the force F applied to an object equals the mass m multiplied with the acceleration a , $F = ma$, make up the damped spring model which is used to emulate an object's 702 movement.

Using this model a stationary object can be made to behave dynamically and respond to user induced commands and thereby confirming the actions taken in an intuitive way. The model can also be used to anchor stationary objects but enable them to have an emulated movement as a result of physical reactions, such when a collision is detected the stationary object could react by shaking or bouncing as a result of the shock from the collision with the moving object.

It can also be used as a safe guard feature as the movements of some objects for which the damped spring is applied become more restricted and to allow an object to collide with another a more forceful and deliberate motion is needed to overcome the simulated resistance offered by the spring. In other words, a realistic bounce back effect provides protection for erroneous movements as a more deliberate movement is needed to touch or collide with other object before bouncing back.

The damped spring model can also be used when moving an object. In figure 7b an illustrative example is shown. An

object 700 is to be moved to a new position 708 and the new position 708 is set to be the fixed point 708 of the model. A modelled spring is then automatically stretched to a displacement x equal to the distance from the fixed
5 point 708 and the object 700 subjecting the object to a force $F_s = kx$. Also a modelled damper is also stretched. As the object 700 is let go the force F_x will accelerate the object 700 towards the fixed point 708 and due to this the object 700 starts to move towards the fixed
10 point 708 and build up a speed v . The damper will then exert a force F_d acting in the opposite direction and in size equal to $F_d = cv$ which will slow down the object 700. As the object 700 comes closer to the fixed point 708 the accelerating force F_s will decrease at the same time as
15 the de-accelerating force F_d will grow. The object 700 will most often overshoot the fixed point's position 708 and the modelled spring will force the object 700 towards the fixed point 708 again and the object 700 will eventually rest at the new position 708. The time to
20 reach the new position for the first time is denoted as a rise time and the time for it to settle on the new position is denoted as a settling time.

This principle can be applied to key events and scroll
25 events, motion gesture control and touch control such as tap input for example.

It is also possible to maintain a virtual or emulated constant force affecting all dynamic objects, much like a
30 gravitational force. The gravitational force can either be directed internally in the phone for example always towards the bottom of the screen or externally as in coinciding with the direction of the Earths gravitational field. This will enable the objects to behave even more

realistic and also safeguard against accidental movements as the objects always strive to fall down and a safe place, object or area like the originating place should be positioned at the lowest point of gravity. For an
5 action to be initiated the controlling motion would thus need to overcome the gravitational field or force and thus be required to be more deliberate. An opened object that is left alone or undisturbed will thus simply fall
10 back into the originating box which in practise will implement a timeout feature for any action taken by the user.

In one embodiment an area object having an associated function DELETE is arranged in the very top of a display.
15 The user interface is also arranged with an externally directed gravitational force. To delete an object a user simply turns a device having such a user interface on its head and allows the object to be deleted to be affected by the simulated gravity and sink into the delete area
20 and be deleted. This leads to the mental image of deleting an object by pouring it out of the top of the device.

It should be understood for all embodiments described
25 herein that an object can also exist outside of the graphical representation, the graphical representation thus only acting as a window into the user interface.

It should also be noted that for some objects a collision
30 is determined to have happened only if there is a total overlap of two objects' extents. This can be used for areas wherein the object to be effected by a function of an area is only affected if it totally enters the area. In the example above this would mean that if the delete

area is said to be just outside the displayed area the object would have to leave the screen completely before being deleted.

5 Figure 8 show an example of how a gravitational force would affect the situation in fig 4b. An object 809 has been opened from the missed call box object 806 and is currently hanging in mid air. A gravitational force denoted F in the figure is acting on the notification
10 object 409 causing it to fall back towards the missed call box 806. Unless the user controls the objects movement by motioning the device 800 to make it fly up towards one of the other objects 807, 808 to initiate a function the notification object 809 will fall back into
15 the missed call box object 806 and will be saved there for a later time. Thus a variable timeout for the operation of opening the missed call box is achieved during which time period it is possible to either perform an action on the produced notification object 809 or to
20 postpone or reset the time out by hoisting the object 809 further.

It could also be possible to introduce an element, possibly as a stationary object, in which the other
25 objects will be moving. Such an element can be used to simulate different environment having particular properties. One example is to simulate a water-filled screen in which the objects float around. Depending on their extent, their body mass and the density of the
30 surrounding element or water, they will either sink or float up as is known from Archimedes' principle.

For example if a user interface surface or area is designed to be half-filled with water a model for

functions only applicable to some objects or where some functions requires added security is achieved. One such situation could be where all other objects float and the delete operation is modelled in an object at the bottom.

5 To delete an object a forced movement pushing the object under water is thus required and will most likely not happen by chance.

The elements can also be used to implement different

10 timeouts and timeout functions for different objects by making some float and some sink and at speeds that depend on their density or mass. Some objects will thus rise to one function object and some will sink to another function object if left alone or undisturbed. The density

15 will determine the speed i.e. the timeout time period.

It is also possible to add texture objects having a certain friction or other characteristic influencing the movements of the other objects as well as creating a

20 visual effect that can be used to increase the visual conception of the graphical representation of the user interface and thus further the understanding of how it works leading to an easier and more intuitive user interface.

25 As the object behaves like a real object, the mental connection between the operation and its effect becomes more intuitive and thus easy to learn.

30 The various aspects of what is described above can be used alone or in various combinations. The teaching of this application may be implemented by a combination of hardware and software, but can also be implemented in hardware or software. The teaching of this application

can also be embodied as computer readable code on a computer readable medium. It should be noted that the teaching of this application is not limited to the use in mobile communication terminals such as mobile phones, but
5 can be equally well applied in Personal digital Assistants (PDAs), MP3 players, personal organizers or any other device designed for providing information while maintaining low power consumption.

10 The teaching of the present application has numerous advantages. Different embodiments or implementations may yield one or more of the following advantages. It should be noted that this is not an exhaustive list and there may be other advantages which are not described herein.
15 One advantage of the teaching of this application is that a device can be made to display information in a manner that is easy to learn and intuitive to use.

Another advantage of the teaching of the present
20 application is that a user can operate certain functions such as retrieving information from a device with only a simple and imprecise command or movement not requiring the full attention of a user.

25 Although the teaching of the present application has been described in detail for purpose of illustration, it is understood that such detail is solely for that purpose, and variations can be made therein by those skilled in the art without departing from the scope of the teaching
30 of this application.

For example, although the teaching of the present application has been described in terms of a mobile phone, it should be appreciated that the teachings of the

present application may also be applied to other types of electronic devices, such as music players, palmtop computers and the like. It should also be noted that there are many alternative ways of implementing the methods and apparatuses of the teachings of the present application.

The term "comprising" as used in the claims does not exclude other elements or steps. The term "a" or "an" as used in the claims does not exclude a plurality. A unit or other means may fulfil the functions of several units or means recited in the claims.

TABLES

Table 1: Floating-point to Fixed-point replacements.

<u>Floating point operation</u>	<u>Fixed point operation</u>
x*y	(x*y)>>Q
x/y	(x<<Q)/y
sqrt(x)	sqrt(x<<Q)
sin(x)	sinT[(x>>Q)]
cos(x)	sinT[(x>>Q) + 90]

5 Table 2: Object characteristics and corresponding purposes.

Characteristic	Purpose
Extent	To determine graphical representation and for collision detection.
Position	To determine graphical representation and for collision detection.
Mass	For determining movement through acceleration, de-acceleration, inertia and effect upon collision.
Elasticity	The object's behaviour upon collision both for continued movement and for graphical appearance.
Friction	To determine continued movement upon collision.
Data value	Used to notify or carry a value.
Function	Enables a function to be initiated upon activation through a movement pattern or a collision.
Spring coefficient	To determine movement.

Damping coefficient	To determine movement.
Velocity	To determine movement.
Acceleration	To determine movement. This is an implicit value that can also be handled exclusively by the controller.
Force	To determine movement. This is an implicit value that can also be handled exclusively by the controller.
Orientation	To determine what to show in the graphical representation and how to determine further movement.

Table 3 Functions and their associated movement patterns.

Function	Movement pattern
For a call reminder:	
Hoist	OPEN
Throw away	DELETE
Collide with phone symbol	Place call
Collide with trash can	Delete
Collide with mail symbol	Send message
Repeated hoist	Open next reminder
For an alarm	
Throw away	Postpone - the acceleration determines how much the alarm will be delayed.
Tap	Snooze
Double tap	Start media player and snooze.

CLAIMS:

1. A user interface module comprising a display and a motion detector arranged to detect a motion, said module
5 being arranged to display an emulated movement of a graphical representation of a first object on said display according to a motion detected by said motion detector, wherein said first object comprises a physical characteristic and said user interface module further
10 comprises a controller module arranged to generate said emulated movement based on said physical characteristic.
2. A user interface module according to claim 1, wherein said generation of said emulated movement comprises
15 determining an updated position from an original position depending on said physical characteristic and said motion detected by the motion detector and wherein said displaying of said emulated movement comprises displaying said object at said updated position.
- 20
3. A user interface module according to claim 1, wherein said physical characteristic comprise a mass for emulating inertia of said object.
- 25
4. A user interface module according to claim 1, wherein said physical characteristic comprise a spring coefficient and a damping coefficient and wherein said generation of said emulated movement is based on a damped spring dynamic.
- 30
5. A user interface module according to claim 1, wherein said physical characteristic comprises an extent.

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6. A user interface module according to claim 1, wherein said display has a display area and wherein said graphical representation of said object is smaller than said display area.
- 5
7. A user interface module according to claim 1, wherein said physical characteristic comprises a velocity vector.
8. A user interface module according to claim 1 further
10 arranged to display graphical representations of at least one additional object, wherein said at least one additional object has a physical characteristic and said generation of said emulated movement of said first object is further based on said physical characteristic of said
15 at least one additional object.
9. A user interface module according to claim 1 or 8 wherein said first object and/or said at least one additional object has a data value wherein said user
20 interface module is further arranged to display said data value as part of said graphical representation of said object.
10. A user interface module according to claim 1 further
25 arranged to execute a function associated with a movement pattern and wherein said controller module is arranged to execute said function on said object upon detection of said movement pattern.
- 30 11. A user interface module according to claim 10, wherein said movement pattern corresponds to a throwing movement and said function is a delete operation.

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12. A user interface module according to claim 10, wherein said movement pattern corresponds to an upwards movement and said function is an open operation.
- 5 13. A user interface module according to claim 1, wherein an object has an associated function.
14. A user interface module according to claim 13, wherein a movement pattern corresponds to an emulated
10 collision between one object having a data value and one object having an associated function, and wherein said user interface is arranged to execute said function on said data value upon detection of said emulated collision
- 15 15. A user interface module according to claim 14, wherein said movement function is any taken from the group comprising: a delete operation, a call operation, a send message operation, a postpone operation, an open operation and a read out operation.
- 20 16. A user interface module according to claim 1, wherein said motion detector and said display are arranged in one housing.
- 25 17. A device having a module as in claim 1.
18. A device according to claim 17, wherein said device is a mobile terminal.
- 30 19. A method for controlling a user interface comprising a display, a motion detector and at least one object, said method comprising:
detecting a motion,

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emulating a movement for said at least one object according to said motion,

5 wherein an updated position is determined, and

displaying said at least one object at said updated position,

wherein said movement emulation is based on a physical
10 characteristic of said object

20. A method according to claim 19, further comprising determining whether a collision between a first and a second object is caused by said emulated movement and
15 emulating said movement accordingly.

21. A method according to claim 19,

wherein an object has an associated function
20 corresponding to a movement pattern and said method further comprises

determining whether said detected motion completes said movement pattern and if so execute said function.

25

22. A method according to claim 19 and 20, wherein said movement pattern is a collision.

23. A method according to claim 20, wherein said at least
30 one object has a data value and said method further comprises executing said associated function on said data value upon a completed movement pattern.

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24. A method according to claim 20, wherein said execution of said associated function comprises generating an additional object.

5 25. A computer readable medium including at least computer program code for controlling a user interface comprising a display, motion detector and at least one object, said computer readable medium comprising:

software code for receiving a motion through said
10 motion detector,

software code for emulating a movement for said at least one object, and

software code for displaying said movement of said at least one object.

15

26. A computer readable medium as in claim 25 further comprising software code for determining whether said motion completes a movement pattern and if so for executing an associated function corresponding to said
20 movement pattern.

27. A device incorporating and implementing a computer readable medium according to claim 25.

25 28. A user interface module comprising motion detector means for detecting a motion, and display means for displaying an emulated movement of a graphical representation of a first object according to a motion detected by said motion detector means.

30

29. A user interface module according to claim 28, wherein said first object comprises a physical characteristic and said user interface module further

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comprises controller means for generating said emulated movement based on said physical characteristic.

30. A user interface module according to claim 28,
5 wherein said first object and/or at least one additional object has a data value wherein said user interface module further comprises display means for displaying said data value as part of said graphical representation.

10 31. A user interface module according to claim 28 further comprising means for executing a function associated with a movement pattern on said object upon detection of said movement pattern.

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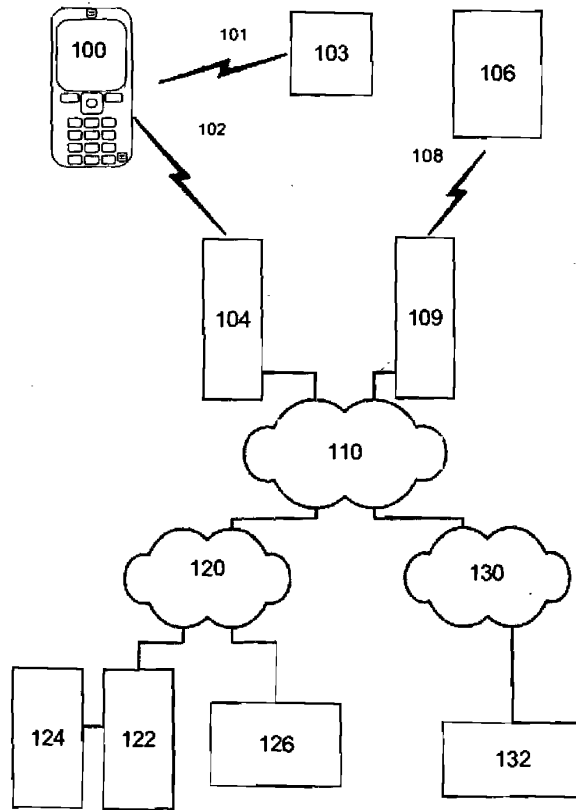


Fig 1

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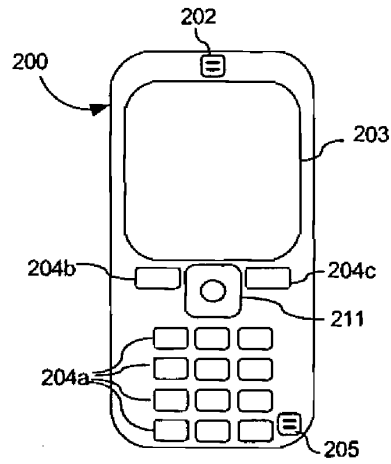


Fig 2

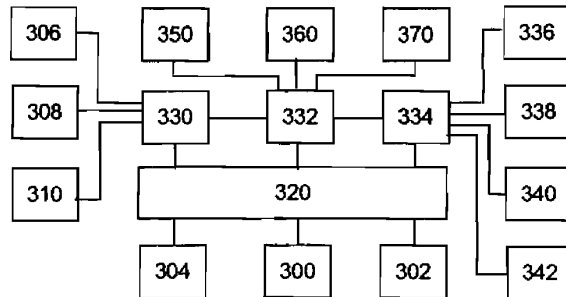


Fig 3

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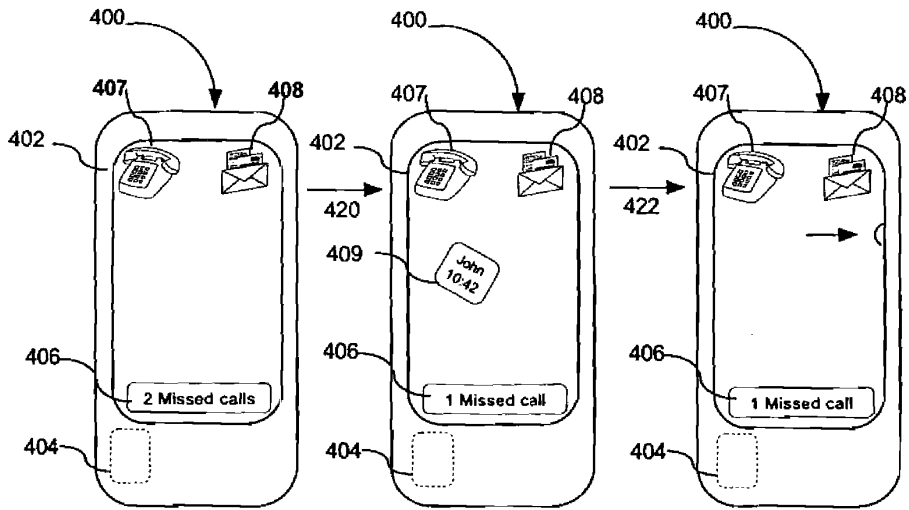


Fig 4a

Fig 4b

Fig 4c

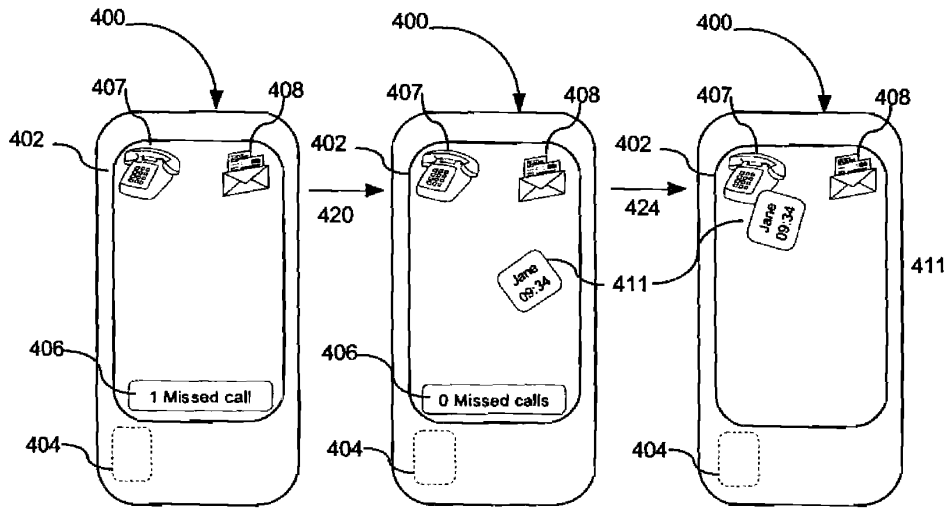


Fig 4d

Fig 4e

Fig 4f

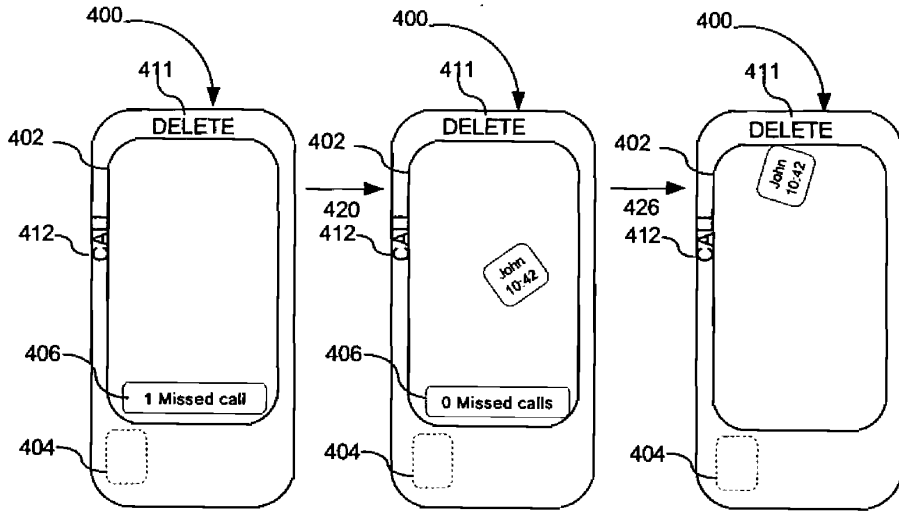


Fig 4g

Fig 4h

Fig 4i

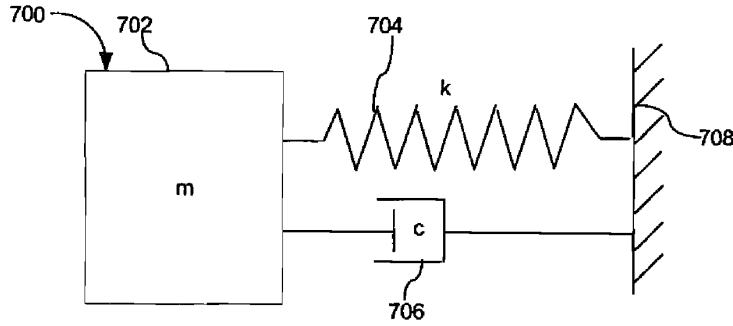


Fig 7a

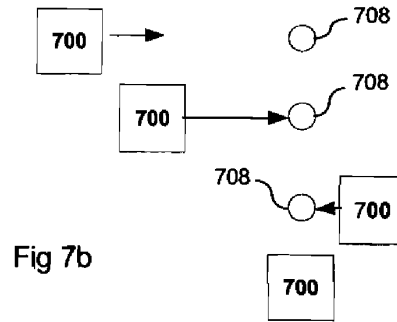


Fig 7b

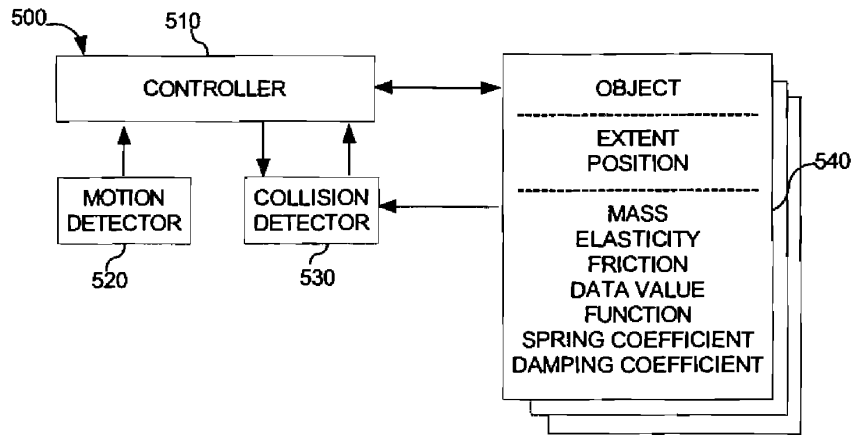


Fig 5a

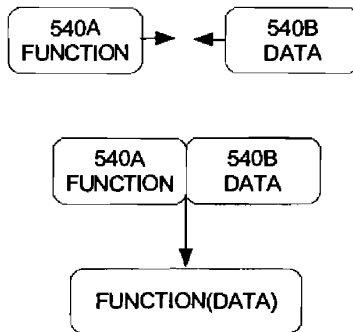


Fig 5b

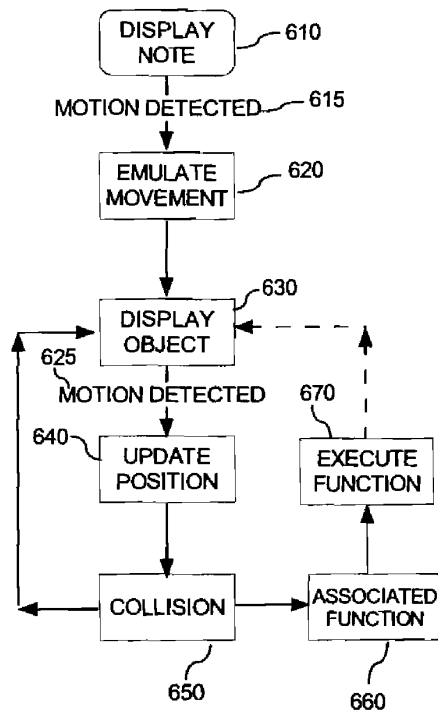


Fig 6a

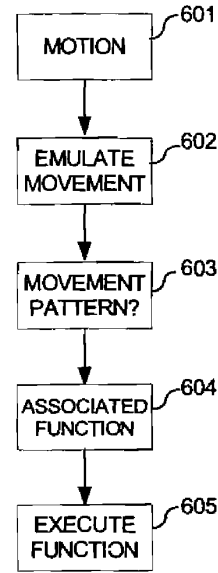


Fig 6b

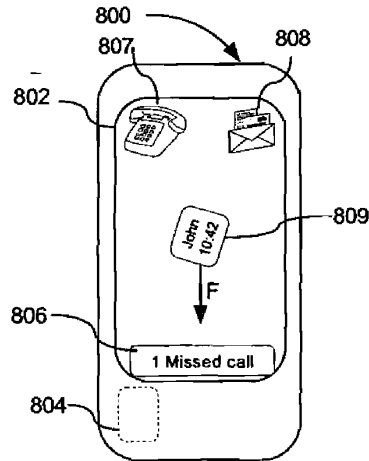


Fig 8

INTERNATIONAL SEARCH REPORT

International application No
PCT/EP2008/008662

A. CLASSIFICATION OF SUBJECT MATTER INV. G06F3/048		
According to International Patent Classification (IPC) or to both national classification and IPC		
B. FIELDS SEARCHED		
Minimum documentation searched (classification system followed by classification symbols) G06F		
Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched		
Electronic data base consulted during the international search (name of data base and, where practical, search terms used) EPO-Internal, WPI Data, INSPEC, COMPENDEX, IBM-TDB		
C. DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 2007/178974 A1 (MASUYAMA IWAO [JP] ET AL) 2 August 2007 (2007-08-02) abstract paragraphs [0012] - [0015], [0111], [0193] - [0196]	1-31
<input type="checkbox"/> Further documents are listed in the continuation of Box C. <input checked="" type="checkbox"/> See patent family annex.		
* Special categories of cited documents : *A* document defining the general state of the art which is not considered to be of particular relevance *E* earlier document but published on or after the international filing date *L* document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified) *O* document referring to an oral disclosure, use, exhibition or other means *P* document published prior to the international filing date but later than the priority date claimed *T* later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention *X* document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone *Y* document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art. *&* document member of the same patent family		
Date of the actual completion of the international search 11 February 2009		Date of mailing of the international search report 19/02/2009
Name and mailing address of the ISA/ European Patent Office, P.B. 5818 Patentlaan 2 NL - 2200 HV Rijswijk Tel: (+31-70) 340-2040 Fax: (+31-70) 340-3016		Authorized officer Wiedmeyer, Vera

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INTERNATIONAL SEARCH REPORT

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International application No

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Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 2007178974	A1	02-08-2007	NONE

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- (71) Applicant (for all designated States except US):
SENSEG OY [FI/FI]; Valimotie 27, FI-00380 Helsinki (FI).
- (72) Inventors; and
- (75) Inventors/Applicants (for US only): MÄKINEN, Ville [FI/FI]; Metsänvartijantie 3 F, FI-02720 Espoo (FI). SU-VANTO, Petro [FI/FI]; Keilakuja 2 C 32, FI-01280 Van-
taa (FI). LINJAMA, Jukka [FI/FI]; Tuurinniitynkuj 9, FI-02200 Espoo (FI).
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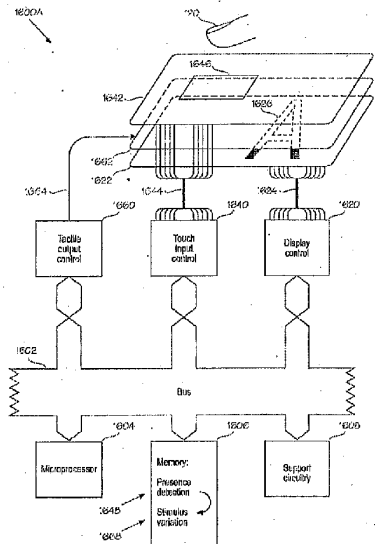
Declarations under Rule 4.17:

— of inventorship (Rule 4.17(iv))

[Continued on next page]

(54) Title: INTERFACE APPARATUS FOR TOUCH INPUT AND TACTILE OUTPUT COMMUNICATION

Fig. 16A



(57) Abstract: An interface apparatus (1600A) comprises a surface (1642) touchable by a finger (120). The surface has a touch-sensitive area with a predetermined position (1646), to which a function is assigned. The finger's presence at the predetermined position (1646) is detected. An electrosensory stimulus is generated to the finger by applying an alternating electrical drive to one or more electrodes (1662). Each electrode is provided with an insulator, which prevents DC flow from the electrode to the finger and a capacitive coupling over the insulator is formed between the electrode (1662) and the finger (120). The capacitive coupling and electrical drive are dimensioned to produce an electrosensory sensation, independently of mechanical vibration of the electrode. The electrosensory stimulus is varied temporally based on the detected presence or absence of the of the finger (120) near the at least one touch-sensitive area having the predetermined position (1646).

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Published:

— with international search report (Art. 21(3))

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Interface apparatus for touch input and tactile output communication

Background of the invention

[0001] The invention relates to a touch device interface. By way of example, the inventive touch device interface can be used as a user-input section of a touch screen interface. Although a touch screen appears to be a unitary piece of hardware, it actually comprises an output device, namely a display or screen, and an input device which is sensitive to touching or approaching the surface of the display with a finger or stylus. Touch screens can be implemented by organizing an x-y matrix of infrared rays over the screen, in which case touching the display surface is not necessary. Alternatively the screen can be overlaid by a transparent pressure-sensitive switch matrix which is scanned in substantially similarly to the way electronic keyboard matrices are scanned. The layout of the switch matrix may resemble that of a general-purpose typewriter, or the layout may be dedicated to specific purposes or applications. Touch screen interfaces are frequently used in connection with laptop or palmtop computers, personal digital assistants ("PDA"), remote control devices, digital cameras, navigators, entertainment devices, and many other types of devices.

[0002] A problem with conventional touch screen interfaces is that the user of the touch screen interface must be able to see the layout of the switch matrix in order to be able to select a specific key to be activated ("pushed"). Seeing the layout of the switch matrix is not always possible or easy, and visually impaired persons are a prime example. Even in cases wherein the user could see the switch matrix layout, looking at the switch matrix layout may disturb the user, such as the driver of a car.

Brief description of the invention

[0003] An object of the invention is to develop a method and equipment so as to alleviate one or more of the problems identified above. In other words the object of the invention is to provide an improved touch screen interface which requires less visual attention from its user than prior art touch screen interfaces do. The object of the invention is attained by methods and equipment as specified in the attached independent claims. The dependent claims and the present description relate to specific embodiments of the invention.

[0004] An aspect of the invention is a interface apparatus according to claim 1. The interface apparatus according to claim 1, which provides two-way

communication with the user, comprises a touch input section and a tactile output section. The term "section" implies that the touch input section and a tactile output section are comprised within the two-way interface apparatus. The touch input section comprises a surface arranged so as to be touched or approached by a body member, which typically is the user's finger. This surface may be called a touch surface. The touch surface has at least one touch-sensitive area having a predetermined position. The touch input section comprises or is operatively connectable to data processing means for assigning at least one function to the least one touch-sensitive area. The touch input section comprises presence-detecting means for detecting a presence or absence of a user's body member near the at least one touch-sensitive area. Touch-sensitive smart phones, car navigators, touch pads of laptop or palmtop computers, or the like provide illustrative but non-restrictive examples of the touch input section. The data processing means comprises an appropriately programmed microprocessor with associated hardware. The microprocessor and its associated hardware can reside within the interface apparatus or in an external data processing system. The presence-detecting means are typically implemented by appropriate programming of the microprocessor: the surface touched or approached by the body member is typically arranged as an X-Y matrix which is scanned by the associated electronics of the touch input section. When the user's body member presses an area of the surface, one or more of the X lines are connected to one or more of the Y lines, and the X and Y coordinates of the connection are detected by the processor. The X and Y coordinates are typically compared with coordinates that define predetermined areas.

[0005] In an illustrative but non-restrictive example, the function assigned to the touch-sensitive area is providing an input to an application program, such as a selection of an option ("yes/no/cancel") or a selection of an act to be performed. The border or perimeter of the touch-sensitive area need not be a sharply-defined one, so long as it is possible to say that touching or approaching a point within the touch-sensitive area invokes the function assigned to the touch-sensitive area, while touching or approaching another point outside the area does not.

[0006] The number of functions assigned to a touch-sensitive area is not restricted to one. Instead it is possible to assign multiple functions to one, some or all touch-sensitive areas, such that a single touch ("click") invokes a

first function, two touches within a predefined time window ("double click") invokes a second function, and so on.

[0007] An illustrative example of an interface apparatus which comprises the function-assigning means is a standalone device, such as a palmtop computer, a smart telephone or a remote controller. An illustrative example of a touch device which is connectable to the function-assigning means is an interface panel which does not contain any application-level programs but is connectable to an external data processing equipment executing one or more application-level programs which use the interface panel as an input device. In such environments it is beneficial to define an application programming interface (API), via which the application-level programs can accept input from a user, and optionally provide feedback to the user.

[0008] As regards functionality, the touch input section can be implemented via conventional technology. As stated earlier, the conventional technology causes the problem that the user must see what area(s) of the touch input section need to be pushed.

[0009] In order to solve the problems associated with conventional touch input technology, the inventive interface apparatus also comprises a tactile output section, which in turn comprises an electro-sensory stimulus generator for generating an electro-sensory stimulus to the body member. The electro-sensory stimulus generator comprises one or more conducting electrodes, each conducting electrode being provided with an insulator wherein, when the body member is proximate to the conducting electrode, the insulator prevents flow of direct current from the conducting electrode to the body member and a capacitive coupling over the insulator is formed between the conducting electrode and the body member. The electro-sensory stimulus generator also comprises a high-voltage source for applying an electrical drive to the one or more conducting electrodes, wherein the electrical drive comprises a first frequency component in a frequency range between 1 Hz and 1000 Hz. The capacitive coupling and electrical drive are dimensioned to produce an electro-sensory sensation, independently of any mechanical vibration of the one or more conducting electrodes or insulators.

[0010] As stated earlier, the touch input section comprises presence-detecting means for detecting a presence or absence of a user's body member near the at least one touch-sensitive area. The tactile output section according to the invention is operatively coupled to the presence-detecting means and

comprises stimulus-variation means, such that the stimulus-variation means are configured to receive an input from the presence-detecting means and to temporally vary the electro-sensory stimulus based on input from the presence-detecting means. The stimulus may be varied by varying one or more of the electrical parameters defining it, including drive voltage, frequency or the capacitive coupling.

[0011] The significance of such a stimulus-variation means may not be immediately apparent. Yet the stimulus-variation means provides a clear benefit, for the following reason. Touch input devices, such as touch-sensitive displays, may provide a large number of distinct predefined areas. In some cases, the number of distinct predefined areas roughly equals the size of the touch-sensitive display divided by the size of a typical fingertip. For example, a modern smart phone may provide up to 20 distinct predefined areas, or even more, in its touch-sensitive display. The invention aims at eliminating or reducing the need to see the touch-sensitive display, in order to identify the distinct predefined areas. As regards the inventive tactile output section, however, it may be technically challenging to match the spatial resolution of the touch input section. The significance of the stimulus-variation means will be easiest to understand by assuming that the user touches the touch-sensitive display by only one finger at a time. Information on the area touched by the user's finger is detected by the presence-detecting means and relayed to the stimulus-variation means. The stimulus-variation means utilizes this information, such that touching different areas by the finger causes different electro-sensory stimuli to the finger. This means that tactile output section of the inventive interface apparatus may utilize relatively coarse spatial resolution and good temporal resolution to create an illusion of a spatial resolution that matches that of the touch input section. Under the assumption that the user touches the touch-sensitive display by only one finger at a time, even one electrode suffices to create an illusion of a much higher spatial resolution. In reality, the entire surface of the electrode provides the same stimulus intensity, but by varying the stimulus intensity based on information of the area touched by the user's finger, the inventive interface apparatus creates an illusion of multiple areas, each of which provides a distinct stimulus intensity. Such feedback may be provided by the interface section of device itself and/or the application-level program and/or the API that couples the application-level program to the interface device. Thus the inventive interface apparatus is

capable of creating an illusion of a tactile output section with a spatial resolution exceeding its actual spatial resolution. An advantage of this feature is that the number of electrodes can be quite small, sometimes as low as one. The required number of electrodes equals the number of simultaneous, individually controlled stimuli. If, say, the tactile output section needs to create an individually controllable stimulus for each of two halves of the touch surface, two electrodes are sufficient. In many applications the user touches the touch surface with only one fingertip at a time, which means that one tactile output electrode suffices to create an illusion of a spatial resolution equal to that of the touch input section. Accordingly, the electrode(s) may be quite large, such as over 5 mm in both dimensions, up to the full size of the touch surface.

[0012] In an illustrative example, the electro-sensory stimulus is more intensive within the touch-sensitive areas. It is not necessary for the intensity of the electro-sensory stimulus to vary in precise accordance with the border(s) of the touch-sensitive area(s). For instance, assuming that the size and shape of the touch-sensitive areas correspond to a typical fingertip, it suffices to provide an intensity peak for the electro-sensory stimulus at the centre of each touch-sensitive area.

[0013] As an alternative to a comprehensive two-way interface apparatus which comprises the touch input section and tactile output section as described above, the invention can also be embodied as an upgrade to existing touch input devices. Accordingly, another aspect of the invention is a tactile output device, which comprises all features of the tactile output section as defined in claim 1. The tactile output device is adapted for installation into a touch input device comprising all features of the touch input section as defined in claim 1, such that installation of the tactile output device into the touch input device results in the interface apparatus according to claim 1.

[0014] The usage of the terms "interface apparatus", "device" and "section" is such that "apparatus" refers to a comprehensive two-way interface apparatus which comprises the touch input section and tactile output section. In other words, the two "sections" are portions of the comprehensive two-way interface apparatus. On the other hand, the word "device" is used in contexts where the tactile output device is provided separately, for upgrading an existing touch input device. Thus the terms "section" and "device" are functionally interchangeable, and the difference between them is such that "sections" form parts of a comprehensive apparatus, while "devices" may be sold separately,

such that an inventive tactile output device may upgrade an existing touch input device such the upgrading results in an inventive interface apparatus.

[0015] The invention solves or at least alleviates the problems associated with prior art touch screen interfaces by providing the user with a spatially variant electro-sensory stimulus, wherein the spatial variations of the electro-sensory stimulus are based on the layout of the touch-sensitive areas of the touch screen interface. The expression "are based on" refers to the fact that a touch screen interface may comprise up to three superimposed layouts: a first layout defines the touch-sensitive areas, a second layout defines the spatially variant electro-sensory stimulus according to the present invention, while a third layout defines the visual cues which in prior art devices help the user see the layout of the switch matrix. The third layout (the visual cues), which is virtually mandatory in prior art devices, is optional in the inventive touch screen interface because its function can be delegated to the inventive second layout, namely the spatially variant electro-sensory stimulus. Naturally, all the two or three layouts should correspond to one another but absolute precision is not required, so long as no confusion arises regarding which touch-sensitive area is currently activated.

[0016] Touch screen interfaces are frequently used in connection with equipment in which the keyboard or keypad legend varies over time. A prime example is an automat which serves customers in several languages. Another example is a multi-function remote controller, wherein the keypad legend varies depending on which set or piece of equipment is being controlled. A residual problem in touch screen interfaces is that the act of touching per se does not provide the user with any feedback as to whether the key press was accepted or not. This is why prior art touch screen interfaces are normally provided with a separate feedback system which may employ visual or aural information. But for the reasons stated above, visual feedback is not always satisfactory and aural feedback has its own problems, such as difficulty of detection in noisy surroundings.

[0017] Accordingly, some embodiments of the invention address the above-described feedback problems by providing electro-sensory feedback indicating whether or not a touch-sensitive area is currently being activated.

[0018] In order to provide the electro-sensory stimulus which provides the user with an indication of the layout of the touch-sensitive areas, the touch screen interface according to the invention can be implemented by means of a

capacitive electro-sensory interface as described in commonly assigned patent applications FI20075651, filed 18 September 2007, or US 60/960899, filed 18 October 2007, both titled "Sensory interface". Later in this document, the acronym "CEI" refers to a capacitive electro-sensory interface.

- 5 [0019] The electro-sensory stimulus generator is preferably dimensioned such that the electrosensory sensation is produced independently of relative motion between the user's body member, such as a finger, and the insulated electrode(s). Creation of the electrosensory sensation without finger movement provides the benefit that the user's finger can feel an underlying area, to which
- 10 a function is assigned. Some prior art techniques require finger movement to create the electrosensory sensation. For instance, reference document 1 (Yamamoto) discloses a technique in which a variable electric field is used to modulate the frictional force between the finger and the underlying surface. This means that the inventive technique can provide an indication when the
- 15 user's finger is (stationary) on top of a predefined area, whereas the prior art, as exemplified by Yamamoto, can only indicate when the user's finger is moving over the predefined area. The ability to provide an indication of a stationary finger on top of a predefined area brings about the benefit that the user may select the function assigned to the predefined area, and then let their
- 20 finger rest in place to wait for an acknowledgment that the user's selection of function has been accepted. The acknowledgment may be provided by varying the electrosensory stimulus, while the user's finger is stationary on top of the predefined area.

Brief description of the drawings

- 25 [0020] In the following the invention will be described in greater detail by means of specific embodiments with reference to the attached drawings, in which
- Figure 1 illustrates the operating principle of a capacitive electro-sensory interface ("CEI");
- 30 Figure 2 illustrates an embodiment of the CEI;
- Figure 3 shows an enhanced embodiment with multiple independently-controllable electrodes;
- Figure 4 shows a specific implementation of the embodiment shown in Figure 3;

Figure 5 is a graph which schematically illustrates the sensitivity of a test subject to sensations produced by the inventive capacitive electro-sensory interface at various frequencies; and

Figure 6 is a graph which further clarifies the operating principle of the CEI;

5 Figures 7A and 7B show an implementation of the CEI wherein the strength of the capacitive coupling is adjusted by electrode movement;

Figure 8 shows an implementation of the CEI wherein the charges of different electrodes have opposite signs;

10 Figure 9 shows an implementation of the CEI wherein a group of electrodes are organized in the form of a matrix;

Figure 10 illustrates distribution of an electric field-generating potential in capacitive couplings when the apparatus is grounded;

Figure 11 illustrates distribution of an electric field-generating potential in capacitive couplings when the apparatus is floating (not grounded);

15 Figure 12 illustrates distribution of an electric field-generating potential in capacitive couplings when the apparatus is floating and the user is sufficiently close to the apparatus and capacitively grounded to the ground (reference) potential of the apparatus;

20 Figure 13 shows an arrangement wherein capacitive couplings are utilized to detect touching;

Figures 14 and 15 illustrate embodiments in which a single electrode and temporal variations in the intensity of the electro-sensory stimulus can be used to create illusions of a textured touch screen surface;

25 Figure 16A shows an embodiment of the invention in which the electrode(s) for the tactile output section are positioned between the touch input section and the display layer; and

Figure 16B shows an embodiment of the invention in which the electrode(s) for the tactile output section are positioned on top of a touch input section, which in turn is positioned on top of a display layer.

30 Detailed description of specific embodiments

[0021] The embodiments described in the following relate to the operation and implementation of a capacitive electro-sensory interface ("CEI") which can be employed in the inventive touch screen interface.

35 **[0022]** Figure 1 illustrates the operating principle of the CEI. Reference numeral 100 denotes a high-voltage amplifier. The output of the high-voltage amplifier 100, denoted OUT, is coupled to an electrode 106 which is insulated

against galvanic contact by an insulator 108 which comprises at least one insulation layer or member. Reference numeral 120 generally denotes a body member to be stimulated, such as a human finger. Human skin, which is denoted by reference numeral 121, is a relatively good insulator when dry, but
5 the CEI provides a relatively good capacitive coupling between the electrode 106 and the body member 120. The capacitive coupling is virtually independent from skin conditions, such as moisture. The inventors' hypothesis is that the capacitive coupling between the electrode 106 and the body member 120 generates a pulsating Coulomb force. The pulsating Coulomb
10 force stimulates vibration-sensitive receptors, mainly those called Pacinian corpuscles which reside under the outermost layer of skin in the ipodermis 121. The Pacinian corpuscles are denoted by reference numeral 122. They are shown schematically and greatly magnified.

[0023] The high-voltage amplifier 100 is driven by a signal IN which results in a
15 substantial portion of the energy content of the resulting Coulomb forces to reside in a frequency range to which the Pacinian corpuscles 122 are sensitive. For humans this frequency range is between 10 Hz and 1000 Hz, preferably between 50 Hz and 500 Hz and optimally between 100 Hz and 300 Hz, such as about 240 Hz. The frequency response of the Pacinian corpuscles
20 is further discussed in connection with Figures 5 and 6.

[0024] It should be understood that, while "tactile" is frequently defined as relating to a sensation of touch or pressure, the electrosensory interface according to the present CEI, when properly dimensioned, is capable of creating a sensation of vibration to a body member even when the body
25 member 120 does not actually touch the insulator 108 overlaying the electrode 106. This means that unless the electrode 106 and/or insulator 108 are very rigid, the pulsating Coulomb forces between the electrode 106 and body member 120 (particularly the Pacinian corpuscles 122) may cause some slight mechanical vibration of the electrode 106 and/or insulator 108, but the method
30 and apparatus according to the CEI are capable of producing the electrosensory sensation independently of such mechanical vibration.

[0025] The high-voltage amplifier and the capacitive coupling over the insulator 108 are dimensioned such that the Pacinian corpuscles or other mechanoreceptors are stimulated and an electrosensory sensation (a
35 sensation of apparent vibration) is produced. For this, the high-voltage amplifier 100 must be capable of generating an output of several hundred volts

or even several kilovolts. In practice, the alternating current driven into the body member 120 has a very small magnitude and can be further reduced by using a low-frequency alternating current.

5 [0026] Figure 2 illustrates an apparatus which implements an illustrative embodiment of the present CEI. In this embodiment the high-voltage amplifier 100 is implemented as a current amplifier 102 followed by a high-voltage transformer 104. In the embodiment shown in Figure 2, the secondary winding of the high-voltage transformer 104 is in a more or less flying configuration with respect to the remainder of the apparatus. The amplifier 100, 102 is driven with
10 a modulated signal whose components are denoted by 112 and 114. The output of the high-voltage amplifier 100 is coupled to an electrode 106 which is insulated against galvanic contact by the insulator 108. Reference numeral 120 generally denotes a member to be stimulated, such as a human finger. Human skin, which is denoted by reference numeral 121, is a relatively good insulator
15 when dry, but the CEI provides a relatively good capacitive coupling between the electrode 106 and the electrically conductive tissue underneath the skin surface 121. Mechanoreceptors, such as the Pacinian corpuscles 122, reside in this conductive tissue. In Figures 1 and 2, the Pacinian corpuscles 122 are shown schematically and greatly magnified.

20 [0027] A benefit of the capacitive coupling between the electrode 106 and the electrically conductive tissue underneath the skin surface, which is known as the Corneus Layer and which contains the Pacinian corpuscles 122, is that the capacitive coupling eliminates high local current densities to finger tissue, which would result from contact that is conductive at direct current.

25 [0028] It is beneficial, although not strictly necessary, to provide a grounding connection which helps to bring the subject to be stimulated, such as the user of the apparatus, closer to a well-defined (non-floating) potential with respect to the high-voltage section of the apparatus. In the embodiment shown in Figure 2, the grounding connection, denoted by reference numeral 210, connects a
30 reference point REF of the high-voltage section to a body part 222 which is different from the body part(s) 120 to be stimulated. In the embodiment shown in Figure 2, the reference point REF is at one end of the secondary winding of the transformer 104, while the drive voltage for the electrode(s) 206A, 206B, 206C is obtained from the opposite end of the secondary winding.

35 [0029] In an illustrative implementation, the apparatus is a hand-held apparatus which comprises a touch display activated by finger(s) 120. The

grounding connection 210 terminates at a grounding electrode 212. An illustrative implementation of the grounding electrode 212 is one or more ground plates which are arranged such that they are conveniently touched one hand 222 of the user while the apparatus is manipulated by the other hand.

5 The ground plate(s) may be positioned on the same side of the apparatus with the touch display and next to the touch display, or it/they may be positioned on adjacent or opposite side(s) from the side which comprises the touch display, depending on ergonomic considerations, for example.

[0030] In real-world apparatuses, the coupling 210 between the reference point REF and the non-stimulated body part 222 may be electrically complex. In addition, hand-held apparatuses typically lack a solid reference potential with respect to the surroundings. Accordingly, the term "grounding connection" does not require a connection to a solid-earth ground. Instead the grounding connection means any connection which helps to decrease the potential difference between the reference potential of the apparatus and a second body member distinct from the body member(s) to be stimulated. This definition does not rule out any capacitive parallel or stray elements, so long as the grounding connection 210 helps bring the user of the apparatus, along with the non-stimulated body part 222, to a potential which is reasonably well defined with respect to the high-voltage section of the apparatus. A capacitive grounding connection will be discussed in connection with Figure 12. In the present context, the reasonably well-defined potential should be understood in view of the voltage OUT which drives the electrode(s) 206A, 206B, 206C. If the electrode drive voltage OUT is, say, 1000 V, a potential difference of, say, 100 V, between the user's body and the reference point REF may not be significant.

[0031] The non-capacitive coupling 210 between the reference point REF of the high-voltage section and the non-stimulated body part 222 greatly enhances the electro-sensory stimulus experienced by the stimulated body part 120. Conversely, an equivalent electro-sensory stimulus can be achieved with a much lower voltage and/or over a thicker insulator when the non-capacitive coupling 210 is being used.

[0032] The amplifier 100, 102 is driven with a high-frequency signal 112 which is modulated by a low-frequency signal 114 in a modulator 110. The frequency of the low-frequency signal 114 is such that the Pacinian corpuscles, which reside in the electrically conductive tissue underneath the skin surface, are

responsive to that frequency. The frequency of the high-frequency signal 112 is preferably slightly above the hearing ability of humans, such as 18 to 25 kHz, more preferably between about 19 and 22 kHz. If the frequency of the signal 112 is within the audible range of humans, the apparatus and/or its drive circuit may produce distracting sounds. On the other hand, if the frequency of the signal 112 is far above the audible range of humans, the apparatus drives more current into the member 120. A frequency of about 20 kHz is advantageous in the sense that components designed for audio circuits can generally be used, while the 20 kHz frequency is inaudible to most humans. Experiments carried out by the inventors suggest that such modulation is not essential for the CEI. Use of a high-frequency signal with low-frequency modulation, such as the one schematically shown in Figure 2, as opposed to a system which relies on the low-frequency signal alone, provides the benefit that the relatively high alternating voltage (a few hundred volts or a few kilovolts) can be generated with a relatively small transformer 104.

[0033] Terms like frequency or kHz should not be understood such that the high- or low-frequency signals 112, 114 are restricted to sinusoidal signals, and many other waveforms can be used, including square waves. The electrical components, such as the modulator 110, amplifier 102 and/or transformer 104 can be dimensioned such that harmonic overtones are suppressed. The inventors have discovered that pulses with durations of 4 ms (approximately one half-cycle of the low-frequency signal) or longer can be readily detected and with a practical insulator thickness the peak-to-peak voltage in the electrode 106 needs to be at least 500 V, preferably about 750 V. Unloaded peak-to-peak voltage measured in the electrode 106 should be in the range of approximately 750 V - 100 kV. Near the lower limit of this voltage range, the insulator thickness may be 0.05 - 1 mm, for example. As material technology and nanotechnology develop, even thinner durable insulating surfaces may become available. This may also permit a reduction of the voltages used.

[0034] The elements of Figures 1 and 2 described so far produce a steady-state electrosensory sensation as long as the body member, such as the finger 120, is in the vicinity of the electrode 106. In order to convey useful information, the electrosensory sensation must be modulated. In some simple embodiments, such modulation can be implemented by positioning the electrode 106 such that useful information is conveyed by the fact that the

finger 120 can sense the presence of the electrode 106. For example, the electrode 106 can be positioned over a switch, or in the vicinity of it, such that the switch can be detected without having to see it.

[0035] In other embodiments, such information-carrying modulation can be provided by electronically controlling one or more operating parameters of the inventive apparatus. The information-carrying modulation should not be confused with the modulation of the high-frequency signal 112 by the low-frequency signal 114, the purpose of which is to reduce the size of the transformer 104. In the schematic drawing shown in Figure 2, such information-carrying modulation is provided by controller 116, which controls one or more of the operating parameters of the inventive apparatus. For instance, the controller 116 may enable, disable or alter the frequency or amplitude of the high- or low-frequency signals 112, 114, the gain of the amplifier 102, or it may controllably enable or disable the power supply (not shown separately) or controllably break the circuit at any point.

[0036] Figure 3 shows an enhanced embodiment of the inventive apparatus with multiple independently-controllable electrodes. In Figure 3, elements with reference numerals less than 200 have been described in connection with Figures 1 and 2, and a repeated description is omitted. This embodiment comprises multiple independently-controllable electrodes 206A, 206B and 206C, of which three are shown but this number is purely arbitrary. Reference numeral 216 denotes an implementation of a controller which controls a switch matrix 217 which provides the high-voltage signal OUT to the electrodes 206A, 206B and 206C under control of the controller 216. The controller 216 may be responsive to commands from an external equipment, such as a data processing equipment (not shown separately).

[0037] A benefit of the embodiment shown in Figure 3 is that virtually all the drive circuitry, including the high-voltage amplifier 100, controller 216, and switch matrix 217, can be integrated into a common enclosure which is denoted by reference numeral 200. In this embodiment only the electrodes 206A, 206B and 206C and a single connecting wire for each electrode are outside the enclosure 200. As stated earlier, the electrodes need to be nothing more than simple conducting or semi-conducting plates covered by appropriate insulators. Therefore the enclosure 200 can be positioned in virtually any convenient position because the only elements external to it are very simple

electrodes and connecting wires (and, in some implementations a power supply, not shown separately).

[0038] Some prior art systems provide direct stimulation of nerves via galvanic current conduction to the outermost layer of the skin. Because of the galvanic current conduction, such systems require two electrodes to stimulate an area of skin. In contrast to such prior art systems, the embodiment described in connection with Figure 3 involves multiple electrodes 206A, 206B and 206C, but each electrode alone stimulates a distinct area of skin, or more precisely, the mechanoreceptors, including the Pacinian corpuscles underlying the outermost layers of skin. Therefore a configuration of n electrodes conveys n bits of information in parallel.

[0039] Figure 4 shows a specific implementation of the embodiment shown in Figure 3. In this implementation the switch matrix 217 comprises a bank of triacs 207A, 207B and 207C, but other types of semiconductor switches can be used, including semiconductor relays. Conventional electromechanical relays can be used as well. In this embodiment the switches (triacs) 207A, 207B and 207C are positioned logically after the transformer 104, ie, in the high-voltage circuitry. This implementation requires high-voltage switches (several hundred volts or several kilovolts) but it provides the benefit that the remainder of the circuitry, including the elements 100 through 114, can serve all of the electrodes 206A, 206B and 206C. As shown in Figure 4, the controller 216 may be connectable to a data processing equipment, an example of which is shown here as a personal computer PC.

[0040] Figure 5 is a graph which schematically illustrates the sensitivity of a randomly selected test subject to sensations produced by an apparatus substantially similar to the one shown in Figure 2. The x-axis of the graph shows frequency of the low-frequency signal (Item 114 in Figure 2) multiplied by two, while the y-axis shows the amplitude required to detect an electrosensory stimulation. The amplitude scale is relative. The small dip at 75 Hz may be a measurement anomaly, or it may be caused by a sensitivity peak of mechanoreceptors other than Pacinian corpuscles. The reason for placing the doubled low-frequency signal on the x-axis is that the Coulomb forces between the electrode 106 and the body member 120 have two intensity peaks for each cycle of a sinusoidal low-frequency signal, as will be schematically illustrated in connection with Figure 6.

[0041] The relative sensitivity at various frequencies is remarkably similar to the one published in section 2.3.1 (figure 2.2) of Reference document 2 (Gunther). Reference document 2 relates to vibrotactile (mechanical) stimulation of skin, but the similarity of the frequency response shown in Figure 5 to the one published in Reference document 2 suggests that the present CEI operates such that the electrode 106 and the sensitive member 120 (see Figure 1) form a capacitor over the insulator 108, and in that capacitor the oscillating Coulomb forces are converted to mechanical vibrations which are sensed by mechanoreceptors, including the Pacinian corpuscles. The inventors have also studied an alternative hypothesis wherein the Pacinian corpuscles are stimulated by current flowing through them, but this hypothesis does not explain the observations as well as the one which is based on Coulomb forces acting on the Pacinian corpuscles. However, the technical CEI described herein does not depend on the correctness of any particular hypothesis attempting to explain why the CEI operates the way it does.

[0042] Figure 6 is a graph which further clarifies the operating principle of the CEI and the interpretation of frequencies in connection with the present CEI. Reference numeral 61 denotes the low-frequency drive signal to the modulator 110 (shown as item 114 in Figure 2). Reference numeral 62 denotes the output of the modulator, ie, the high-frequency drive signal as modulated by the low-frequency drive signal.

[0043] Reference numerals 63 and 64 denote the resulting Coulomb forces in the capacitive coupling between the electrode 106 and the body member 120 over the insulator 108. Because the two sides of the capacitive coupling have opposite charges, the Coulomb force between the two sides is always attractive and proportional to the square of the voltage. Reference numeral 63 denotes the actual Coulomb force while reference numeral 64 denotes its envelope. The envelope 64 is within the range of frequencies to which the Pacinian corpuscles are sensitive, but because the Coulomb force is always attractive, the envelope 64 has two peaks for each cycle of the modulator output signal 62, whereby a frequency-doubling effect is produced. Because the Coulomb force is proportional to the square of the voltage, any exemplary voltages disclosed herein should be interpreted as effective (RMS) values in case the voltages are not sinusoidal.

[0044] The statement that the two sides of the capacitive coupling have opposite charges whereby the Coulomb force is always attractive holds for a

case in which the apparatus and the body member to be stimulated are at or near the same potential. High static charges can cause deviations from this ideal state of affairs, which is why some form of grounding connection between a reference potential of the high-voltage source and the body element other than the one(s) to be stimulated is recommended, as the grounding connection helps to lower the potential differences between the apparatus and its user.

5 [0045] The CEI can be implemented as part of an input/output peripheral apparatus which is connectable to a data processing equipment. In such a configuration the data processing equipment can provide prompting and/or feedback via electrically-controllable electrosensory sensation.

10 [0046] Figures 7A and 7B show implementations of the CEI wherein the strength of the capacitive coupling is adjusted by electrode movement. Generation of the electric field, and its variation as necessary, is effected via a set of electrodes 704 which comprises individual electrodes 703. The individual electrodes 703 are preferably individually controllable, wherein the controlling of an electrode affects its orientation and/or protrusion. Figure 7A shows an implementation wherein a group of electrodes 703 are oriented, via the output signal from the controller 216, such that the electrodes 703 collectively form a plane under the insulator 702. In this situation the high-voltage current (DC or AC) from the high-voltage amplifier 100 to the electrodes 703 generates an opposite-signed charge of sufficient strength to a body member (eg the finger 120) in close proximity to the apparatus. A capacitive coupling between the body member and the apparatus is formed over the insulator 702, which may give rise to a sensory stimulus.

25 [0047] Figure 7B shows the same apparatus shown in Figure 7A, but in this case the strength of the capacitive coupling generated with the current from the high-voltage amplifier 100 is minimized by orienting the electrodes (now shown by reference numeral 714) such that they do not form a plane under the insulator 702. In some implementations of the present invention, the electric field alternating with a low frequency can be generated by alternating the state of the apparatus between the two states shown in Figures 7A and 7B. The frequency of the state alternation can be in the order of several hundred, eg 200 to 300 full cycles per second.

30 [0048] Figure 8 shows an implementation of the CEI wherein the individual electrodes 803 in the set of electrodes 804 may have charges of opposite signs. The charges of individual electrodes 803 may be adjusted and

controlled via the controller 216. The individual electrodes 803 may be separated by insulator elements 806, so as to prevent sparking or shorting between the electrodes. The capacitive coupling between the CEI and the body member proximate to it may give rise to areas having charges with opposite signs 801. Such opposing charges are mutually attractive to one another. Hence it is possible that coulomb forces stimulating the Pacinian corpuscles may be generated not only between the CEI and the body member but between infinitesimal areas within the body member itself.

[0049] Figure 9 shows an implementation of the CEI wherein a group of individually controllable electrodes 910a through 910i are organized in the form of a matrix. Such a matrix can be integrated into a touch screen apparatus. Since the CEI described above does not require direct connection (touching) between the CEI and a body member of its user, the electrodes of the CEI apparatus can be positioned behind the touch screen, wherein "behind" means the side of the touch screen opposite to the side facing the user during normal operation. Alternatively, the electrodes can be very thin and/or transparent, whereby the electrodes can overlay the touch screen on the side normally facing the user. The electric charges, which are conducted from the high-voltage amplifier 100 to the electrodes 910a through 910i via the switch array 217, may all have similar signs or the charges conducted to different electrodes may have different signs, as illustrated in connection with Figure 8. For instance, the controller 216 may control the switches in the switch array individually, or certain groups may form commonly-controllable groups. The surface of an individual electrode and/or its associated insulator can be specified according to the intended range of operations or applications. The minimum practical area is about 0.01 cm², while the practical maximum is roughly equal to the size of a human hand. It is expected that surface areas between 0.1 and 1 cm² will be found most usable in practice.

[0050] The matrix of electrodes 910a through 910i and the switch array 217 provide a spatial variation of the electro-sensory stimulation. In other words, the sensory stimulation provided to the user depends on the location of the user's body member, such as a finger, proximate to the CEI apparatus which is integrated to the inventive touch screen. The spatially varying sensory stimulation provides the user with an indication of the layout of the touch-sensitive areas of the touch screen interface.

[0051] In addition to the spatially varying sensory stimulation, the controller 216 may direct the switch array 217 to produce a temporally varying electro-sensory stimulation, which can be used for a wide variety of useful effects. For instance, the temporally varying electro-sensory stimulation can be used to indicate a detected activation of a touch-sensitive area ("key press"). This embodiment address a common problem associated with prior art touch screen apparatuses, namely the fact that a detection of a key press produces no tactile feedback. It is true that the application-level program used via the touch screen apparatus may provide visual or aural feedback, which exhibit various problems described earlier. In addition production of the visual or aural feedback from the application-level program causes a burden on the programming and execution of those programs. In some implementations of the invention, an interface-level or driver-level program provides a tactile feedback from a detected activation of a touch-sensitive area by using the temporally and spatially variant electro-sensory stimulation, and such interface-level or driver-level programs can be used by any application-level programs. For example, the application-level programs can be coupled to the inventive touch screen interface via an application programming interface ("API") whose set of available functions includes the feedback generation described above.

[0052] The temporally and spatially variant electro-sensory stimulation can also be used to change the layout of the touch-sensitive areas "on the fly". This operation is roughly analogous to changing the keyboard or keypad layout depending on the application program or user interface screen currently executed. However, when prior art touch screen apparatuses change keyboard or keypad layout on the fly, the new layout must be somehow indicated to the user, and this normally requires that the user sees the touch screen apparatus.

[0053] Some embodiments of the inventive interface apparatus eliminate the need to see the touch screen section or device, assuming that the layout of the touch-sensitive areas is sufficiently simple. For instance, up to about two dozen different "key legends" can be indicated to the user by providing different patterns for the temporally and spatially variant electro-sensory stimulation. As used herein, the expression "key legend" refers to the fact that prior art touch screen apparatuses, which produce no tactile feedback, normally produce visual cues, and these are commonly called "legends". In some embodiments of the present invention, the function of the key legends can be provided via different patterns. For instance, the following patterns can

be identified with one fingertip: pulses with low, medium or high repetition rate; sweeps to left, right, up or down, each with a few different repetition rates; rotations clockwise or anti-clockwise, each with a few different repetition rates.

[0054] From the above, it is evident that the inventive electro-sensory interface
5 can produce a large number of different touch-sensitive areas, each with a
distinct "feel" (technically: a different pattern for the temporal and spatial
variation of the electro-sensory stimulus). Hence the screen section of a
conventional touch screen is not absolutely needed in connection with the
present invention, and the term "touch input device" or "touch input section"
10 should be interpreted as an interface equipment which, among other things, is
suitable for applications commonly associated with touch screen equipment,
although the presence of the screen is not mandatory.

[0055] Moreover, the strength of the capacitive coupling between the inventive
CEI and a body member of its user (or the capacitive coupling between an
15 individual electrode or a group of electrodes and the user's body member) can
be determined by direct or indirect measurements. This measurement
information can be utilized in various ways. For instance, the strength of the
capacitive coupling can indicate the body member's proximity to the electrode,
or it can indicate touching the electrode by the body member. Such
20 measurement functionality can be provided by a dedicated measurement unit
(not shown) or it can be integrated into one of the blocks described earlier,
such as the switch matrix 217. The switch matrix 217 (or the optional dedicated
measurement unit) can send the measurement information to the controller
216 which can utilize it to vary the electric fields generated by the electrodes,
25 by varying the voltage or frequency. In addition or alternatively the controller
216 may forward the measurement information, or some information
processed from it, to a data processing equipment, such as the personal
computer PC shown in Figure 4.

[0056] Yet further, two or more inventive interface devices can be
30 interconnected via some communication network(s) and data processing
equipment. In such an arrangement, the electro-sensory stimulation provided
to the users of the touch screen devices may be based on some function of all
users' contribution to the proximity to their respective devices. In one
illustrative example, such an interconnection of two (or more) touch screen
35 devices can provide their users with tactile feedback whose strength depends
on the sum of the areas of hands touch the touch-sensitive areas. This

technique simulates a handshake whose strength reflects the sum of hand pressure exerted by both (or all) users. In another illustrative example, a music teacher might "sense" how a remotely located student presses the keys of a simulated piano keyboard.

- 5 [0057] Figure 10 illustrates distribution of an electric field-generating potential in capacitive couplings when the apparatus is grounded. The underlying theory is omitted here, and it suffices to say that in the arrangement shown in Figure 10, the drive voltage e of an electrode is divided depending on based on the ratio of capacitances C_1 and C_2 , wherein C_1 is the capacitance between the
10 finger and the electrode and C_2 is the stray capacitance of the user. The electric field experienced by the finger is caused by voltage U_1 :

$$U_1 = \frac{C_2}{C_1 + C_2} e$$

- [0058] This voltage is lower than the drive voltage e from the voltage source. In a general case the reference potential of the apparatus may be floating, as
15 will be shown in Figure 11. This arrangement further decreases the electric field directed to the body member, such as finger.

- [0059] For these reasons some embodiments of the invention aim at keeping the capacitance C_1 low in comparison to that of C_2 . At least capacitance C_1 should not be significantly higher than C_2 . Some embodiments aim at
20 adjusting or controlling C_2 , for instance by coupling the reference potential of the apparatus back to the user, as will be shown in Figure 12.

- [0060] Instead of the measures described in connection with Figures 10 through 12, or in addition to such measures, stray capacitances can be controlled by arrangements in which several electrodes are used to generate
25 potential differences among different areas of the touch screen surface. By way of example, this technique can be implemented by arranging the touch-sensitive surface of a hand-held device (eg the top side of the device) to a first potential, while the opposite side is arranged to a second potential, wherein the two different potentials can be the positive and negative poles of the device. Alternatively, a first surface area can be the electric ground (reference
30 potential), while a second surface area is charged to a high potential.

- [0061] Moreover, within the constraints imposed by the insulator layer(s), it is possible to form minuscule areas of different potentials, such as potentials with opposite signs or widely different magnitudes, wherein the areas are small

enough that the user's body member, such as finger, is simultaneously subjected to the electric fields from several areas with different potentials.

[0062] Figure 13 shows an embodiment in which the capacitive coupling is utilized to detect touching or approaching by the user's body member, such as
5 finger. A detected touching or approaching by the user's body member can be passed as an input to a data processing equipment. In the embodiment shown in Figure 13, the voltage source is floating. A floating voltage source can be implemented, via inductive or capacitive coupling and/or with break-before-make switches. A secondary winding of a transformer is an example of a
10 simple yet effective floating voltage source. By measuring the voltage U_4 , it is possible to detect a change in the value(s) of capacitance(s) C_1 and/or C_2 . Assuming that the floating voltage source is a secondary winding of a transformer, the change in capacitance(s) can be detected on the primary side as well, for example as a change in load impedance. Such a change in
15 capacitance(s) serves as an indication of a touching or approaching body member.

[0063] In one implementation, the apparatus is arranged to utilize such indication of the touching or approaching body member such that the apparatus uses a first (lower) voltage to detect the touching or approaching by
20 the body member and a second (higher) voltage to provide feedback to the user. For instance, such feedback can indicate any of the following: the outline of the/each touch-sensitive area, a detection of the touching or approaching body member by the apparatus, the significance of (the act to be initiated by) the touch-sensitive area, or any other information processed by the application
25 program and which is potentially useful to the user.

[0064] Figure 14 schematically illustrates an embodiment in which a single electrode and temporal variations in the intensity of the electro-sensory stimulus can be used to create illusions of a textured touch screen surface. Reference numeral 1400 denotes a touch-sensitive screen which, for the
30 purposes of describing the present embodiment, comprises three touch-sensitive areas A_1 , A_2 and A_3 . The approaching or touching by the touch-sensitive areas A_1 , A_2 and A_3 of a user's finger 120 is detected by a controller 1406.

[0065] According to an embodiment of the invention, a conventional touch-sensitive screen 1400 can be complemented by a tactile output device
35 according to an embodiment of the invention. Reference numeral 1404

denotes an electrode which is an implementation of the electrodes described in connection with previously-described embodiments, such as the electrode 106 described in connection with Figures 1 and 2. A supplemental insulator 1402 may be positioned between the touch-sensitive screen 1400 and the inventive
5 electrode 1404, in case the touch-sensitive screen 1400 itself provides sufficient insulation.

[0066] In addition to conventional touch-screen functionality, namely detection of approaching or touching by the touch-sensitive areas by the user's finger, the controller 1406 uses information of the position of the finger 120 to
10 temporally vary the intensity of the electro-sensory stimulation invoked by the electrode 1404 on the finger 120. Although the intensity of the electro-sensory stimulation is varied over time, time is not an independent variable in the present embodiment. Instead, timing of the temporal variations is a function of the position of the finger 120 relative to the touch-sensitive areas (here: A_1 , A_2
15 and A_3). Thus it is more accurate to say that the present embodiment is operable to cause variations in the intensity of the electro-sensory stimulation invoked by the electrode 1404 on the finger 120, wherein the variations are based on the position of the finger 120 relative to the touch-sensitive areas.

[0067] The bottom side of Figure 14 illustrates this functionality. The three
20 touch-sensitive area A_1 , A_2 and A_3 are demarcated by respective x coordinate pairs $\{x_1, x_2\}$, $\{x_3, x_4\}$ and $\{x_6, x_7\}$. (Processing in the y direction is analogous and a detailed description is omitted.) The controller 1406 does not sense the presence of the finger, or senses the finger as inactive, as long as the finger is to the left of any of the touch-sensitive areas A_1 , A_2 and A_3 . In this example the
25 controller 1406 responds by applying a low-intensity signal to the electrode 1404. As soon as the finger 120 crosses the x coordinate value x_1 , the controller 1406 detects the finger over the first touch-sensitive area A_1 and starts to apply a medium-intensity signal to the electrode 1404. Between the areas A_1 and A_2 (between x coordinates x_2 and x_3), the controller again applies
30 a low-intensity signal to the electrode 1404. The second touch-sensitive area A_2 is processed similarly to the first touch-sensitive area A_1 , but the third touch-sensitive area A_3 is processed somewhat differently. As soon as the controller 1406 detects the finger 120 above or in close proximity to the area A_3 , it begins to apply the medium-intensity signal to the electrode 1404, similarly to areas A_1
35 and A_2 . But the user decides to press the touch screen 1400 at a point x_6 within the third area A_3 . The controller 1406 detects the finger press (activation

of the function assigned to the area A_3) and responds by applying a high-intensity signal to the electrode 1404.

[0068] Thus the embodiment shown in Figure 14 can provide the user with a tactile feedback which creates an illusion of a textures surface, although only a single electrode 1404 was used to create the electro-sensory stimulus. A residual problem is, however, that the user has to memorize the significance of the several touch-sensitive areas or obtain visual or aural information on their significance.

[0069] Figure 15 shows a further enhanced embodiment from the one described in connection with Figure 14. The embodiment shown in Figure 15 uses different temporal variations of the intensity of the electro-sensory stimulus, wherein the different temporal variations provide the user with a tactile feedback indicating the significance of the touch-sensitive areas.

[0070] The operation of the embodiment shown in Figure 15 differs from the one described in connection with Figure 14 in that the controller, here denoted by reference numeral 1506, applies different temporal variations to the intensity of the signal to the electrode 1404. In this example, the first touch-sensitive area A_1 is processed similarly to the preceding embodiment, or in other words, the intensity of the electro-sensory stimulus depends only on the presence of the finger 120 in close proximity to the area A_1 . But in close proximity to areas A_2 and A_3 , the controller 1506 also applies temporal variations to the intensity of the electro-sensory stimulus. For example the significance (coarsely analogous with a displayed legend) of area A_2 is indicated by a pulsed electro-sensory stimulus at a first (low) repetition rate, while the significance of area A_3 is indicated by a pulsed electro-sensory stimulus at a second (higher) repetition rate. In an illustrative example, the three touch-sensitive areas A_1 , A_2 and A_3 can invoke the three functions in a yes/no/cancel -type user interface, wherein the user can sense the positions of the user interface keys (here: the three touch-sensitive areas) and the indication of an accepted input only via tactile feedback. In other words, the user needs no visual or aural information on the positions of the touch-sensitive areas or on the selected function. The embodiment described in connection with Figure 15 is particularly attractive in car navigators or the like, which should not require visual attention from their users.

[0071] In the embodiments shown in Figures 14 and 15, when the user's finger 120 has selected the function assigned to area A_3 and the controller CTRL

1406, 1506 generates the high-intensity electro-sensory stimulus via the electrode 1404, the high-intensity stimulus is sensed via any of the areas A₁, A₂ and A₃. In other words, if one finger of the user presses the area A₃, other finger(s) in close proximity to the other areas A₂ and/or A₃ will also sense the high-intensity stimulus. In cases where this is not desirable, the embodiments shown in Figures 14 and 15 can be combined with the multi-electrode embodiment disclosed in connection with Figure 9, such that the signal to each of several electrodes (shown in Figure 9 as items 910a through 910i) is controlled individually.

10 [0072] In the scenarios shown in Figures 14 and 15, the variation of the electrosensory stimulus on the finger 120 was synchronized on the basis of the finger's movement over the areas A₁, A₂ and A₃. But unlike some prior art technologies, such as the one disclosed in reference document 1, the present invention does not require finger movement to create the electrosensory stimulus or the user's sensation. In other words, the illusion of a textured surface is based on the finger's position (and the stimulus intensity applied by the controller at the various positions) but not on finger movement.

15 [0073] Figure 16A shows an embodiment of the invention in which the electrode(s) for the tactile output section are positioned between the touch input section and the display layer. The present embodiment, generally denoted by reference numeral 1600A, comprises a bus 1602 providing inter-element connections between a microprocessor 1604, memory 1606, processor support circuitry 1608, display controller 1620 and touch input controller 1640. The display controller 1620 control a display 1622, such as a liquid-crystal display via an array of connecting wires 1624. In a similar manner, the touch input controller 1640 control a touch-sensitive layer 1642 via an array of connecting wires 1644.

20 [0074] The embodiment 1600A also comprises a tactile output section, which is comprised of a tactile output controller 1660 and an insulated electrode layer 1662, interconnected by an interconnection wire 1664. In Figure 16A, the emphasis on integration of the tactile output section 1660 - 1662 with a substantially known touch-sensitive display, including the elements 1602 through 1644. For details of the tactile output controller 1660 and the insulated electrode layer 1662, a reference is made to the previously described
25
30
35 embodiments.

[0075] As shown in Figure 16A, the display layer shows information, generally denoted by reference numeral 1626, which is seen by the user via the touch-sensitive layer 1642 and the insulated electrode layer 1662. The touch-sensitive layer 1642 is scanned by the touch input controller 1640, such that the microprocessor 1604, under control of software stored in and executed from the memory 1606, is aware of the presence or absence of the user's finger 120 on top of a predefined area 1646. The surface of the touch-sensitive layer 1642 may be completely homogenous, and the predefined areas, one of which is indicated by reference numeral 1646, are created dynamically by the microprocessor, under control of the software, such that the X and Y coordinates of the user's finger, as it touches the touch-sensitive layer 1642, are compared with predefined borders of the predefined area 1646. Reference numeral 1648 denotes a presence-detection logic within the memory 1606. Execution of the presence-detection logic 1648 by the microprocessor 1604 causes the detection of the presence or absence of the user's finger 120 at the predefined area 1646. A visual cue, such as a name of the function or activity associated with the predefined area, is typically displayed on the display 1622, as part of the displayed information 1626, so as to help the user find the desired area 1646.

[0076] Reference numeral 1668 denotes a stimulus-variation logic within the memory 1606. Input information to the stimulus-variation logic 1668 includes information on the presence or absence of the user's finger 120 at the predefined area 1646. Based on this presence information, the stimulus-variation logic 1668 has the effect that the microprocessor 1604 instructs the tactile output controller 1660 to vary the electrical input to the electrode layer 1662, thus varying the electrosensory stimulus caused to the body member 120. Thus it is possible for the user to detect the presence or absence of the body member 120 at the predefined area 1646, as well as a feedback caused by activation of a function associated with the predefined area 1646, merely via tactile information, that is, without requiring the visual clues.

[0077] Figure 16B shows an embodiment of the invention in which the electrode(s) for the tactile output section are positioned on top of a touch input section, which in turn is positioned on top of a display layer. As used in the present context, "X is on top of Y" means that X is closer to the user's eyes than Y, when the apparatus is in normal operation position. In most respects, the present embodiment, generally denoted by reference numeral 1600B is

very similar to the embodiment 1600A shown in Figure 16A, and only the differences are described. A first difference is simply a reversed mutual order of the insulated electrode layer 1662 and the touch-sensitive layer 1642. A second difference is that because the insulated electrode layer 1662 resides on top of the touch-sensitive layer 1642, the insulated electrode layer 1662 must be divided into several relatively small electrically floating sections, so as not to interfere with the underlying touch-sensitive layer 1642, which is typically based on capacitive detection.

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[0078] The embodiment 1600A shown in Figure 16A provides the benefit that the insulated electrode layer 1662 resides underneath the touch-sensitive layer 1642 and cannot interfere with its operation. On the other hand, the embodiment 1600B shown in Figure 16B more easily lends itself to upgrade devices for pre-existing touch-sensitive displays.

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[0079] In some implementations, it is beneficial to provide a floating energy feed and signalling interface to the touch input section of the interface apparatus. Benefits of the floating coupling include the possibility to share elements between the touch-sensitive layer 1642 and the insulated electrode layer 1662. For instance, a conductive film may act as both the touch-sensitive layer 1642 and the insulated electrode layer 1662. The tactile output controller 1660 may be isolated from the bus 1602, wherein the isolation is applied to both energy feed and signalling. Energy feed to the tactile output controller 1660 may be inductive or capacitive, for example. Optical isolation may be used for signalling. This makes it possible to use the touch-sensitive layer 1642, together with its control electronics, also as the insulated electrode layer 1662. The insulation for the floating coupling can be installed on either side of the touch input controller 1640.

20
[0080] One specific implementation involves creating a patterned structure on top of capacitive sensing area. The patterned structure has areas of different conductivity. When the topmost electrosensory layer is not charged to a high voltage for usage as a tactile output, it provides a spatial distribution of conductivity to an underlying capacitive detector or a grid of capacitive detectors which respond to variations of the capacitive coupling between the user's finger and the capacitive sensing area as the user's finger approaches or touches various positions of the sensing area. Such a grid for capacitive sensing may be called a projected capacitive screen. The capacitive detectors are operated at a relatively high frequency compared to the capacitive output

system. The input devices typically operate using frequencies from several kilohertz to several megahertz, while the capacitive electrosensory output system operates at a frequency between a few dozens and a few hundred Hertz. Thus the capacitive input is able to detect the location of the touching
5 body member. When the tactile output is used in the low frequency range, the top layer becomes approximately evenly charged and provides the electrosensory tactile output. In the case of a touch screen, the conductive areas can be made of indium tin oxide (ITO), for example, and the less conductive areas can be made of either thinner, less conductive, ITO or a
10 semiconductive transparent polymer, for example.

[0081] Grounding of the interface apparatus and its user was studied in connection with Figures 10 through 13 by means of equivalent diagrams. As regards practical implementation, grounding may be of capacitive or galvanic (resistive or semi-conductive) in nature. Capacitive grounding isolates direct
15 current while the other forms of grounding conduct direct current at least to some degree. While galvanic grounding, ie, grounding via negligible resistance, is functionally good, in some circumstances it may be uncomfortable to the user because of intensive static discharges. In an implementation with multiple individually controlled electrodes, a ground
20 reference for an electrode may be provided by its neighbour electrodes.

[0082] It is readily apparent to a person skilled in the art that, as the technology advances, the inventive concept can be implemented in various ways. The invention and its embodiments are not limited to the examples described above but may vary within the scope of the claims.

25. **References:**

1. Yamamoto, A. et al., "*Electrostatic Tactile Display with Thin Film Slider and Its Application to Tactile Telepresentation Systems*", IEEE Transactions on Visualization and Computer Graphics, Vol.12, Issue 2, March-April 2006, p. 168-177.
- 30 2. Gunther, Eric: "*Skinscape: A Tool for Composition in the Tactile Modality*" Master's thesis, Massachusetts Institute of Technology 2001, available on the Internet at address:
<http://mf.media.mit.edu/pubs/thesis/guntherMS.pdf>

Claims

1. An interface apparatus (1600A, 1600B) comprising:
- a touch input section (1640 - 1644); and
 - a tactile output section (1660 - 1664);
- 5 wherein the touch input section comprises:
- a touch surface (1642) arranged so as to be touched or approached by a body member (120), wherein the touch surface has at least one touch-sensitive area having a predetermined position (1646);
 - and wherein the touch input section comprises or is operatively connectable to data processing means (1602 - 1608) for assigning at least one function to the least one touch-sensitive area;
 - wherein the touch input section comprises presence-detecting means (1640, 1648) for detecting a presence or absence of the body member (120) near the at least one touch-sensitive area having the predetermined position (1646);
- 10 and wherein the tactile output section comprises an electrosensory stimulus generator for generating an electrosensory stimulus to the body member, wherein the electrosensory stimulus generator comprises:
- one or more conducting electrodes (106), each conducting electrode being provided with an insulator (108) wherein, when the body member (120) is proximate to the conducting electrode, the insulator prevents flow of direct current from the conducting electrode to the body member and a capacitive coupling over the insulator (108) is formed between the conducting electrode (106) and the body member (120);
 - a high-voltage source (100, 102, 104) for applying an electrical drive (OUT) to the one or more conducting electrodes, wherein the electrical drive comprises a first frequency component (114) in a frequency range between 1 Hz and 1000 Hz;
 - wherein the capacitive coupling and electrical drive are dimensioned to produce an electrosensory sensation; and
 - whereby the electrosensory sensation is produced independently of any mechanical vibration of the one or more conducting electrodes (106) or insulators (108);
- 15 and wherein the tactile output section further comprises stimulus-variation means (1660, 1668), wherein the stimulus-variation means are configured to receive an input from the presence-detecting means (1640, 1648) and to
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- 25
- 30
- 35

temporally vary the electrosensory stimulus based on input from the presence-detecting means.

2. The interface apparatus according to claim 1, wherein the touch input section is configured to detect a simultaneous presence of multiple body members at multiple areas, and wherein the tactile output section comprises several electrodes ("distinct tactile output areas") and is configured to apply an individually controllable electrical drive signal to the several electrodes, based on the detected simultaneous presence of the multiple body members.
3. The interface apparatus according to claim 1 or 2, wherein the interface apparatus is adapted for installation in connection with a location-based touch input device, by sharing a conductive layer between the input section and the tactile output section.
4. The interface apparatus according to any one of the preceding claims, wherein:
 - the touch surface is responsible to capacitive variations and covers the one or more conducting electrodes;
 - the one or more conducting electrodes are constructed of a patterned structure wherein multiple regions are separated from one another by a grid having a conductivity lower than the conductivity of the multiple separated regions.
5. The interface apparatus according to any one of the preceding claims, wherein the touch input section is galvanically isolated from the tactile output section, and the tactile output section is arranged to supply energy to the touch input section.
6. The interface apparatus according to any one of the preceding claims, wherein the touch input section further comprises function selection means for entering a user-selected function, and the stimulus-variation means (1660, 1668) are configured to vary the electrosensory stimulus based on input from the function selection means, whereby the interface apparatus is able to provide tactile feedback from the user-selected function to the body member.
7. The interface apparatus according to any one of the preceding claims, wherein the electrical drive also comprises a second frequency component

(112) having a frequency which is higher than the frequency of the first frequency component (114) and lower than 500 kHz.

8. The interface apparatus according to claim 7, comprising means (110) for modulating the second frequency component (112) by the first frequency component (114).
5

9. The interface apparatus according to any one of the preceding claims, wherein the electrical drive to the one or more conducting electrodes (106) has a peak-to-peak voltage of 500 to 100,000 Volts.

10. The interface apparatus according to any one of the preceding claims, wherein the insulator has a thickness between 0.1 mm and 50 mm.
10

11. The interface apparatus according to any one of the preceding claims, further comprising a grounding connection (210) between:

- 15 - a reference voltage (REF) of the high-voltage source (100, 102, 104) other than the electrical drive (OUT) to the one or more conducting electrodes; and
- at least one grounding electrode (212) separate from the one or more conducting electrodes (106), wherein the grounding electrode (212) is positioned so as to be touched by a second body member (222) distinct from each of the at least one body member to be stimulated (120; 220A, 220B, 220C).
20

12. A tactile output device,

- wherein the tactile output device comprises all features of the tactile output section as defined in claim 1; and
- 25 - wherein the tactile output device is adapted for installation into a touch input device comprising all features of the touch input section as defined in claim 1;
- whereby installation of the tactile output device into the touch input device results in the interface apparatus according to claim 1.

13. An interfacing method comprising:

- 30 - providing a touch surface (1642) arranged so as to be touched or approached by a body member (120), wherein the touch surface has at least one touch-sensitive area having a predetermined position (1646),

and assigning at least one function to the least one touch-sensitive area;

- detecting a presence or absence of a body member (120) near the at least one touch-sensitive area having the predetermined position (1646);

5

generating an electrosensory stimulus to the body member, wherein said generation of the electrosensory stimulus comprises:

- applying an electrical drive (OUT) to one or more conducting electrodes (106), wherein the electrical drive comprises a first frequency component (114) in a frequency range between 1 Hz and 1000 Hz;
- wherein each of the one or more conducting electrodes (106) is provided with an insulator (108) wherein, when the body member (120) is proximate to the conducting electrode, the insulator prevents flow of direct current from the conducting electrode to the body member and a capacitive coupling over the insulator (108) is formed between the conducting electrode (106) and the body member (120);
- wherein the capacitive coupling and electrical drive are dimensioned to produce an electrosensory sensation; and
- whereby the electrosensory sensation is produced independently of any mechanical vibration of the one or more conducting electrodes (106) or insulators (108);

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temporally varying the electrosensory stimulus based on the detected presence or absence of the of the body member (120) near the at least one touch-sensitive area having the predetermined position (1646).

Fig. 1

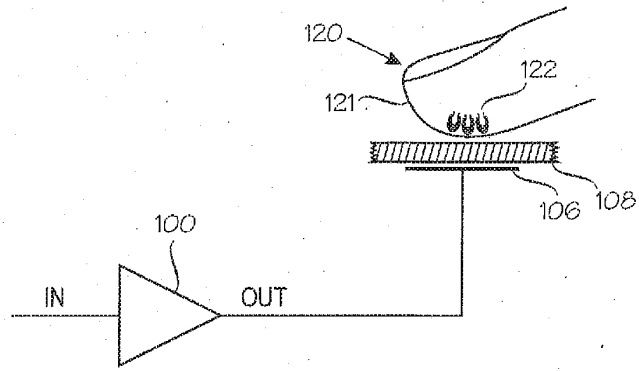


Fig. 2

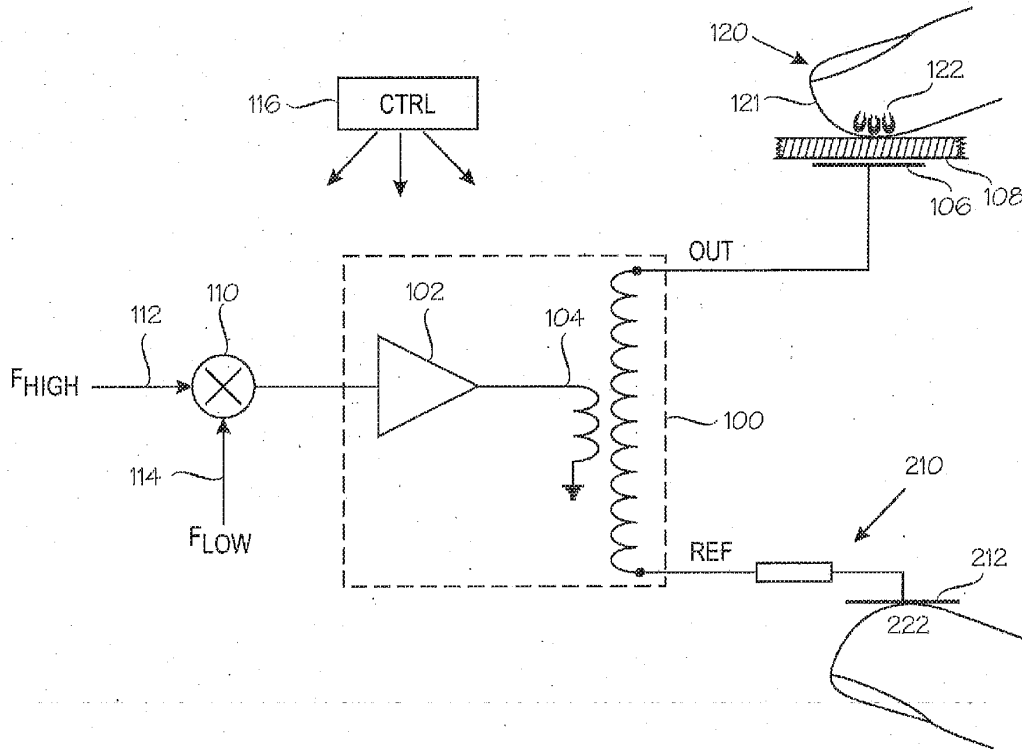


Fig. 3

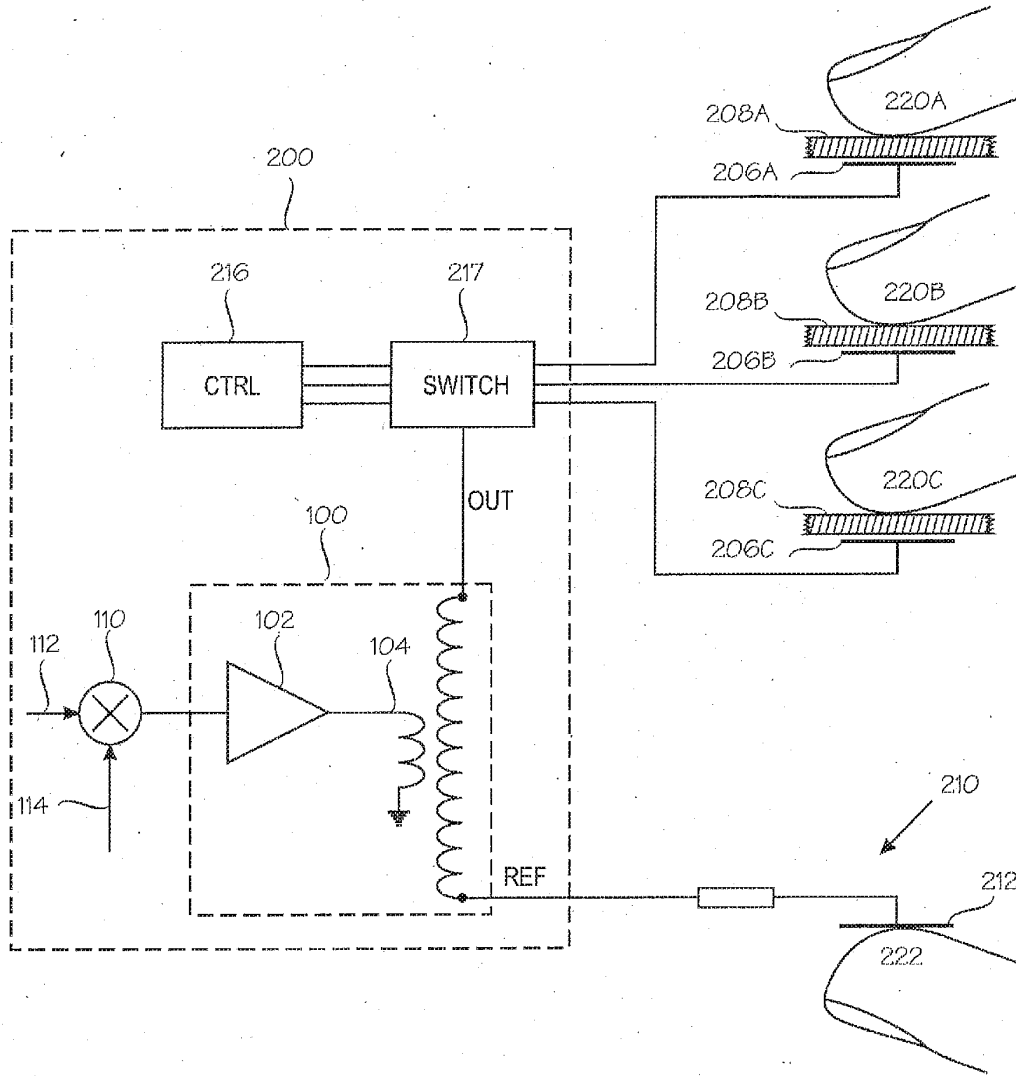
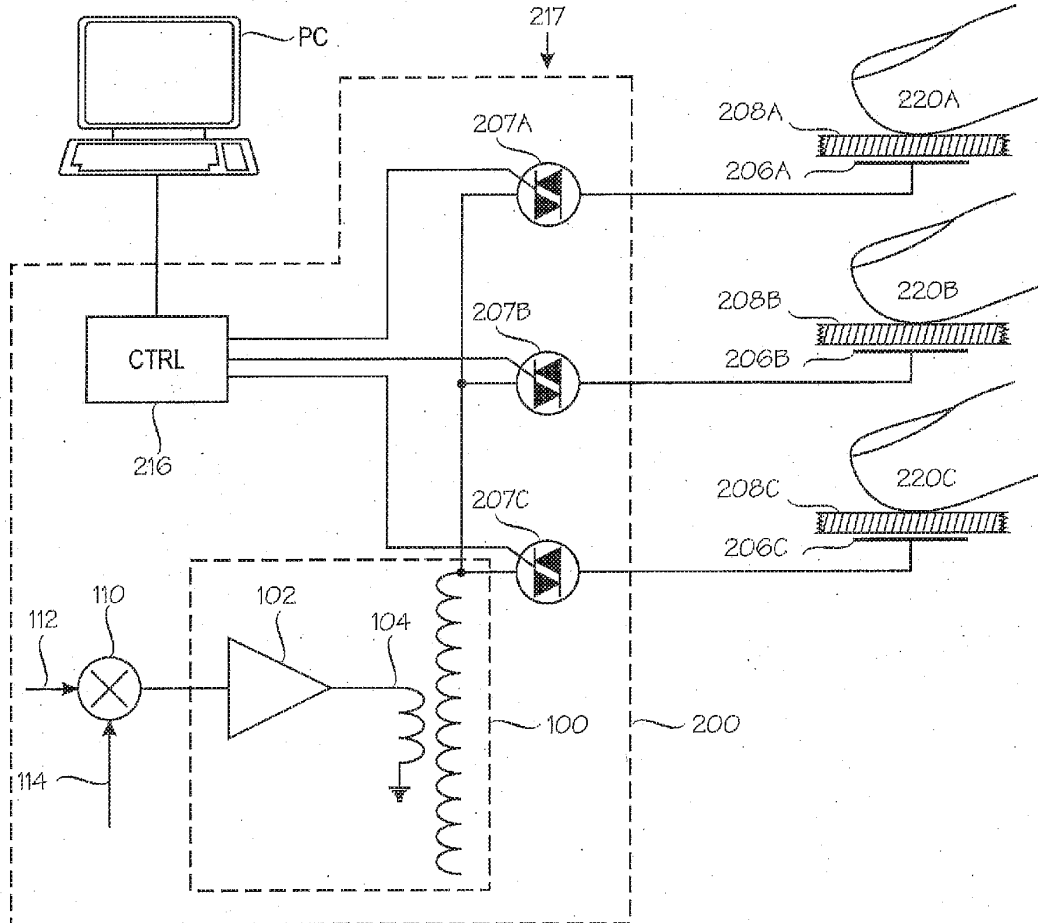


Fig. 4



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Fig. 5

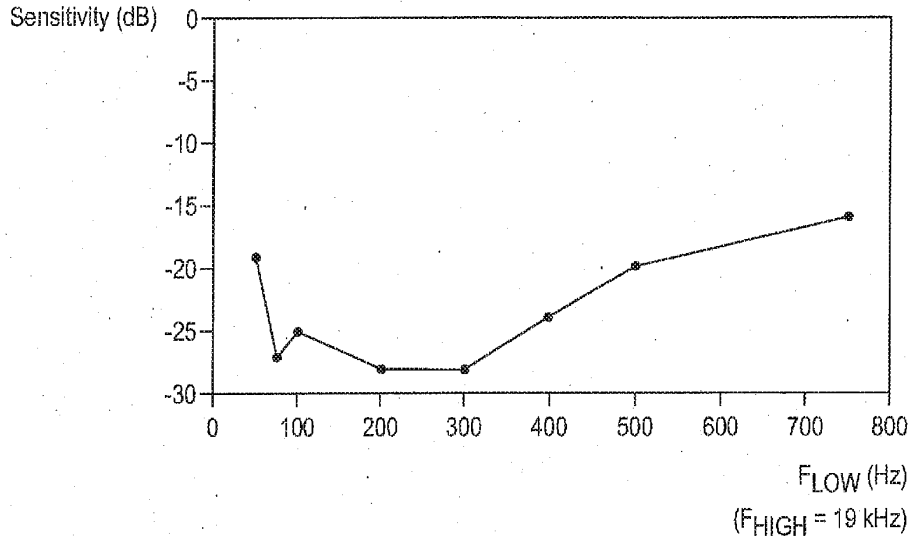


Fig. 6

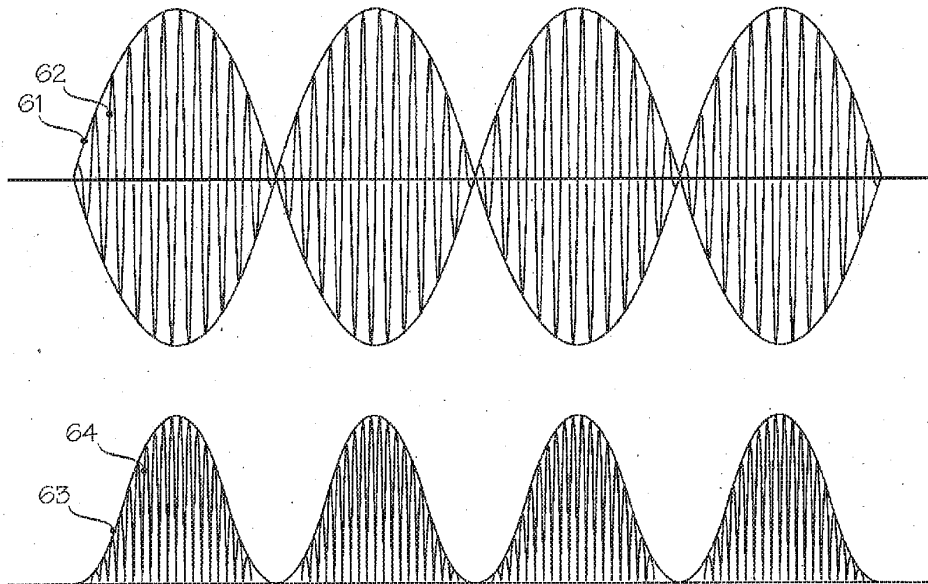


Fig. 7A

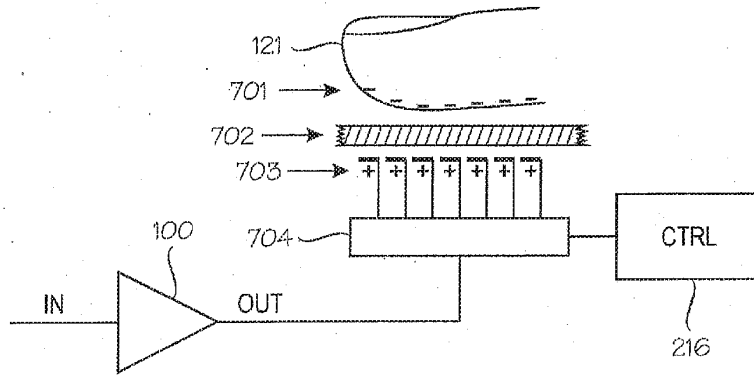


Fig. 7B

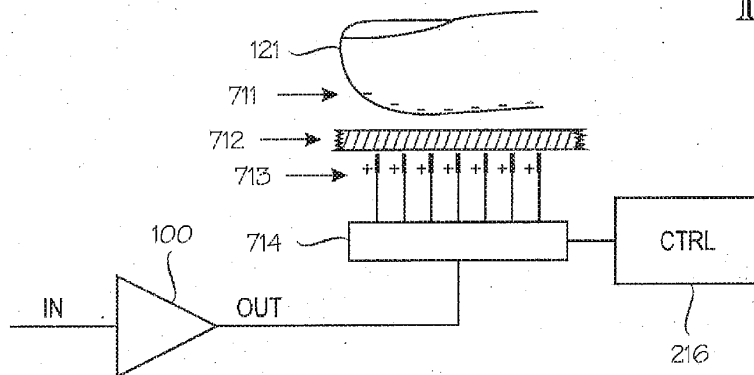


Fig. 8

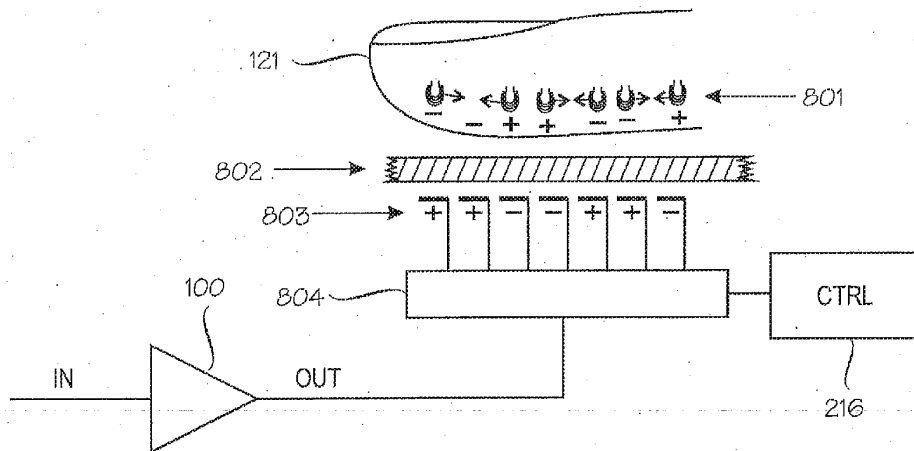


Fig. 9

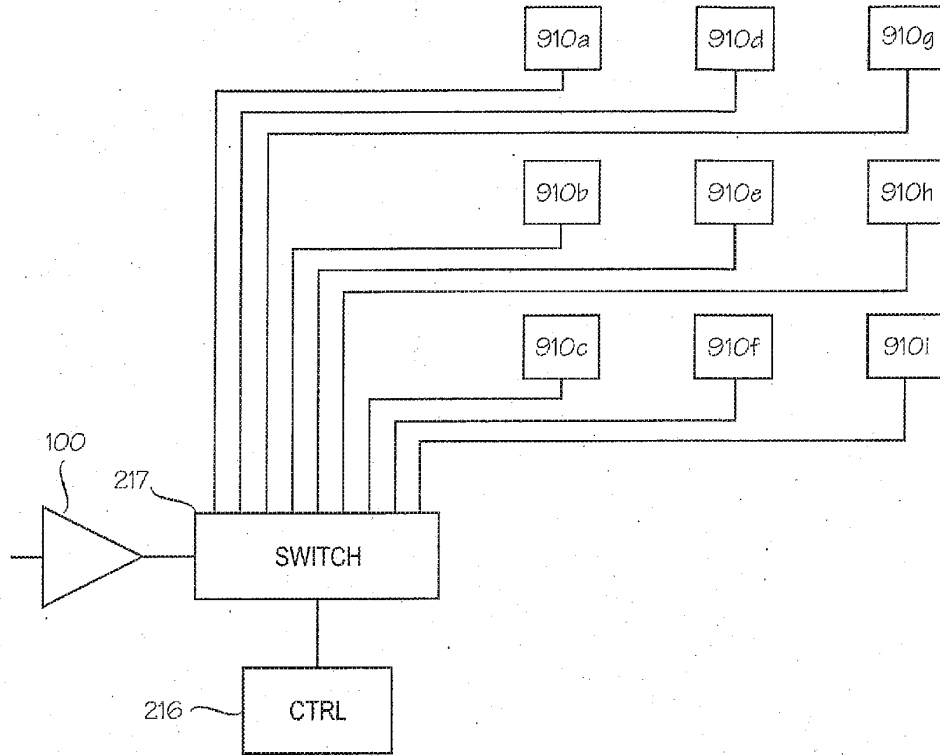


Fig. 10

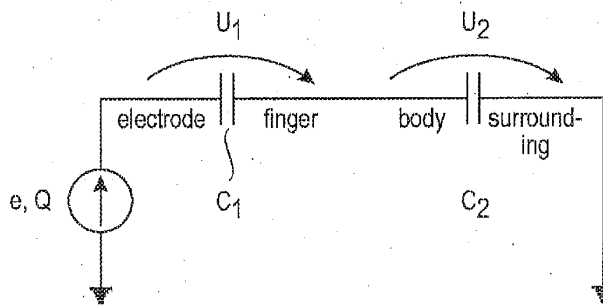


Fig. 11

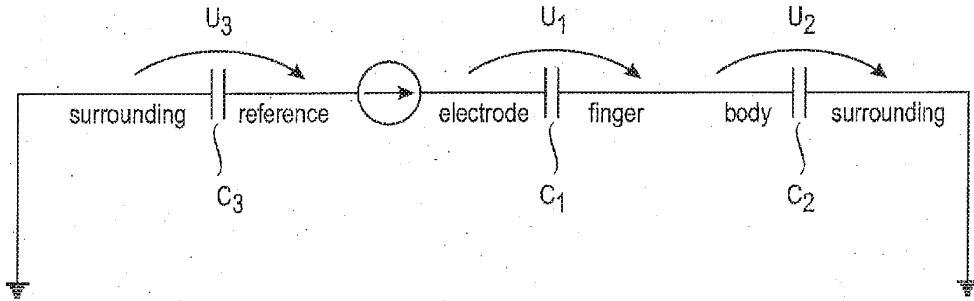


Fig. 12

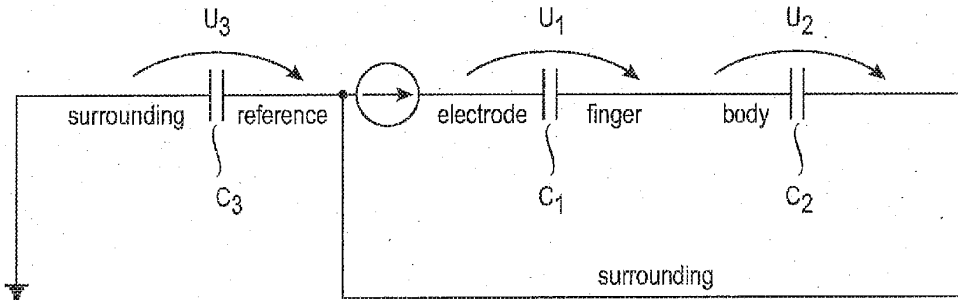


Fig. 13

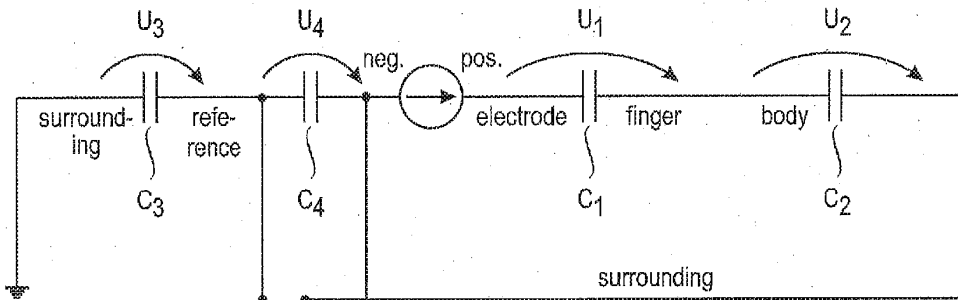


Fig. 14

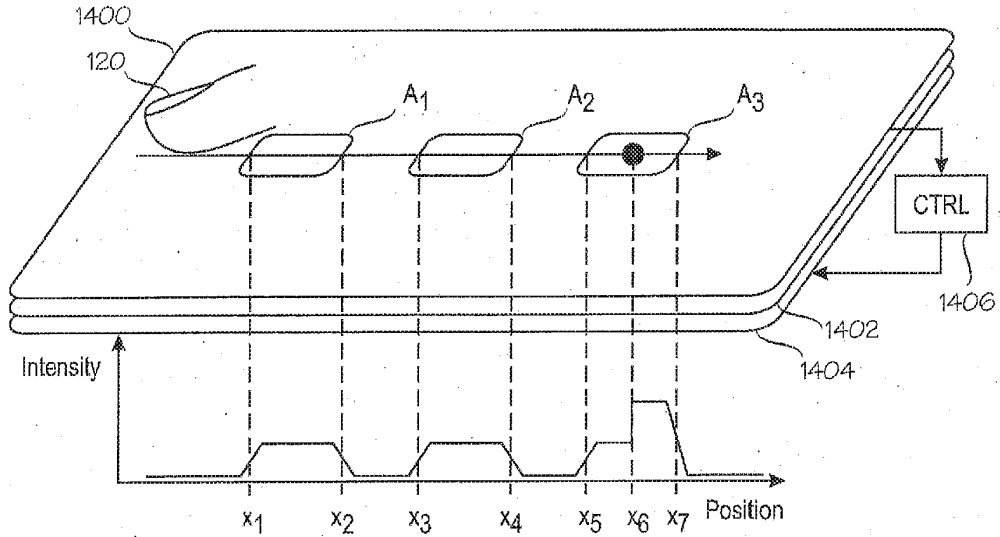


Fig. 15

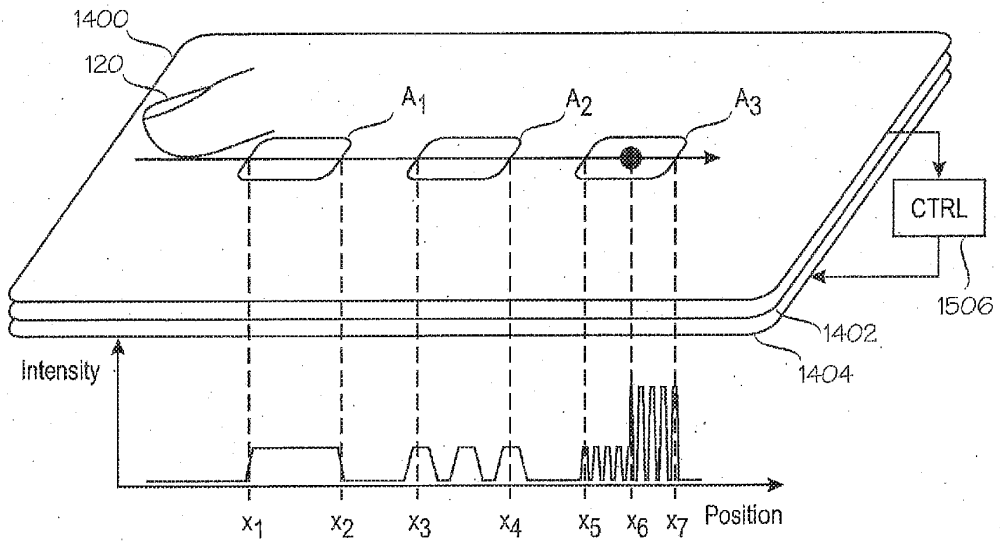
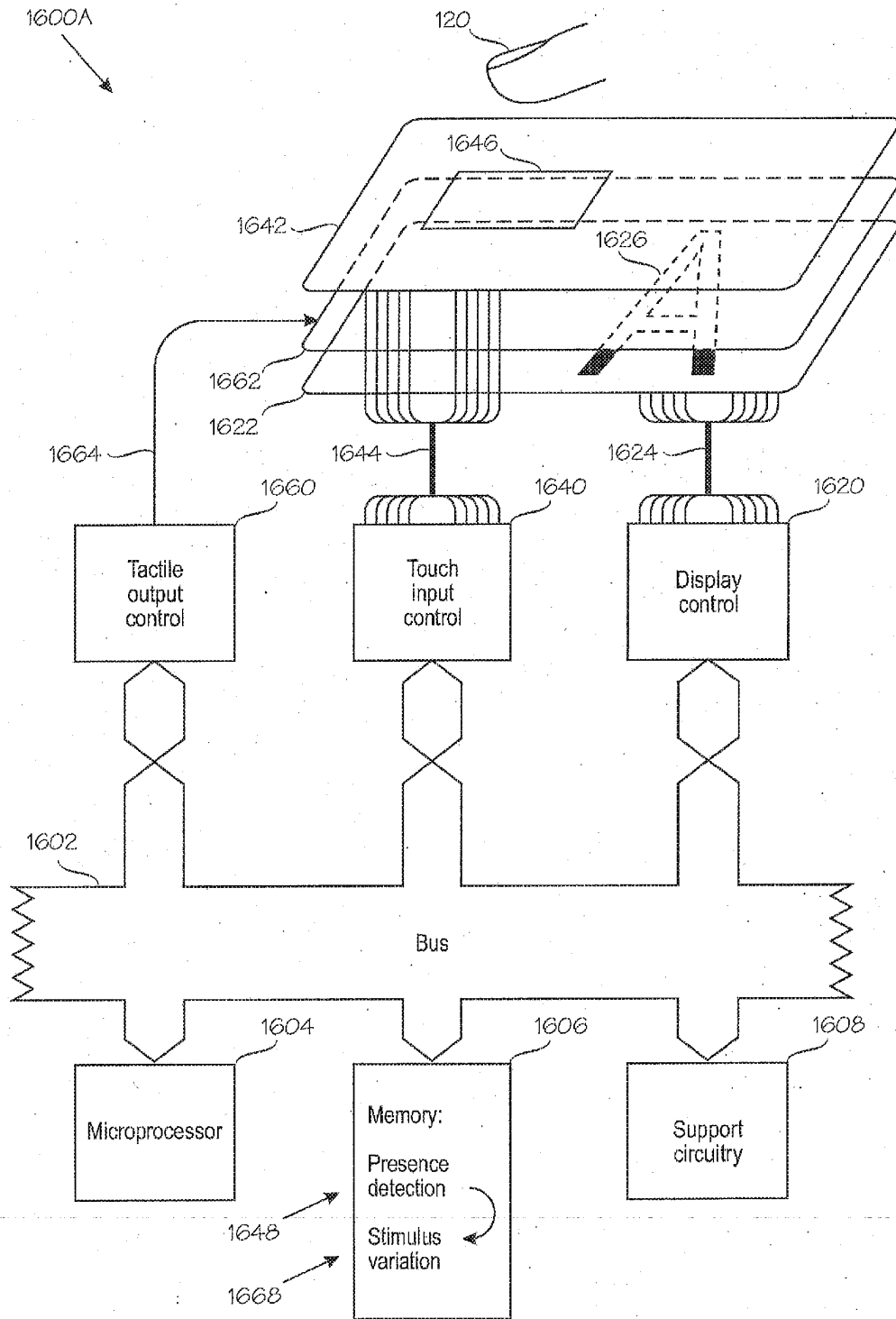
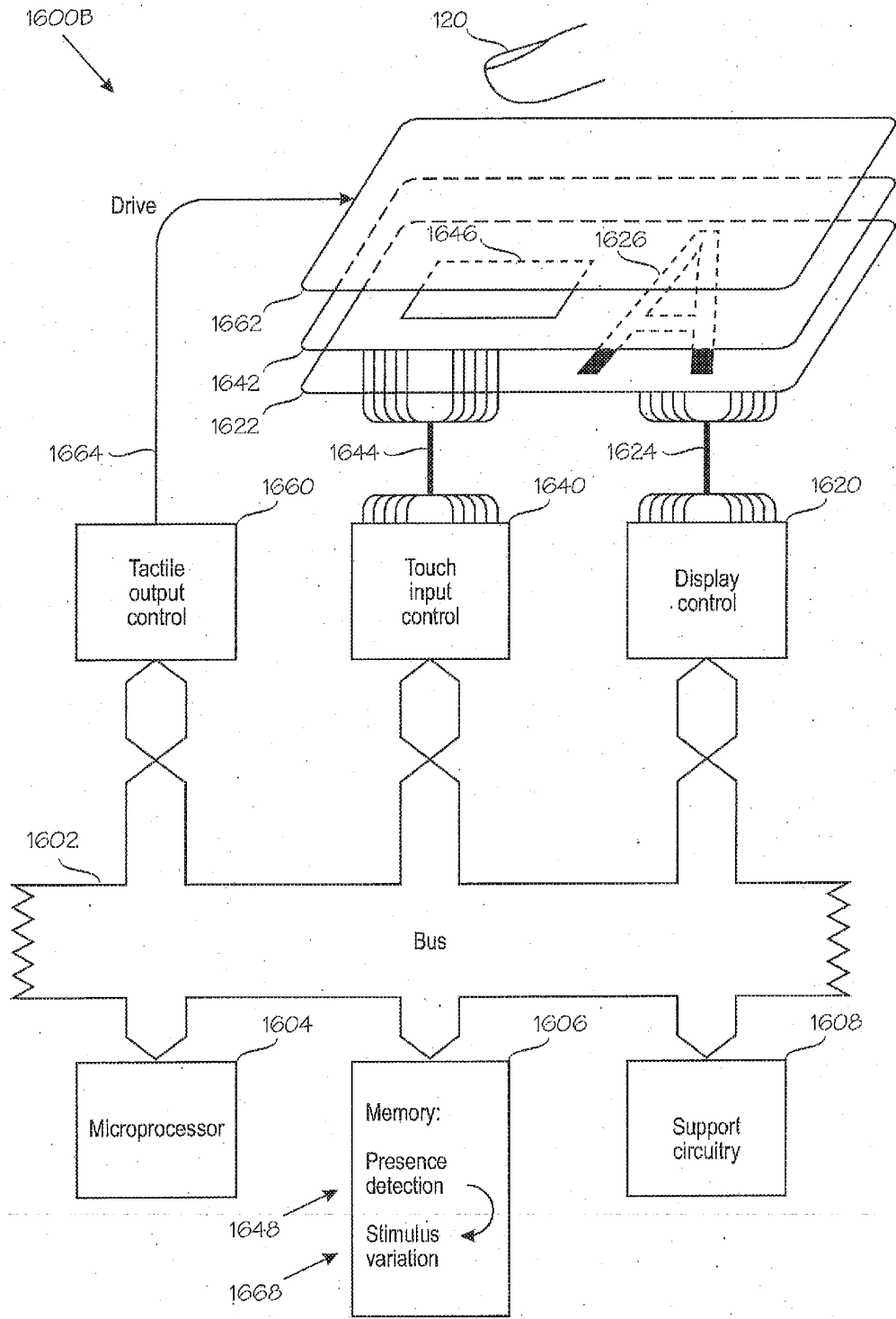


Fig. 16A



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Fig. 16B



INTERNATIONAL SEARCH REPORT

International application No.

PCT/FI2009/050416

A. CLASSIFICATION OF SUBJECT MATTER See extra sheet According to International Patent Classification (IPC) or to both national classification and IPC		
B. FIELDS SEARCHED Minimum documentation searched (classification system followed by classification symbols) IPC: G06F, G09B, H03K Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched FI, SE, NO, DK Electronic data base consulted during the international search (name of data base and, where practicable, search terms used) EPO-Internal, WPI, BIOSIS, BOCA, COMPDX, EMBASE, INSPEC, MEDLINE, NPL, TDB, XPAIP, XPESP, XPI3E, XPIEE, XPITF, XPIPCOM, XPMISC, XPOAC, XPRD, XPTK, Google Scholar		
C. DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	YAMAMOTO A et al., 'Electrostatic Tactile Display with Thin Film Slider and its Application to Tactile Telepresentation Systems'. IEEE Transactions on Visualization and Computer Graphics, ISSN 1077-2626, March/April 2006, Vol. 12, No. 2, p. 168 - 177, cited in the application abstract; figure 2; sections 3.1, 4.2.1, 6.2 and 6.3; figures 17 - 22	1 - 2, 4, 6 - 10, 12 - 13
Y		3
Y	TANG H & BEEBE D J, 'A Microfabricated Electrostatic Haptic Display for Persons with Visual Impairments'. IEEE Transactions on Rehabilitation Engineering, ISSN 1063-6528, September 1998, Vol. 6, No. 3, p. 241 - 248, XP 011053920, abstract; figure 1; sections II.A, II.B and II.D	1 - 3, 6 - 10, 12 - 13
Y	KACZMAREK K A et al., 'Polarity Effect in Electro vibration for Tactile Display'. IEEE Transactions on Biomedical Engineering, ISSN 0018-9294, October 2006, Vol. 53, No. 10, p. 2047 - 2054, figures 1 - 2; section II: 'Methods: Apparatus'	1 - 3, 6 - 10, 12 - 13
<input checked="" type="checkbox"/> Further documents are listed in the continuation of Box C.		<input checked="" type="checkbox"/> See patent family annex.
* Special categories of cited documents: "A" document defining the general state of the art which is not considered to be of particular relevance "E" earlier application or patent but published on or after the international filing date "L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified) "O" document referring to an oral disclosure, use, exhibition or other means "P" document published prior to the international filing date but later than the priority date claimed		"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention "X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone "Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art "&" document member of the same patent family
Date of the actual completion of the international search 11 September 2009 (11.09.2009)	Date of mailing of the international search report 22 September 2009 (22.09.2009)	
Name and mailing address of the ISA/II National Board of Patents and Registration of Finland P.O. Box 1160, FI-00101 HELSINKI, Finland Facsimile No. +358 9 6939 5328	Authorized officer Antti Salmela Telephone No. +358 9 6939 500	

Form PCT/ISA/210 (second sheet) (July 2008)

INTERNATIONAL SEARCH REPORT

International application No.

PCT/FI2009/050416

Box No. II Observations where certain claims were found unsearchable (Continuation of item 2 of first sheet)

This international search report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. Claims Nos.:
because they relate to subject matter not required to be searched by this Authority, namely:

2. Claims Nos.: 5
because they relate to parts of the international application that do not comply with the prescribed requirements to such an extent that no meaningful international search can be carried out, specifically:
No support for claim 5 can be found in the description. Accordingly, claim 5 fails to comply with PCT Article 6.

3. Claims Nos.:
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

Box No. III Observations where unity of invention is lacking (Continuation of item 3 of first sheet)

This International Searching Authority found multiple inventions in this international application, as follows:

1. As all required additional search fees were timely paid by the applicant, this international search report covers all searchable claims.
2. As all searchable claims could be searched without effort justifying additional fees, this Authority did not invite payment of additional fees.
3. As only some of the required additional search fees were timely paid by the applicant, this international search report covers only those claims for which fees were paid, specifically claims Nos.:

4. No required additional search fees were timely paid by the applicant. Consequently, this international search report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:

Remark on Protest

- The additional search fees were accompanied by the applicant's protest and, where applicable, the payment of a protest fee.
- The additional search fees were accompanied by the applicant's protest but the applicable protest fee was not paid within the time limit specified in the invitation.
- No protest accompanied the payment of additional search fees.

INTERNATIONAL SEARCH REPORT

International application No.

PCT/FI2009/050416

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	AGARWAL A K et al., 'A hybrid natural/artificial electrostatic actuator for tactile stimulation'. Proceedings of the 2nd Annual International IEEE-EMBS Special Topic Conference on Microtechnologies in Medicine & Biology, 2 - 4 May, 2002, Madison, Wisconsin, USA. Piscataway: IEEE, 2002, ISBN 0-7803-7480-0, p. 341 - 345, abstract; sections II.A, II.B and III.A; figures 1 - 2	1 - 3, 6 - 10, 12 - 13
Y	BEEBE D J et al., 'A Polyimide-on-silicon Electrostatic Fingertip Tactile Display'. Proceedings of the IEEE 17th Annual Conference of the Engineering in Medicine and Biology Society, 20 - 23 September, 1995, Montréal, Canada. Piscataway: IEEE, 1997, ISBN 0-7803-2475-7, Vol. 2, p. 1545 - 1546, XP 010214849, whole document	1 - 3, 6 - 10, 12 - 13
Y	REKIMOTO J, 'SmartSkin: An Infrastructure for Freehand Manipulation on Interactive Surfaces'. Proceedings of the SIGCHI conference on Human factors in computing systems: Changing our world, changing ourselves (CHI 2002), 20 - 25 April, 2002, Minneapolis, Minnesota, USA. New York: ACM, 2002, ISBN 1-58113-453-3, Vol. 4, No. 1, p. 113 - 120, XP 001099406, abstract; figure 2; section 'SmartSkin sensor architecture'; figures 12 - 14; sections 'Interactions by using fingers and hand gestures' and 'Combination with tactile feedback'	1 - 2, 6 - 10, 12 - 13
Y	POUPYREV I et al., 'Ambient Touch: Designing Tactile Interfaces for Handheld Devices'. Proceedings of the 15th Annual Symposium on User Interface Software and Technology (UIST'02), 27 - 30 October, 2002, Paris, France. New York: ACM, 2002, ISBN 1-58113-488-6, Vol. 4, No. 2, p. 51 - 60, XP 001171567, abstract; section 'TouchEngine display'	1 - 2, 6 - 10, 12 - 13
Y	FUKUMOTO M & SUGIMURA T, 'Active Click: Tactile Feedback for Touch Panels'. Proceedings of the Conference on Human Factors in Computing Systems (CHI 2001), 31 March - 5 April, 2001, Seattle, Washington, USA. New York: ACM, 2001, ISBN 1-58113-340-5, p. 121 - 122, whole document	1 - 2, 6 - 10, 12 - 13
Y	US 2003067449 A1 (YOSHIKAWA OSAMU et al.) 10 April 2003 (10.04.2003), figure 3; paragraph [0071]	3
A	DIETZ P & LEIGH D, 'DiamondTouch: A Multi-User Touch Technology'. Proceedings of the 14th annual ACM symposium on User interface software and technology (UIST '01), 11 - 14 November, 2001, Orlando, Florida, USA. New York: ACM, 2001, ISBN 1-58113-438-X; p. 219 - 226	
A	REILLY J P et al., 'Electrocutaneous Stimulation with High Voltage Capacitive Discharges'. IEEE Transactions on Biomedical Engineers, ISSN 0018-9294, October 1983, Vol. BME-30, No. 10, p. 631 - 641, XP 011173420	

Form PCT/ISA/210 (continuation of second sheet) (July 2008)

INTERNATIONAL SEARCH REPORT

International application No.

PCT/FI2009/050416

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	KUROKI S et al., 'Proposal for tactile sense presentation that combines electrical and mechanical stimulus'. Proceedings of the Second Joint EuroHaptics Conference and Symposium on Haptic Interfaces for Virtual Environment and Teleoperator Systems (World Haptics 2007), 22 - 24 March, 2007, Tsukuba, Japan. Piscataway: IEEE, 2007, ISBN 0-7695-2738-8, p. 121 - 126, XP 031070663	
A	KAJIMOTO H et al., 'Psychophysical evaluation of receptor selectivity in electro-tactile display'. Paper presented at the 13th International Symposium on Measurement & Control in Robotics (ISMCR'03), 11 - 12 December, 2003, Madrid, Spain [retrieved on 2009-08-31]. Retrieved from the Internet: <URL: http://files.tachilab.org/intconf2000/kajimoto200312ISMCR.pdf >	

Form PCT/ISA/210 (continuation of second sheet) (July 2008)

INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.
PCT/FI2009/050416

Patent document cited in search report	Publication date	Patent family members(s)	Publication date
US 2003067449 A1	10/04/2003	JP 2003122507 A	25/04/2003
.....			

INTERNATIONAL SEARCH REPORT

International application No.
PCT/FI2009/050416

CLASSIFICATION OF SUBJECT MATTER

Int.Cl.

G06F 3/01 (2006.01)

G06F 3/044 (2006.01)

G09B 21/00 (2006.01)

H03K 17/96 (2006.01)

Electronic Acknowledgement Receipt

EFS ID:	12797179
Application Number:	13472698
International Application Number:	
Confirmation Number:	6404
Title of Invention:	METHOD AND APPARATUS FOR PRODUCING A DYNAMIC HAPTIC EFFECT
First Named Inventor/Applicant Name:	David Birnbaum
Customer Number:	103772
Filer:	Catherine C. Maresh/Dawn Rose
Filer Authorized By:	Catherine C. Maresh
Attorney Docket Number:	IMM389C1
Receipt Date:	16-MAY-2012
Filing Date:	
Time Stamp:	17:40:46
Application Type:	Utility under 35 USC 111(a)

Payment information:

Submitted with Payment	no
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File Listing:

Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
1		IMM389C1FILEDIDS.pdf	674958 81d5fb78171c1a075de8cf8a262b794d5e577250	yes	24

Multipart Description/PDF files in .zip description					
Document Description			Start	End	
Transmittal Letter			1	2	
Information Disclosure Statement (IDS) Form (SB08)			3	24	
Warnings:					
Information:					
2	Foreign Reference	DE20019074.pdf	2841994	no	23
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3	Foreign Reference	EP0899650.pdf	1853034	no	48
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Information:					

18	Foreign Reference	WO2009141502.pdf	7145020	no	49
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19	Foreign Reference	BIET.pdf	581708	no	8
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Information:					
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Information:					

27	Foreign Reference	IWAMOTOEurohaptics2008.pdf	6979170	no	10
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Information:					
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29	Foreign Reference	MARKS.pdf	196212	no	2
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36	Foreign Reference	YAO.pdf	1308233	no	6
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Warnings:

Information:

Total Files Size (in bytes):	68082025
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New Applications Under 35 U.S.C. 111

If a new application is being filed and the application includes the necessary components for a filing date (see 37 CFR 1.53(b)-(d) and MPEP 506), a Filing Receipt (37 CFR 1.54) will be issued in due course and the date shown on this Acknowledgement Receipt will establish the filing date of the application.

National Stage of an International Application under 35 U.S.C. 371

If a timely submission to enter the national stage of an international application is compliant with the conditions of 35 U.S.C. 371 and other applicable requirements a Form PCT/DO/EO/903 indicating acceptance of the application as a national stage submission under 35 U.S.C. 371 will be issued in addition to the Filing Receipt, in due course.

New International Application Filed with the USPTO as a Receiving Office

If a new international application is being filed and the international application includes the necessary components for an international filing date (see PCT Article 11 and MPEP 1810), a Notification of the International Application Number and of the International Filing Date (Form PCT/RO/105) will be issued in due course, subject to prescriptions concerning national security, and the date shown on this Acknowledgement Receipt will establish the international filing date of the application.

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Application of:)	
)	
David Birnbaum et al.	)	Examiner:
)	
Application No. 13/472,698	)	Art Unit:
)	
Filed: May 16, 2012)	
	)	Confirmation No. 6404
For: METHOD AND APPARATUS FOR)	
PRODUCING A DYNAMIC HAPTIC)	
EFFECT)	
)	

Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

NOTIFICATION OF SHARED REFERENCES

Sir:

The present application shares the same references as co-pending application 13/092,269, filed on April 22, 2011, co-pending application 13/472,709, filed on May 16, 2012, and co-pending application 13/472,713, filed on May 16, 2012.

Respectfully submitted,
IMMERSSION CORPORATION

Dated: 5/16, 2012

/Thomas A. Hassing/
Thomas A. Hassing
Reg. No. 36,159

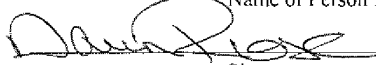
30 Rio Robles
San Jose, CA 95134
(408) 467-1900

CERTIFICATE OF ELECTRONIC FILING

I hereby certify that this correspondence is being deposited with the United States Patent and Trademark Office via electronic filing through the United States Patent and Trademark Electronic Filing System on:

5/16/2012
Date of Deposit

Dawn Rose
Name of Person Filing Correspondence


Signature

5/16/2012
Date

SCORE Placeholder Sheet for IFW Content

Application Number: 13472698

Document Date: 5/16/2012

The presence of this form in the IFW record indicates that the following document type was received in electronic format on the date identified above. This content is stored in the SCORE database.

- Drawings – Other than Black and White Line Drawings

Since this was an electronic submission, there is no physical artifact folder, no artifact folder is recorded in PALM, and no paper documents or physical media exist. The TIFF images in the IFW record were created from the original documents that are stored in SCORE.

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- Examiners may access SCORE content via the eDAN interface.
- Other USPTO employees can bookmark the current SCORE URL (<http://es/ScoreAccessWeb/>).
- External customers may access SCORE content via the Public and Private PAIR interfaces.

Form Revision Date: February 8, 2006



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Table with 7 columns: APPLICATION NUMBER, FILING or 371(c) DATE, GRP ART UNIT, FIL FEE REC'D, ATTY DOCKET NO, TOT CLAIMS, IND CLAIMS. Row 1: 13/472,698, 05/16/2012, 2629, 2150, IMM389C1, 30, 3

CONFIRMATION NO. 6404

103772
Immersion Corporation
30 Rio Robles
San Jose, CA 95134

FILING RECEIPT



Date Mailed: 05/31/2012

Receipt is acknowledged of this non-provisional patent application. The application will be taken up for examination in due course. Applicant will be notified as to the results of the examination. Any correspondence concerning the application must include the following identification information: the U.S. APPLICATION NUMBER, FILING DATE, NAME OF APPLICANT, and TITLE OF INVENTION. Fees transmitted by check or draft are subject to collection. Please verify the accuracy of the data presented on this receipt. If an error is noted on this Filing Receipt, please submit a written request for a Filing Receipt Correction. Please provide a copy of this Filing Receipt with the changes noted thereon. If you received a "Notice to File Missing Parts" for this application, please submit any corrections to this Filing Receipt with your reply to the Notice. When the USPTO processes the reply to the Notice, the USPTO will generate another Filing Receipt incorporating the requested corrections

Applicant(s)

David BIRNBAUM, San Jose, CA;
Juan Manuel CRUZ-HERNANDEZ, Montreal, CANADA;
Danny GRANT, Montreal, CANADA;
Chris ULLRICH, Ventura, CA;

Assignment For Published Patent Application

Immersion Corporation, San Jose, CA

Power of Attorney: The patent practitioners associated with Customer Number 103772

Domestic Priority data as claimed by applicant

This application is a CON of 61/599,145 02/15/2012

Foreign Applications (You may be eligible to benefit from the Patent Prosecution Highway program at the USPTO. Please see http://www.uspto.gov for more information.)

Permission to Access - A proper Authorization to Permit Access to Application by Participating Offices (PTO/SB/39 or its equivalent) has been received by the USPTO.

If Required, Foreign Filing License Granted: 05/25/2012

The country code and number of your priority application, to be used for filing abroad under the Paris Convention, is US 13/472,698

Projected Publication Date: 09/06/2012

Non-Publication Request: No

Early Publication Request: Yes

Title

METHOD AND APPARATUS FOR PRODUCING A DYNAMIC HAPTIC EFFECT

Preliminary Class

345

PROTECTING YOUR INVENTION OUTSIDE THE UNITED STATES

Since the rights granted by a U.S. patent extend only throughout the territory of the United States and have no effect in a foreign country, an inventor who wishes patent protection in another country must apply for a patent in a specific country or in regional patent offices. Applicants may wish to consider the filing of an international application under the Patent Cooperation Treaty (PCT). An international (PCT) application generally has the same effect as a regular national patent application in each PCT-member country. The PCT process **simplifies** the filing of patent applications on the same invention in member countries, but **does not result** in a grant of "an international patent" and does not eliminate the need of applicants to file additional documents and fees in countries where patent protection is desired.

Almost every country has its own patent law, and a person desiring a patent in a particular country must make an application for patent in that country in accordance with its particular laws. Since the laws of many countries differ in various respects from the patent law of the United States, applicants are advised to seek guidance from specific foreign countries to ensure that patent rights are not lost prematurely.

Applicants also are advised that in the case of inventions made in the United States, the Director of the USPTO must issue a license before applicants can apply for a patent in a foreign country. The filing of a U.S. patent application serves as a request for a foreign filing license. The application's filing receipt contains further information and guidance as to the status of applicant's license for foreign filing.

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For information on preventing theft of your intellectual property (patents, trademarks and copyrights), you may wish to consult the U.S. Government website, <http://www.stopfakes.gov>. Part of a Department of Commerce initiative, this website includes self-help "toolkits" giving innovators guidance on how to protect intellectual property in specific countries such as China, Korea and Mexico. For questions regarding patent enforcement issues, applicants may call the U.S. Government hotline at 1-866-999-HALT (1-866-999-4158).

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Title 35, United States Code, Section 184

Title 37, Code of Federal Regulations, 5.11 & 5.15

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PATENT APPLICATION FEE DETERMINATION RECORD

Substitute for Form PTO-875

Application or Docket Number
13/472,698

APPLICATION AS FILED - PART I

(Column 1)		(Column 2)	SMALL ENTITY		OR	OTHER THAN SMALL ENTITY	
FOR	NUMBER FILED	NUMBER EXTRA	RATE(\$)	FEE(\$)		RATE(\$)	FEE(\$)
BASIC FEE (37 CFR 1.16(a), (b), or (c))	N/A	N/A	N/A			N/A	380
SEARCH FEE (37 CFR 1.16(k), (l), or (m))	N/A	N/A	N/A			N/A	620
EXAMINATION FEE (37 CFR 1.16(o), (p), or (q))	N/A	N/A	N/A			N/A	250
TOTAL CLAIMS (37 CFR 1.16(i))	30 minus 20 = *	10			OR	x 60 =	600
INDEPENDENT CLAIMS (37 CFR 1.16(h))	3 minus 3 = *				OR	x 250 =	0.00
APPLICATION SIZE FEE (37 CFR 1.16(s))	If the specification and drawings exceed 100 sheets of paper, the application size fee due is \$310 (\$155 for small entity) for each additional 50 sheets or fraction thereof. See 35 U.S.C. 41(a)(1)(G) and 37 CFR 1.16(s).						0.00
MULTIPLE DEPENDENT CLAIM PRESENT (37 CFR 1.16(j))							0.00
* If the difference in column 1 is less than zero, enter "0" in column 2.			TOTAL			TOTAL	1850

APPLICATION AS AMENDED - PART II

(Column 1)		(Column 2)	(Column 3)	SMALL ENTITY		OR	OTHER THAN SMALL ENTITY	
AMENDMENT A	CLAIMS REMAINING AFTER AMENDMENT	HIGHEST NUMBER PREVIOUSLY PAID FOR	PRESENT EXTRA	RATE(\$)	ADDITIONAL FEE(\$)		RATE(\$)	ADDITIONAL FEE(\$)
Total (37 CFR 1.16(i))	*	Minus **	=	x	=	OR	x	=
Independent (37 CFR 1.16(h))	*	Minus ***	=	x	=	OR	x	=
Application Size Fee (37 CFR 1.16(s))						OR		
FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM (37 CFR 1.16(j))						OR		
				TOTAL ADD'L FEE		OR	TOTAL ADD'L FEE	
AMENDMENT B	CLAIMS REMAINING AFTER AMENDMENT	HIGHEST NUMBER PREVIOUSLY PAID FOR	PRESENT EXTRA	RATE(\$)	ADDITIONAL FEE(\$)		RATE(\$)	ADDITIONAL FEE(\$)
Total (37 CFR 1.16(i))	*	Minus **	=	x	=	OR	x	=
Independent (37 CFR 1.16(h))	*	Minus ***	=	x	=	OR	x	=
Application Size Fee (37 CFR 1.16(s))						OR		
FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM (37 CFR 1.16(j))						OR		
				TOTAL ADD'L FEE		OR	TOTAL ADD'L FEE	

* If the entry in column 1 is less than the entry in column 2, write "0" in column 3.
 ** If the "Highest Number Previously Paid For" IN THIS SPACE is less than 20, enter "20".
 *** If the "Highest Number Previously Paid For" IN THIS SPACE is less than 3, enter "3".
 The "Highest Number Previously Paid For" (Total or Independent) is the highest found in the appropriate box in column 1.



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IMMERSION CORPORATION
30 RIO ROBLES
SAN JOSE, CA 95134

MAILED
JUN 18 2012

OFFICE OF PETITIONS

Doc Code: TRACK1.GRANT

<p>Decision Granting Request for Prioritized Examination (Track I or After RCE)</p>	<p>Application No.: 13/472,698</p>
<p>1. THE REQUEST FILED <u>5/16/12</u> IS GRANTED.</p> <p>The above-identified application has met the requirements for prioritized examination</p> <p>A. <input checked="" type="checkbox"/> for an original nonprovisional application (Track I). B. <input type="checkbox"/> for an application undergoing continued examination (RCE).</p> <p>2. The above-identified application will undergo prioritized examination. The application will be accorded special status throughout its entire course of prosecution until one of the following occurs:</p> <p>A. filing a petition for extension of time to extend the time period for filing a reply; B. filing an amendment to amend the application to contain more than four independent claims, more than thirty total claims, or a multiple dependent claim; C. filing a request for continued examination; D. filing a notice of appeal; E. filing a request for suspension of action; F. mailing of a notice of allowance; G. mailing of a final Office action; H. completion of examination as defined in 37 CFR 41.102; or I. abandonment of the application.</p> <p>Telephone inquiries with regard to this decision should be directed to Terri Johnson at 571-272-2991</p> <p>/Terri Johnson/ Petitions Examiner</p> <hr/> <p>[Signature] (Title)</p>	

PLUS Search Results for S/N 13472698, Searched Fri Jun 29 11:35:47 EDT 2012
The Patent Linguistics Utility System (PLUS) is a USPTO automated search system for U.S. Patents from 1971 to the present PLUS is a query-by-example search system which produces a list of patents that are most closely related linguistically to the application searched. This search was prepared by the staff of the Scientific and Technical Information Center, SIRA.

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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
13/472,698	05/16/2012	David BIRNBAUM	IMM389C1	6404
103772	7590	07/09/2012	EXAMINER	
Immersion Corporation 30 Rio Robles San Jose, CA 95134			SITTA, GRANT	
			ART UNIT	PAPER NUMBER
			2629	
			MAIL DATE	DELIVERY MODE
			07/09/2012	PAPER

Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

Office Action Summary	Application No. 13/472,698	Applicant(s) BIRNBAUM ET AL.	
	Examiner GRANT SITTA	Art Unit 2629	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --
Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) Responsive to communication(s) filed on 16 May 2012.
- 2a) This action is **FINAL**.
- 2b) This action is non-final.
- 3) An election was made by the applicant in response to a restriction requirement set forth during the interview on _____; the restriction requirement and election have been incorporated into this action.
- 4) Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 5) Claim(s) 1-30 is/are pending in the application.
- 5a) Of the above claim(s) _____ is/are withdrawn from consideration.
- 6) Claim(s) _____ is/are allowed.
- 7) Claim(s) 1-30 is/are rejected.
- 8) Claim(s) _____ is/are objected to.
- 9) Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

- 10) The specification is objected to by the Examiner.
- 11) The drawing(s) filed on 16 May 2012 is/are: a) accepted or b) objected to by the Examiner.
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 12) The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

- 13) Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
a) All b) Some * c) None of:
1. Certified copies of the priority documents have been received.
2. Certified copies of the priority documents have been received in Application No. _____.
3. Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).
* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

- 1) Notice of References Cited (PTO-892)
- 2) Notice of Draftsperson's Patent Drawing Review (PTO-948)
- 3) Information Disclosure Statement(s) (PTO/SB/08)
Paper No(s)/Mail Date 5/16/2012
- 4) Interview Summary (PTO-413)
Paper No(s)/Mail Date. _____.
- 5) Notice of Informal Patent Application
- 6) Other: _____.

DETAILED ACTION

Claim Rejections - 35 USC § 101

1. Claims 23-33 are rejected under 35 U.S.C. 101 because the claimed invention is directed to non-statutory subject matter with respect to subject matter eligibility of computer readable media.

Please see: http://www.uspto.gov/patents/law/notices/101_crm_20100127.pdf

Claim Rejections - 35 USC § 102

2. The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

A person shall be entitled to a patent unless –

(e) the invention was described in (1) an application for patent, published under section 122(b), by another filed in the United States before the invention by the applicant for patent or (2) a patent granted on an application for patent by another filed in the United States before the invention by the applicant for patent, except that an international application filed under the treaty defined in section 351(a) shall have the effects for purposes of this subsection of an application filed in the United States only if the international application designated the United States and was published under Article 21(2) of such treaty in the English language.

3. Claims 1, 3, 5, 7-11, 14, 16, 18-22, 25, 27, and 29-30 are rejected under 35 U.S.C. 102(e) as being anticipated by Birnbaum et al 2010/0017489, hereinafter Birnbaum.

4. In regards to claim 1, Birnbaum teaches a method of producing a haptic effect comprising (abstract):

receiving a first gesture signal [0032, 0074-0076];

receiving a second gesture signal (fig. 1 (114) “sensors”);

generating an interaction parameter using the first gesture signal and the second gesture signal ([0032-0033] for example tilt and acceleration) ; and
applying a drive signal to a haptic actuator according to the interaction parameter [0036] (fig. 1 (118)).

5. In regards to claim 12, Birnbaum teaches a haptic effect enabled system comprising (abstract):

a haptic actuator [0032, 0074-0076];

a drive module electronically coupled to the actuator for receiving a first gesture signal (fig. 1 (114) “sensors”);

receiving a second gesture signal, and generating an interaction parameter using the first gesture signal and the second gesture signal ([0032-0033] for example tilt and acceleration) and

a drive circuit electronically coupled to the drive module and the actuator for applying a drive signal to the actuator according to the interaction parameter [0036] (fig. 1 (118)).

6. In regards to claim 23, Birnbaum teaches a computer readable medium having instructions stored thereon that, when executed by a processor, causes the processor to produce a haptic effect, the instructions comprising (abstract):

receiving a first gesture signal [0032, 0074-0076];

receiving a second gesture signal (fig. 1 (114) “sensors”);

generating an interaction parameter using the first gesture signal and the second gesture signal ([0031-0033] for example tilt and acceleration) and

applying a drive signal to a haptic actuator according to the interaction parameter [0036] (fig. 1 (118)).

7. In regards to claims 3, 14, and 25 Birnbaum teaches the method of claim 1 wherein the first or second gesture signal comprises an on-screen signal (fig. 5a and 5b (520 and 530))

8. In regards to claim 5, 16, and 27 Birnbaum fails to teach the method of claim 1 wherein generating an interaction parameter comprises generating an interaction parameter using the first gesture signal and the second gesture signal and a physical model [0025].

9. In regards to claims 7, 18 and 29, Birnbaum teaches the method of claim 1 further comprising (abstract):

receiving a first device sensor signal [0030];

receiving a second device sensor signal (fig. 3b 302); and

wherein generating an interaction parameter comprises generating an interaction parameter using the first gesture signal and the second gesture signal and the first device sensor signal and the second device sensor signal [0029-0032].

10. In regards to claims 8, 19, and 30 Birnbaum teaches the method of claim 1 wherein the first device sensor signal or the second device sensor signal comprises an accelerometer signal [0019].

11. In regards to claim 9, and 20 Birnbaum teaches the method of claim 1 wherein the first device sensor signal or the second device sensor signal comprises a gyroscope signal.[0019]

12. In regards to claim 10 and 21 Birnbaum teaches the method of claim 1 wherein the first device sensor signal or the second device sensor signal comprises an ambient signal.[0019]

13. In regards to claim 11 and 22 Birnbaum teaches the method of claim 1 wherein the first device sensor signal or the second device sensor signal comprises a virtual sensor signal [0019].

Claim Rejections - 35 USC § 103

14. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

15. The factual inquiries set forth in *Graham v. John Deere Co.*, 383 U.S. 1, 148 USPQ 459 (1966), that are applied for establishing a background for determining obviousness under 35 U.S.C. 103(a) are summarized as follows:

1. Determining the scope and contents of the prior art.
2. Ascertaining the differences between the prior art and the claims at issue.
3. Resolving the level of ordinary skill in the pertinent art.
4. Considering objective evidence present in the application indicating obviousness or nonobviousness.

16. Claims 2,4, 6, 13, 15, 17, 24, 26 and 28 are rejected under 35 U.S.C. 103(a) as being unpatentable over Birnbaum in view of Westerman et al (2002/0015024) hereinafter, Westerman.

17. In regards to claims 2, 13, and 24 Birnbaum fails to teach the method of claim 1 wherein the first or second gesture signal comprises a vector signal.

However, Westerman teaches wherein the first or second gesture signal comprises a vector signal [0041-0042, 180, 203-205, 208, 233, 257, and 261].

It would have been obvious to one of ordinary skill in the art to modify the sensing means of Birnbaum to further include wherein the first or second gesture signal comprises a vector signal as taught by Westerman in order to determine roll, tilt, and direction [0261].

18. In regards to claim 4, 15, and 26 Birnbaum fails to teach the method of claim 1 wherein generating an interaction parameter comprises generating an interaction

parameter from a difference between the first gesture signal and the second gesture signal.

However, Westerman teaches wherein generating an interaction parameter comprises generating an interaction parameter from a difference between the first gesture signal and the second gesture signal [00261].

It would have been obvious to one of ordinary skill in the art to modify the sensing means of Birnbaum to further include herein generating an interaction parameter comprises generating an interaction parameter from a difference between the first gesture signal and the second gesture signal as taught by Westerman in order to determine roll, tilt, and direction [0261].

19. In regards to claim 6, 17, and 28 Birnbaum fails to teach the method of claim 1 wherein generating an interaction parameter comprises generating an interaction parameter using the first gesture signal and the second gesture signal and an animation.

However, Westerman teaches wherein generating an interaction parameter comprises generating an interaction parameter using the first gesture signal and the second gesture signal and an animation (fig. 13 (201-208)).

It would have been obvious to one of ordinary skill to modify the interaction parameter of Birnbaum to use wherein generating an interaction parameter comprises generating an interaction parameter using the first gesture signal and the second

gesture signal and an animation as taught by Westerman in order to provide interaction of hand contacts [00128-00129].

Conclusion

Any inquiry concerning this communication or earlier communications from the examiner should be directed to GRANT SITTA whose telephone number is (571)270-1542. The examiner can normally be reached on M-F 9-6.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Alexander Beck can be reached on 571-272-7765. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

/Grant D Sitta/
Primary Examiner, Art Unit 2629

Application/Control Number: 13/472,698
Art Unit: 2629

Page 9

Notice of References Cited	Application/Control No. 13/472,698	Applicant(s)/Patent Under Reexamination BIRNBAUM ET AL.	
	Examiner GRANT SITTA	Art Unit 2629	Page 1 of 1

U.S. PATENT DOCUMENTS

*	Document Number Country Code-Number-Kind Code	Date MM-YYYY	Name	Classification
*	A US-2010/0017489	01-2010	Birnbaum et al.	709/206
*	B US-2002/0015024	02-2002	Westerman et al.	345/173
*	C US-2010/0152620	06-2010	Ramsay et al.	600/595
	D US-			
	E US-			
	F US-			
	G US-			
	H US-			
	I US-			
	J US-			
	K US-			
	L US-			
	M US-			

FOREIGN PATENT DOCUMENTS

*	Document Number Country Code-Number-Kind Code	Date MM-YYYY	Country	Name	Classification
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	P				
	Q				
	R				
	S				
	T				

NON-PATENT DOCUMENTS

*	Include as applicable: Author, Title Date, Publisher, Edition or Volume, Pertinent Pages)
U	
V	
W	
X	

*A copy of this reference is not being furnished with this Office action. (See MPEP § 707.05(a).)
Dates in MM-YYYY format are publication dates. Classifications may be US or foreign.

Receipt date: 05/16/2012

13472698 - GAU: 2629

Doc code: IDS
 Doc description: Information Disclosure Statement (IDS) Filed

PTO/SB/08a (01-10)
 Approved for use through 07/31/2012. OMB 0651-0031
 U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE

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INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)	Application Number		13472698
	Filing Date		2012-05-16
	First Named Inventor	BIRNBAUM	
	Art Unit		
	Examiner Name		
	Attorney Docket Number		IMM389C1

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Examiner Initial*	Cite No	Patent Number	Kind Code ¹	Issue Date	Name of Patentee or Applicant of cited Document	Pages, Columns, Lines where Relevant Passages or Relevant Figures Appear
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If you wish to add additional U.S. Patent citation information please click the Add button.

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Receipt date: 05/16/2012

13472698 - GAU: 2629

INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)	Application Number	13472698
	Filing Date	2012-05-16
	First Named Inventor	BIRNBAUM
	Art Unit	
	Examiner Name	
	Attorney Docket Number	IMM389C1

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	Filing Date		2012-05-16		
	First Named Inventor	BIRNBAUM			
	Art Unit				
	Examiner Name				
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	52	20090167508		2009-07-02	Fadell et al.	
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	55	20090250267		2009-10-08	Heubel et al.	
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	63	20100045619		2010-02-25	Birnbaum et al.	
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	75	20110025609		2011-02-03	Modarres et al.	
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FOREIGN PATENT DOCUMENTS

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	1	DE 200 19 074			2001-02-22	Siemens AG		<input type="checkbox"/>
	2	EP 0 899 650			1999-03-03	Xerox Corp.		<input type="checkbox"/>
	3	EP 1 401 185			2004-03-24	Samsung Electronics Co. Ltd.		<input type="checkbox"/>
	4	EP 1 691 263			2003-11-06	Apple		<input type="checkbox"/>
	5	EP 1 731 993			2006-12-13	Sony Corp.		<input type="checkbox"/>
	6	FR 2 910 160			2008-06-20	France Telecom		<input type="checkbox"/>
	7	GB 2 416 962			2006-02-08	Vodafone PLC		<input type="checkbox"/>
	8	WO 2004/044728 A2			2004-05-27	Sony Comp Entertainment Inc.		<input type="checkbox"/>

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	Attorney Docket Number		IMM389C1	

9	WO 2004/075169 A2			2004-09-02	KONINKLIJKE PHILIPS ELECTRONICS, N.V.		<input type="checkbox"/>
10	WO 2004/081778 A1			2004-09-23	Handshake Interactive Technology		<input type="checkbox"/>
11	WO 2005/103863 A			2005-11-03	Fujitsu Limited		<input type="checkbox"/>
12	WO 2008/132540 A1			2008-11-06	Nokia Corp. et al.		<input type="checkbox"/>
13	WO 2009/037379			2009-03-26	MÄKINEN et al.		<input type="checkbox"/>
14	WO 2009/071750 A1			2009-06-11	Nokia Corporation		<input type="checkbox"/>
15	WO 2009/074185 A1			2009-06-18	Nokia Corp. et al.		<input type="checkbox"/>
16	WO 2009/141502			2009-11-26	MÄKINEN et al.		<input type="checkbox"/>
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	Filing Date	2012-05-16
	First Named Inventor	BIRNBAUM
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	Examiner Name	
	Attorney Docket Number	IMM389C1

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3	Bonderud, Doug, "Nokia Files Patent To Make Phones Digitally Stimulating", InventorSpot.com [online], [retrieved 2011-04-21]. Retrieved from the Internet <URL: http://inventorspot.com/articles/nokia_files_patent_make_phones_digitally_stimulating >	<input type="checkbox"/>
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10	Iwamoto, T. et al., "Airborne Ultrasound Tactile Display", The University of Tokyo, SIGGRAPH 2008, Los Angeles, California, August 11-15, 2008, ISBN 978-1-60558-466-9/08/0008	<input type="checkbox"/>
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	Examiner Name	
	Attorney Docket Number	IMM389C1

12	KAARESOJA, T. et al., Snap-Crackle-Pop: Tactile Feedback for Mobile Touch Screens, Proceedings of the Eurohaptics 2006, XP 002551465, at http://isc.univ-evry.fr/eurohaptics/upload/cd/papers/f80 , as available via the Internet and printed 10-20-09.	<input type="checkbox"/>
13	Marks, Paul, "Nokia touchscreen creates texture illusion", New Scientist [online], [retrieved 2011-04-21]. Retrieved from the Internet <URL: http://www.newscientist.com/article/dn19510-nokia-touchscreen-creates-texture-illusion.html >	<input type="checkbox"/>
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17	Smith, Ned, "Feel the future: Touch screens that touch back", MSNBC [online], [retrieved 2011-04-21]. Retrieved from the Internet <URL: http://www.msnbc.msn.com/id/40845743/ns/technology_and_science-tech_and_gadgets/t/feel-future-touch-screens-touch-back/#.T5clU7ONfEY >	<input type="checkbox"/>
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	Attorney Docket Number	IMM389C1

CERTIFICATION STATEMENT

Please see 37 CFR 1.97 and 1.98 to make the appropriate selection(s):

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Signature	/Thomas A. Hassing/	Date (YYYY-MM-DD)	2012-05-16
Name/Print	Thomas A. Hassing	Registration Number	36,159

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	1	7113177		2006-11-07	Tamaru	

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	1	20070236450		2007-10-11	Colgate et al.	
	2	20090284485		2009-11-19	Colgate et al.	
	3	20100108408		2010-05-06	Colgate et al.	
	4	20110260988		2011-10-27	Colgate et al.	

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1. The information on this form will be treated confidentially to the extent allowed under the Freedom of Information Act (5 U.S.C. 552) and the Privacy Act (5 U.S.C. 552a). Records from this system of records may be disclosed to the Department of Justice to determine whether the Freedom of Information Act requires disclosure of these records.
2. A record from this system of records may be disclosed, as a routine use, in the course of presenting evidence to a court, magistrate, or administrative tribunal, including disclosures to opposing counsel in the course of settlement negotiations.
3. A record in this system of records may be disclosed, as a routine use, to a Member of Congress submitting a request involving an individual, to whom the record pertains, when the individual has requested assistance from the Member with respect to the subject matter of the record.
4. A record in this system of records may be disclosed, as a routine use, to a contractor of the Agency having need for the information in order to perform a contract. Recipients of information shall be required to comply with the requirements of the Privacy Act of 1974, as amended, pursuant to 5 U.S.C. 552a(m).
5. A record related to an International Application filed under the Patent Cooperation Treaty in this system of records may be disclosed, as a routine use, to the International Bureau of the World Intellectual Property Organization, pursuant to the Patent Cooperation Treaty.
6. A record in this system of records may be disclosed, as a routine use, to another federal agency for purposes of National Security review (35 U.S.C. 181) and for review pursuant to the Atomic Energy Act (42 U.S.C. 218(c)).
7. A record from this system of records may be disclosed, as a routine use, to the Administrator, General Services, or his/her designee, during an inspection of records conducted by GSA as part of that agency's responsibility to recommend improvements in records management practices and programs, under authority of 44 U.S.C. 2904 and 2906. Such disclosure shall be made in accordance with the GSA regulations governing inspection of records for this purpose, and any other relevant (i.e., GSA or Commerce) directive. Such disclosure shall not be used to make determinations about individuals.
8. A record from this system of records may be disclosed, as a routine use, to the public after either publication of the application pursuant to 35 U.S.C. 122(b) or issuance of a patent pursuant to 35 U.S.C. 151. Further, a record may be disclosed, subject to the limitations of 37 CFR 1.14, as a routine use, to the public if the record was filed in an application which became abandoned or in which the proceedings were terminated and which application is referenced by either a published application, an application open to public inspections or an issued patent.
9. A record from this system of records may be disclosed, as a routine use, to a Federal, State, or local law enforcement agency, if the USPTO becomes aware of a violation or potential violation of law or regulation.

<i>Index of Claims</i> 	Application/Control No. 13472698	Applicant(s)/Patent Under Reexamination BIRNBAUM ET AL.
	Examiner GRANT SITTA	Art Unit 2629

✓	Rejected	-	Cancelled	N	Non-Elected	A	Appeal
=	Allowed	÷	Restricted	I	Interference	O	Objected

Claims renumbered in the same order as presented by applicant
 CPA
 T.D.
 R.1.47

CLAIM		DATE									
Final	Original	07/05/2012									
	1	✓									
	2	✓									
	3	✓									
	4	✓									
	5	✓									
	6	✓									
	7	✓									
	8	✓									
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	27	✓									
	28	✓									
	29	✓									
	30	✓									

Search Notes 	Application/Control No. 13472698	Applicant(s)/Patent Under Reexamination BIRNBAUM ET AL.
	Examiner GRANT SITTA	Art Unit 2629

SEARCHED			
Class	Subclass	Date	Examiner
345	173	7/5/2012	GS

SEARCH NOTES		
Search Notes	Date	Examiner
Searched EAST (USPGPUB, USPAT, USOCR, FPRS, EPO, JPO, DERWENT, IBM)	7/5/2012	GS

INTERFERENCE SEARCH			
Class	Subclass	Date	Examiner

	/GRANT SITTA/ Primary Examiner. Art Unit 2629
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EAST Search History

EAST Search History (Prior Art)

Ref #	Hits	Search Query	DBs	Default Operator	Plurals	Time Stamp
L1	0	"13092484"	USPAT	OR	OFF	2012/07/05 08:37
L2	1	"13092484"	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2012/07/05 08:37
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L4	450	345/173.ccls. and vector and difference	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2012/07/05 08:59
L5	94	345/173.ccls. and vector same difference	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2012/07/05 08:59
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L13	77	first same second same signal same haptic and 345/173.ccls.	US-PGPUB; USPAT; USOCR; FPRS;	OR	OFF	2012/07/05 10:37

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S2	61	((JUAN) near2 (CRUZ-HERNANDEZ)).INV.	US-PGPUB; USPAT	OR	OFF	2012/06/29 11:18
S3	119	((DANNY) near2 (GRANT)).INV.	US-PGPUB; USPAT	OR	OFF	2012/06/29 11:18
S4	8	((CHRIS) near2 (ULLRICH)).INV.	US-PGPUB; USPAT	OR	OFF	2012/06/29 11:18
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EAST Search History

		"20060255683" "20060256074" "20060279476" "20060279542" "20060284849" "20070066283" "20070139366" "20070150826" "20070152984" "20070247429" "20070247442" "20070265096" "20070279392" "20080024459" "20080055277" "20080060856" "20080068334" "20080088580" "20080111788" "20080180406" "20080216001" "20080287147" "20080300055" "20080303782" "20090002328" "20090079550" "20090085878" "20090109007" "20090128503" "20090137269" "20090166098" "20090167508" "20090167509" "20090167704" "20090250267" "20090256817" "20090270046" "20090315830" "20100013653" "20100013761" "20100017489" "20100017759" "20100045619" "20100127819" "20100149134" "20100156818" "20100214243" "20100231539" "20100245254" "20100265208" "20100313124" "20100328053" "20110021272" "20110025609" "20110043454" "20110043527" "20110102340" "20110105103" "20110109588" "20110138277" "20110264491" "20120068957" "20120081276" "20120105333" "5666499" "5825308" "6088019" "6100874" "6166723" "6211861" "6252579" "6300936" "6337678" "6429846" "6448977" "6717573" "6819312" "7024625" "7084854" "7088342" "7205978" "7336260" "7446456" "7456823" "7468573" "7528508" "7554246" "7592999" "7663604" "7755607" "7808488" "7821498" "7825903" "7890863" "7920131" "7924144" "7969288" "7973769" "7978181" "7982588" "7982720" "8004492" "8031181" "8035623" "8059105" "8098235" "RE42064").PN.				
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EAST Search History

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S16	2	"11487873"	US-PGPUB; USPAT; USOCR	OR	OFF	2012/06/29 14:22

EAST Search History (Interference)

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7/ 5/ 2012 10:46:26 AM

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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
13/472,698	05/16/2012	David BIRNBAUM	IMM389C1	6404
103772	7590	08/21/2012	EXAMINER	
Immersion Corporation 30 Rio Robles San Jose, CA 95134			SITTA, GRANT	
			ART UNIT	PAPER NUMBER
			2629	
			MAIL DATE	DELIVERY MODE
			08/21/2012	PAPER

Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

Applicant-Initiated Interview Summary	Application No. 13/472,698	Applicant(s) BIRNBAUM ET AL.	
	Examiner GRANT SITTA	Art Unit 2629	

All participants (applicant, applicant's representative, PTO personnel):

(1) GRANT SITTA. (3) Danny Grant.
(2) Thomas Hassing. (4) Jeff Leng.

Date of Interview: 16 August 2012.

Type: Telephonic Video Conference
 Personal [copy given to: applicant applicant's representative]

Exhibit shown or demonstration conducted: Yes No.
If Yes, brief description: haptic device.

Issues Discussed 101 112 102 103 Others
(For each of the checked box(es) above, please describe below the issue and detailed description of the discussion)

Claim(s) discussed: 1-30.

Identification of prior art discussed: Birnbaum.

Substance of Interview
(For each issue discussed, provide a detailed description and indicate if agreement was reached. Some topics may include: identification or clarification of a reference or a portion thereof, claim interpretation, proposed amendments, arguments of any applied references etc...)

Discussed prior art of record as applied to proposed claim limitations. .

Applicant recordation instructions: The formal written reply to the last Office action must include the substance of the interview. (See MPEP section 713.04). If a reply to the last Office action has already been filed, applicant is given a non-extendable period of the longer of one month or thirty days from this interview date, or the mailing date of this interview summary form, whichever is later, to file a statement of the substance of the interview

Examiner recordation instructions: Examiners must summarize the substance of any interview of record. A complete and proper recordation of the substance of an interview should include the items listed in MPEP 713.04 for complete and proper recordation including the identification of the general thrust of each argument or issue discussed, a general indication of any other pertinent matters discussed regarding patentability and the general results or outcome of the interview, to include an indication as to whether or not agreement was reached on the issues raised.

Attachment

/Grant D Sitta/ Primary Examiner, Art Unit 2629	
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Summary of Record of Interview Requirements

Manual of Patent Examining Procedure (MPEP), Section 713.04, Substance of Interview Must be Made of Record

A complete written statement as to the substance of any face-to-face, video conference, or telephone interview with regard to an application must be made of record in the application whether or not an agreement with the examiner was reached at the interview.

Title 37 Code of Federal Regulations (CFR) § 1.133 Interviews

Paragraph (b)

In every instance where reconsideration is requested in view of an interview with an examiner, a complete written statement of the reasons presented at the interview as warranting favorable action must be filed by the applicant. An interview does not remove the necessity for reply to Office action as specified in §§ 1.111, 1.135. (35 U.S.C. 132)

37 CFR §1.2 Business to be transacted in writing.

All business with the Patent or Trademark Office should be transacted in writing. The personal attendance of applicants or their attorneys or agents at the Patent and Trademark Office is unnecessary. The action of the Patent and Trademark Office will be based exclusively on the written record in the Office. No attention will be paid to any alleged oral promise, stipulation, or understanding in relation to which there is disagreement or doubt.

The action of the Patent and Trademark Office cannot be based exclusively on the written record in the Office if that record is itself incomplete through the failure to record the substance of interviews.

It is the responsibility of the applicant or the attorney or agent to make the substance of an interview of record in the application file, unless the examiner indicates he or she will do so. It is the examiner's responsibility to see that such a record is made and to correct material inaccuracies which bear directly on the question of patentability.

Examiners must complete an Interview Summary Form for each interview held where a matter of substance has been discussed during the interview by checking the appropriate boxes and filling in the blanks. Discussions regarding only procedural matters, directed solely to restriction requirements for which interview recordation is otherwise provided for in Section 812.01 of the Manual of Patent Examining Procedure, or pointing out typographical errors or unreadable script in Office actions or the like, are excluded from the interview recordation procedures below. Where the substance of an interview is completely recorded in an Examiners Amendment, no separate Interview Summary Record is required.

The Interview Summary Form shall be given an appropriate Paper No., placed in the right hand portion of the file, and listed on the "Contents" section of the file wrapper. In a personal interview, a duplicate of the Form is given to the applicant (or attorney or agent) at the conclusion of the interview. In the case of a telephone or video-conference interview, the copy is mailed to the applicant's correspondence address either with or prior to the next official communication. If additional correspondence from the examiner is not likely before an allowance or if other circumstances dictate, the Form should be mailed promptly after the interview rather than with the next official communication.

The Form provides for recordation of the following information:

- Application Number (Series Code and Serial Number)
- Name of applicant
- Name of examiner
- Date of interview
- Type of interview (telephonic, video-conference, or personal)
- Name of participant(s) (applicant, attorney or agent, examiner, other PTO personnel, etc.)
- An indication whether or not an exhibit was shown or a demonstration conducted
- An identification of the specific prior art discussed
- An indication whether an agreement was reached and if so, a description of the general nature of the agreement (may be by attachment of a copy of amendments or claims agreed as being allowable). Note: Agreement as to allowability is tentative and does not restrict further action by the examiner to the contrary.
- The signature of the examiner who conducted the interview (if Form is not an attachment to a signed Office action)

It is desirable that the examiner orally remind the applicant of his or her obligation to record the substance of the interview of each case. It should be noted, however, that the Interview Summary Form will not normally be considered a complete and proper recordation of the interview unless it includes, or is supplemented by the applicant or the examiner to include, all of the applicable items required below concerning the substance of the interview.

A complete and proper recordation of the substance of any interview should include at least the following applicable items:

- 1) A brief description of the nature of any exhibit shown or any demonstration conducted,
- 2) an identification of the claims discussed,
- 3) an identification of the specific prior art discussed,
- 4) an identification of the principal proposed amendments of a substantive nature discussed, unless these are already described on the Interview Summary Form completed by the Examiner,
- 5) a brief identification of the general thrust of the principal arguments presented to the examiner,
(The identification of arguments need not be lengthy or elaborate. A verbatim or highly detailed description of the arguments is not required. The identification of the arguments is sufficient if the general nature or thrust of the principal arguments made to the examiner can be understood in the context of the application file. Of course, the applicant may desire to emphasize and fully describe those arguments which he or she feels were or might be persuasive to the examiner.)
- 6) a general indication of any other pertinent matters discussed, and
- 7) if appropriate, the general results or outcome of the interview unless already described in the Interview Summary Form completed by the examiner.

Examiners are expected to carefully review the applicant's record of the substance of an interview. If the record is not complete and accurate, the examiner will give the applicant an extendable one month time period to correct the record.

Examiner to Check for Accuracy

If the claims are allowable for other reasons of record, the examiner should send a letter setting forth the examiner's version of the statement attributed to him or her. If the record is complete and accurate, the examiner should place the indication, "Interview Record OK" on the paper recording the substance of the interview along with the date and the examiner's initials.

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Application of:)	
)	
David Birnbaum et al.	)	Examiner: Sitta, Grant
)	
Application No. 13/472,698	)	Art Unit: 2629
)	
Filed: May 16, 2012)	
	)	Confirmation No. 6404
For: METHOD AND APPARATUS FOR)	
PRODUCING A DYNAMIC HAPTIC)	
EFFECT)	

Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

AMENDMENT AND RESPONSE UNDER 37 CFR § 1.111

Sir:

In response to the Office Action mailed July 9, 2012, Applicants respectfully request the Examiner enter the following amendments and consider the following remarks.

CERTIFICATE OF ELECTRONIC FILING

I hereby certify that this correspondence is being deposited via electronic filing through the United States Patent and Trademark Electronic Filing System on:

August 24, 2012
Date of Deposit

Dawn Rose
(Type or print name of person mailing paper)

/Dawn Rose/
(Signature of person mailing paper)

August 24, 2012
Date

AMENDMENTS TO THE CLAIMS

1. (Currently Amended) A method of producing a haptic effect comprising:
receiving a first gesture signal;
receiving a second gesture signal;
generating [[an]] a dynamic interaction parameter using the first gesture signal and the second gesture signal; and
applying a drive signal to a haptic output device according to the dynamic interaction parameter.
2. (Original) The method of claim 1 wherein the first or second gesture signal comprises a vector signal.
3. (Original) The method of claim 1 wherein the first or second gesture signal comprises an on-screen signal.
4. (Currently Amended) The method of claim 1 wherein generating [[an]] a dynamic interaction parameter comprises generating [[an]] a dynamic interaction parameter from a difference between the first gesture signal and the second gesture signal.
5. (Currently Amended) The method of claim 1 wherein generating [[an]] a dynamic interaction parameter comprises generating [[an]] a dynamic interaction parameter using the first gesture signal and the second gesture signal and a physical model.

6. (Currently Amended) The method of claim 1 wherein generating [[an]] a dynamic interaction parameter comprises generating [[an]] a dynamic interaction parameter using the first gesture signal and the second gesture signal and an animation.

7. (Currently Amended) The method of claim 1 further comprising:
receiving a first device sensor signal;
receiving a second device sensor signal; and
wherein generating [[an]] a dynamic interaction parameter comprises generating [[an]] a dynamic interaction parameter using the first gesture signal and the second gesture signal and the first device sensor signal and the second device sensor signal.

8. (Original) The method of claim 1 wherein the first device sensor signal or the second device sensor signal comprises an accelerometer signal.

9. (Original) The method of claim 1 wherein the first device sensor signal or the second device sensor signal comprises a gyroscope signal.

10. (Original) The method of claim 1 wherein the first device sensor signal or the second device sensor signal comprises an ambient signal.

11. (Original) The method of claim 1 wherein the first device sensor signal or the second device sensor signal comprises a virtual sensor signal.

12. (Currently Amended) A haptic effect enabled system comprising:
a haptic output device;

a drive module electronically coupled to the haptic output device for receiving a first gesture signal, receiving a second gesture signal, and generating [[an]] a dynamic interaction parameter using the first gesture signal and the second gesture signal; and

a drive circuit electronically coupled to the drive module and the haptic output device for applying a drive signal to the haptic output device according to the dynamic interaction parameter.

13. (Original) The system of claim 12 wherein the first or second gesture signal comprises a vector signal.

14. (Original) The system of claim 12 wherein the first or second gesture signal comprises an on-screen signal.

15. (Currently Amended) The system of claim 12 wherein the drive module comprises a drive module for generating [[an]] a dynamic interaction parameter from a difference between the first gesture signal and the second gesture signal.

16. (Currently Amended) The system of claim 12 wherein the drive module comprises a drive module for generating [[an]] a dynamic interaction parameter using the first gesture signal and the second gesture signal and a physical model.

17. (Currently Amended) The system of claim 12 wherein the drive module comprises a drive module for generating [[an]] a dynamic interaction parameter using the first gesture signal and the second gesture signal and an animation.

18. (Currently Amended) The system of claim 12 wherein the drive module comprises a drive module for receiving a first device sensor signal, receiving a second device sensor signal, and generating [[an]] a dynamic interaction parameter using the first gesture signal and the second gesture signal and the first device sensor signal and the second device sensor signal.

19. (Original) The system of claim 12 wherein the first device sensor signal or the second device sensor signal comprises an accelerometer signal.

20. (Original) The system of claim 12 wherein the first device sensor signal or the second device sensor signal comprises a gyroscope signal.

21. (Original) The system of claim 12 wherein the first device sensor signal or the second device sensor signal comprises an ambient signal.

22. (Original) The system of claim 12 wherein the first device sensor signal or the second device sensor signal comprises a virtual sensor signal.

23. (Currently Amended) A non-transitory computer readable medium having instructions stored thereon that, when executed by a processor, causes the processor to produce a haptic effect, the instructions comprising:

- receiving a first gesture signal;
- receiving a second gesture signal;
- generating [[an]] a dynamic interaction parameter using the first gesture signal and the second gesture signal; and

applying a drive signal to a haptic output device according to the dynamic interaction parameter.

24. (Currently Amended) The non-transitory computer readable medium of claim 23, wherein the first or second gesture signal comprises a vector signal.

25. (Currently Amended) The non-transitory computer readable medium of claim 23, wherein the first or second gesture signal comprises an on-screen signal.

26. (Currently Amended) The non-transitory computer readable medium of claim 23, wherein generating a dynamic interaction parameter comprises generating a dynamic interaction parameter from a difference between the first gesture signal and the second gesture signal.

27. (Currently Amended) The non-transitory computer readable medium of claim 23, wherein generating a dynamic interaction parameter comprises generating a dynamic interaction parameter using the first gesture signal and the second gesture signal and a physical model.

28. (Currently Amended) The non-transitory computer readable medium of claim 23, wherein generating a dynamic interaction parameter comprises generating a dynamic interaction parameter using the first gesture signal and the second gesture signal and an animation.

29. (Currently Amended) The non-transitory computer readable medium of claim 23, further comprising:

receiving a first device sensor signal;

receiving a second device sensor signal; and

wherein generating ~~[[an]]~~ a dynamic interaction parameter comprises generating ~~[[an]]~~ a dynamic interaction parameter using the first gesture signal and the second gesture signal and the first device sensor signal and the second device sensor signal.

30. (Currently Amended) The non-transitory computer readable medium of claim 23, wherein the first device sensor signal or the second device sensor signal comprises a signal selected from the list consisting of accelerometer, gyroscope, ambient, or virtual.

REMARKS

Reconsideration of this application as amended is respectfully requested. Claims 1-30 are pending and Claims 1, 4-7, 12, 15-18 and 23-30 are amended. No new matter is being added by way of this amendment.

TRACK 1 STATUS

Because the present application has been granted Track 1 status, the Examiner is respectfully requested to contact the undersigned by telephone before the next office action if such contact would further the examination of the present application.

REJECTION UNDER 35 U.S.C. § 101

The Examiner is rejecting Claims 23-33 under 35 U.S.C. § 101 as being directed to non-statutory subject matter. Applicants have amended Claims 23-30 to recite a non-transitory computer readable medium. Applicants respectfully submit that the invention according to amended Claims 23-30 is statutory subject matter and the rejection of the claims under 35 U.S.C. § 101 should be removed. Applicants note that Claims 31-33 are not pending in the present application.

REJECTION UNDER 35 U.S.C. § 102

The Examiner is rejecting Claims 1, 3, 5, 7-11, 14, 16, 18-22, 25, 27, and 29-30 under 35 U.S.C. 102(e) as being anticipated by Birnbaum et al., U. S. Patent App. No. 2010/0017489 (hereinafter "Birnbaum"). Applicants note that there is common inventorship between Birnbaum

and the present application and respectfully disagree. Applicants have amended Claims 1, 4-7, 12, 15-18 and 23-30 to recite a dynamic interaction parameter to produce haptic output.

As defined in the present application, a dynamic interaction parameter refers to a haptic effect that evolves over time as it responds to one or more input parameters (present application, paragraph [0027]). A dynamic interaction parameter can be any type of signal that is changing over time or reacting in real time, including a mapping schema which maps an input parameter onto a changing property of the effect signal (present application, paragraph [0028]). In the context of a dynamic interaction parameter, a mapping is a method to convert the sensed information into a haptic effect by modifying one or several haptic effect parameters (present application, paragraph [0028]). Based upon the one or more inputs from the one or more user gestures, a dynamic haptic effect is provided during the user gesture and continuously modified as determined by the dynamic interaction parameter (present application, paragraph [0060]). The dynamic haptic effect may speed up or slow down, increase or decrease in intensity, or change its pattern or duration, or change in any other way, in real-time according to such elements as the speed, direction, pressure, magnitude, or duration of the user gesture itself, or the speed, direction or duration of the user gesture initiated animation, or based on a changing property of a virtual object such as the number of times an image has been viewed (present application, paragraph [0060]). The effect of providing or modifying a dynamic haptic effect in real-time during and even after a user gesture is that no two gestures such as page turns or finger swipes will feel the same to the user (present application, paragraph [0060]). That is, the dynamic haptic effect will always be unique to the user gesture, thereby creating a greater sense connectedness to the device and a more nuanced and compelling user interface experience for the user as compared to a simple static haptic effect provided by a trigger event (present application, paragraph [0060]).

In contrast to the presently claimed invention which shares common inventorship with Birnbaum, Applicants respectfully submit that Birnbaum does not disclose or imply the use of a

dynamic interaction parameter to produce haptic output. Birnbaum describes systems and methods for haptic message transmission. For example, one disclosed method includes the steps of receiving a sensor signal from a sensor configured to sense a physical interaction with a messaging device, determining a virtual force based at least in part on the sensor signal, and applying the virtual force to a virtual message object within a virtual message environment (Birnbaum, paragraph [0004]). With the illustrative device, users can interact with the virtual message environment and/or virtual message objects by using the touch-screen and/or by manipulating the messaging device, for example, by rotating or shaking the device (Birnbaum, paragraph [0018]). The sensor detects the user's gesture and, based on this gesture, sends a sensor signal to the processor. The sensor may comprise: a gyroscope, an accelerometer, a GPS, or other sensor capable of detecting movement. The sensor may be configured to detect when a user moves or tilts the device (Birnbaum, paragraph [0019]). However, Birnbaum is silent with respect to a dynamic interaction parameter to produce haptic output as described and claimed in the present application.

An applicant is entitled to be his or her own lexicographer and may rebut the presumption that claim terms are to be given their ordinary and customary meaning by clearly setting forth a definition of the term that is different from its ordinary and customary meaning(s). MPEP § 2111.01(IV). Applicants respectfully submit that the definition of a dynamic interaction parameter in the specification and claims of the present application does not permit the Examiner to read the amended Claims 1, 3, 5, 7-11, 14, 16, 18-22, 25, 27, and 29-30 on to Birnbaum, and therefore the rejection under 35 U.S.C. § 102(e) has been overcome and should be removed.

REJECTION UNDER 35 U.S.C. § 103

The Examiner is rejecting Claims 2, 4, 6, 13, 15, 17, 24, 26 and 28 under 35 U.S.C. 103(a) as being unpatentable over Birnbaum in view of Westerman et al., U. S. Patent App. 2002/0015024 (hereinafter “Westerman”). Applicants respectfully disagree.

Birnbaum has been discussed above. Westerman describes gestures in the context of a method and apparatus for integrating manual input. For example, a method to capture coarse handwriting gestures without a stylus and without confusing them with pointing motions (Westerman, paragraph [0015]); producing gesture commands or multiple degree-of-freedom manipulation signals when the user slides two or more fingers across the surface (Westerman, paragraph [0043]); hand scaling or rotation gestures (Westerman, paragraph [0204]); enable three-dimensional manipulation with an intuitive gesture such as placing all five fingers on the surface, briefly tapping the palm heels on the surface, and finally resting the palm heels on the surface (Westerman, paragraph [0260]); one-shot command gestures (Westerman, paragraph [0291]); or a layout homing gesture (Westerman, paragraphs [0294-0296]). However, Westerman is silent with respect to a dynamic interaction parameter to produce haptic output as described and claimed in the present application.

Applicants respectfully submit that the definition of a dynamic interaction parameter in the specification and claims of the present application does not permit the Examiner to combine Birnbaum with Westerman to produce the invention of amended Claims 2, 4, 6, 13, 15, 17, 24, 26 and 28, and therefore one of ordinary skill in the art would not have been able to combine Birnbaum with Westerman to produce the presently claimed invention without undue experimentation and the rejection under 35 U.S.C. § 103(a) should be removed.

CONCLUSION

For at least the foregoing reasons, Applicants respectfully submit that the rejections have been overcome. Therefore, all pending claims are in condition for allowance, and reconsideration and allowance are requested.

Respectfully submitted,

IMMERSION CORPORATION

Dated: August 24, 2012

/Thomas A. Hassing/
Thomas A. Hassing
Reg. No. 36,159

30 Rio Robles
San Jose, CA 95134
(408) 467-1900

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Application of:)	
)	
David Birnbaum et al.	)	Examiner: Sitta, Grant
)	
Application No. 13/472,698	)	Art Unit: 2629
)	
Filed: May 16, 2012)	
	)	Confirmation No. 6404
For: METHOD AND APPARATUS FOR)	
PRODUCING A DYNAMIC HAPTIC)	
EFFECT)	
)	

Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

AMENDMENT AND RESPONSE UNDER 37 CFR § 1.111

Sir:

In response to the Office Action mailed July 9, 2012, Applicants respectfully request the Examiner enter the following amendments and consider the following remarks.

CERTIFICATE OF ELECTRONIC FILING

I hereby certify that this correspondence is being deposited via electronic filing through the United States Patent and Trademark Electronic Filing System on:

August 24, 2012
Date of Deposit

Dawn Rose
(Type or print name of person mailing paper)

/Dawn Rose/
(Signature of person mailing paper)

August 24, 2012
Date

AMENDMENTS TO THE CLAIMS

1. (Currently Amended) A method of producing a haptic effect comprising:
receiving a first gesture signal;
receiving a second gesture signal;
generating [[an]] a dynamic interaction parameter using the first gesture signal and the second gesture signal; and
applying a drive signal to a haptic output device according to the dynamic interaction parameter.
2. (Original) The method of claim 1 wherein the first or second gesture signal comprises a vector signal.
3. (Original) The method of claim 1 wherein the first or second gesture signal comprises an on-screen signal.
4. (Currently Amended) The method of claim 1 wherein generating [[an]] a dynamic interaction parameter comprises generating [[an]] a dynamic interaction parameter from a difference between the first gesture signal and the second gesture signal.
5. (Currently Amended) The method of claim 1 wherein generating [[an]] a dynamic interaction parameter comprises generating [[an]] a dynamic interaction parameter using the first gesture signal and the second gesture signal and a physical model.

6. (Currently Amended) The method of claim 1 wherein generating [[an]] a dynamic interaction parameter comprises generating [[an]] a dynamic interaction parameter using the first gesture signal and the second gesture signal and an animation.

7. (Currently Amended) The method of claim 1 further comprising:
receiving a first device sensor signal;
receiving a second device sensor signal; and
wherein generating [[an]] a dynamic interaction parameter comprises generating [[an]] a dynamic interaction parameter using the first gesture signal and the second gesture signal and the first device sensor signal and the second device sensor signal.

8. (Original) The method of claim 1 wherein the first device sensor signal or the second device sensor signal comprises an accelerometer signal.

9. (Original) The method of claim 1 wherein the first device sensor signal or the second device sensor signal comprises a gyroscope signal.

10. (Original) The method of claim 1 wherein the first device sensor signal or the second device sensor signal comprises an ambient signal.

11. (Original) The method of claim 1 wherein the first device sensor signal or the second device sensor signal comprises a virtual sensor signal.

12. (Currently Amended) A haptic effect enabled system comprising:
a haptic output device;

a drive module electronically coupled to the haptic output device for receiving a first gesture signal, receiving a second gesture signal, and generating [[an]] a dynamic interaction parameter using the first gesture signal and the second gesture signal; and

a drive circuit electronically coupled to the drive module and the haptic output device for applying a drive signal to the haptic output device according to the dynamic interaction parameter.

13. (Original) The system of claim 12 wherein the first or second gesture signal comprises a vector signal.

14. (Original) The system of claim 12 wherein the first or second gesture signal comprises an on-screen signal.

15. (Currently Amended) The system of claim 12 wherein the drive module comprises a drive module for generating [[an]] a dynamic interaction parameter from a difference between the first gesture signal and the second gesture signal.

16. (Currently Amended) The system of claim 12 wherein the drive module comprises a drive module for generating [[an]] a dynamic interaction parameter using the first gesture signal and the second gesture signal and a physical model.

17. (Currently Amended) The system of claim 12 wherein the drive module comprises a drive module for generating [[an]] a dynamic interaction parameter using the first gesture signal and the second gesture signal and an animation.

18. (Currently Amended) The system of claim 12 wherein the drive module comprises a drive module for receiving a first device sensor signal, receiving a second device sensor signal, and generating [[an]] a dynamic interaction parameter using the first gesture signal and the second gesture signal and the first device sensor signal and the second device sensor signal.

19. (Original) The system of claim 12 wherein the first device sensor signal or the second device sensor signal comprises an accelerometer signal.

20. (Original) The system of claim 12 wherein the first device sensor signal or the second device sensor signal comprises a gyroscope signal.

21. (Original) The system of claim 12 wherein the first device sensor signal or the second device sensor signal comprises an ambient signal.

22. (Original) The system of claim 12 wherein the first device sensor signal or the second device sensor signal comprises a virtual sensor signal.

23. (Currently Amended) A non-transitory computer readable medium having instructions stored thereon that, when executed by a processor, causes the processor to produce a haptic effect, the instructions comprising:

- receiving a first gesture signal;
- receiving a second gesture signal;
- generating [[an]] a dynamic interaction parameter using the first gesture signal and the second gesture signal; and

applying a drive signal to a haptic output device according to the dynamic interaction parameter.

24. (Currently Amended) The non-transitory computer readable medium of claim 23, wherein the first or second gesture signal comprises a vector signal.

25. (Currently Amended) The non-transitory computer readable medium of claim 23, wherein the first or second gesture signal comprises an on-screen signal.

26. (Currently Amended) The non-transitory computer readable medium of claim 23, wherein generating [[an]] a dynamic interaction parameter comprises generating [[an]] a dynamic interaction parameter from a difference between the first gesture signal and the second gesture signal.

27. (Currently Amended) The non-transitory computer readable medium of claim 23, wherein generating [[an]] a dynamic interaction parameter comprises generating [[an]] a dynamic interaction parameter using the first gesture signal and the second gesture signal and a physical model.

28. (Currently Amended) The non-transitory computer readable medium of claim 23, wherein generating [[an]] a dynamic interaction parameter comprises generating [[an]] a dynamic interaction parameter using the first gesture signal and the second gesture signal and an animation.

29. (Currently Amended) The non-transitory computer readable medium of claim 23, further comprising:

receiving a first device sensor signal;

receiving a second device sensor signal; and

wherein generating [[an]] a dynamic interaction parameter comprises generating [[an]] a dynamic interaction parameter using the first gesture signal and the second gesture signal and the first device sensor signal and the second device sensor signal.

30. (Currently Amended) The non-transitory computer readable medium of claim 23, wherein the first device sensor signal or the second device sensor signal comprises a signal selected from the list consisting of accelerometer, gyroscope, ambient, or virtual.

REMARKS

Reconsideration of this application as amended is respectfully requested. Claims 1-30 are pending and Claims 1, 4-7, 12, 15-18 and 23-30 are amended. No new matter is being added by way of this amendment.

TRACK 1 STATUS

Because the present application has been granted Track 1 status, the Examiner is respectfully requested to contact the undersigned by telephone before the next office action if such contact would further the examination of the present application.

REJECTION UNDER 35 U.S.C. § 101

The Examiner is rejecting Claims 23-33 under 35 U.S.C. § 101 as being directed to non-statutory subject matter. Applicants have amended Claims 23-30 to recite a non-transitory computer readable medium. Applicants respectfully submit that the invention according to amended Claims 23-30 is statutory subject matter and the rejection of the claims under 35 U.S.C. § 101 should be removed. Applicants note that Claims 31-33 are not pending in the present application.

REJECTION UNDER 35 U.S.C. § 102

The Examiner is rejecting Claims 1, 3, 5, 7-11, 14, 16, 18-22, 25, 27, and 29-30 under 35 U.S.C. 102(e) as being anticipated by Birnbaum et al., U. S. Patent App. No. 2010/0017489 (hereinafter "Birnbaum"). Applicants note that there is common inventorship between Birnbaum

and the present application and respectfully disagree. Applicants have amended Claims 1, 4-7, 12, 15-18 and 23-30 to recite a dynamic interaction parameter to produce haptic output.

As defined in the present application, a dynamic interaction parameter refers to a haptic effect that evolves over time as it responds to one or more input parameters (present application, paragraph [0027]). A dynamic interaction parameter can be any type of signal that is changing over time or reacting in real time, including a mapping schema which maps an input parameter onto a changing property of the effect signal (present application, paragraph [0028]). In the context of a dynamic interaction parameter, a mapping is a method to convert the sensed information into a haptic effect by modifying one or several haptic effect parameters (present application, paragraph [0028]). Based upon the one or more inputs from the one or more user gestures, a dynamic haptic effect is provided during the user gesture and continuously modified as determined by the dynamic interaction parameter (present application, paragraph [0060]). The dynamic haptic effect may speed up or slow down, increase or decrease in intensity, or change its pattern or duration, or change in any other way, in real-time according to such elements as the speed, direction, pressure, magnitude, or duration of the user gesture itself, or the speed, direction or duration of the user gesture initiated animation, or based on a changing property of a virtual object such as the number of times an image has been viewed (present application, paragraph [0060]). The effect of providing or modifying a dynamic haptic effect in real-time during and even after a user gesture is that no two gestures such as page turns or finger swipes will feel the same to the user (present application, paragraph [0060]). That is, the dynamic haptic effect will always be unique to the user gesture, thereby creating a greater sense connectedness to the device and a more nuanced and compelling user interface experience for the user as compared to a simple static haptic effect provided by a trigger event (present application, paragraph [0060]).

In contrast to the presently claimed invention which shares common inventorship with Birnbaum, Applicants respectfully submit that Birnbaum does not disclose or imply the use of a

dynamic interaction parameter to produce haptic output. Birnbaum describes systems and methods for haptic message transmission. For example, one disclosed method includes the steps of receiving a sensor signal from a sensor configured to sense a physical interaction with a messaging device, determining a virtual force based at least in part on the sensor signal, and applying the virtual force to a virtual message object within a virtual message environment (Birnbaum, paragraph [0004]). With the illustrative device, users can interact with the virtual message environment and/or virtual message objects by using the touch-screen and/or by manipulating the messaging device, for example, by rotating or shaking the device (Birnbaum, paragraph [0018]). The sensor detects the user's gesture and, based on this gesture, sends a sensor signal to the processor. The sensor may comprise: a gyroscope, an accelerometer, a GPS, or other sensor capable of detecting movement. The sensor may be configured to detect when a user moves or tilts the device (Birnbaum, paragraph [0019]). However, Birnbaum is silent with respect to a dynamic interaction parameter to produce haptic output as described and claimed in the present application.

An applicant is entitled to be his or her own lexicographer and may rebut the presumption that claim terms are to be given their ordinary and customary meaning by clearly setting forth a definition of the term that is different from its ordinary and customary meaning(s). MPEP § 2111.01(IV). Applicants respectfully submit that the definition of a dynamic interaction parameter in the specification and claims of the present application does not permit the Examiner to read the amended Claims 1, 3, 5, 7-11, 14, 16, 18-22, 25, 27, and 29-30 on to Birnbaum, and therefore the rejection under 35 U.S.C. § 102(e) has been overcome and should be removed.

REJECTION UNDER 35 U.S.C. § 103

The Examiner is rejecting Claims 2, 4, 6, 13, 15, 17, 24, 26 and 28 under 35 U.S.C. 103(a) as being unpatentable over Birnbaum in view of Westerman et al., U. S. Patent App. 2002/0015024 (hereinafter “Westerman”). Applicants respectfully disagree.

Birnbaum has been discussed above. Westerman describes gestures in the context of a method and apparatus for integrating manual input. For example, a method to capture coarse handwriting gestures without a stylus and without confusing them with pointing motions (Westerman, paragraph [0015]); producing gesture commands or multiple degree-of-freedom manipulation signals when the user slides two or more fingers across the surface (Westerman, paragraph [0043]); hand scaling or rotation gestures (Westerman, paragraph [0204]); enable three-dimensional manipulation with an intuitive gesture such as placing all five fingers on the surface, briefly tapping the palm heels on the surface, and finally resting the palm heels on the surface (Westerman, paragraph [0260]); one-shot command gestures (Westerman, paragraph [0291]); or a layout homing gesture (Westerman, paragraphs [0294-0296]). However, Westerman is silent with respect to a dynamic interaction parameter to produce haptic output as described and claimed in the present application.

Applicants respectfully submit that the definition of a dynamic interaction parameter in the specification and claims of the present application does not permit the Examiner to combine Birnbaum with Westerman to produce the invention of amended Claims 2, 4, 6, 13, 15, 17, 24, 26 and 28, and therefore one of ordinary skill in the art would not have been able to combine Birnbaum with Westerman to produce the presently claimed invention without undue experimentation and the rejection under 35 U.S.C. § 103(a) should be removed.

CONCLUSION

For at least the foregoing reasons, Applicants respectfully submit that the rejections have been overcome. Therefore, all pending claims are in condition for allowance, and reconsideration and allowance are requested.

Respectfully submitted,

IMMERSION CORPORATION

Dated: August 24, 2012

/Thomas A. Hassing/
Thomas A. Hassing
Reg. No. 36,159

30 Rio Robles
San Jose, CA 95134
(408) 467-1900

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Application of:)	
)	
David Birnbaum et al.	)	Examiner: Sitta, Grant
)	
Application No. 13/472,698	)	Art Unit: 2629
)	
Filed: May 16, 2012)	
	)	Confirmation No. 6404
For: METHOD AND APPARATUS FOR)	
PRODUCING A DYNAMIC HAPTIC)	
EFFECT)	
)	

Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

AMENDMENT AND RESPONSE UNDER 37 CFR § 1.111

Sir:

In response to the Office Action mailed July 9, 2012, Applicants respectfully request the Examiner enter the following amendments and consider the following remarks.

CERTIFICATE OF ELECTRONIC FILING

I hereby certify that this correspondence is being deposited via electronic filing through the United States Patent and Trademark Electronic Filing System on:

August 24, 2012
Date of Deposit

Dawn Rose
(Type or print name of person mailing paper)

/Dawn Rose/
(Signature of person mailing paper)

August 24, 2012
Date

AMENDMENTS TO THE CLAIMS

1. (Currently Amended) A method of producing a haptic effect comprising:
receiving a first gesture signal;
receiving a second gesture signal;
generating [[an]] a dynamic interaction parameter using the first gesture signal and the second gesture signal; and
applying a drive signal to a haptic output device according to the dynamic interaction parameter.
2. (Original) The method of claim 1 wherein the first or second gesture signal comprises a vector signal.
3. (Original) The method of claim 1 wherein the first or second gesture signal comprises an on-screen signal.
4. (Currently Amended) The method of claim 1 wherein generating [[an]] a dynamic interaction parameter comprises generating [[an]] a dynamic interaction parameter from a difference between the first gesture signal and the second gesture signal.
5. (Currently Amended) The method of claim 1 wherein generating [[an]] a dynamic interaction parameter comprises generating [[an]] a dynamic interaction parameter using the first gesture signal and the second gesture signal and a physical model.

6. (Currently Amended) The method of claim 1 wherein generating [[an]] a dynamic interaction parameter comprises generating [[an]] a dynamic interaction parameter using the first gesture signal and the second gesture signal and an animation.

7. (Currently Amended) The method of claim 1 further comprising:
receiving a first device sensor signal;
receiving a second device sensor signal; and
wherein generating [[an]] a dynamic interaction parameter comprises generating [[an]] a dynamic interaction parameter using the first gesture signal and the second gesture signal and the first device sensor signal and the second device sensor signal.

8. (Original) The method of claim 1 wherein the first device sensor signal or the second device sensor signal comprises an accelerometer signal.

9. (Original) The method of claim 1 wherein the first device sensor signal or the second device sensor signal comprises a gyroscope signal.

10. (Original) The method of claim 1 wherein the first device sensor signal or the second device sensor signal comprises an ambient signal.

11. (Original) The method of claim 1 wherein the first device sensor signal or the second device sensor signal comprises a virtual sensor signal.

12. (Currently Amended) A haptic effect enabled system comprising:
a haptic output device;

a drive module electronically coupled to the haptic output device for receiving a first gesture signal, receiving a second gesture signal, and generating [[an]] a dynamic interaction parameter using the first gesture signal and the second gesture signal; and

a drive circuit electronically coupled to the drive module and the haptic output device for applying a drive signal to the haptic output device according to the dynamic interaction parameter.

13. (Original) The system of claim 12 wherein the first or second gesture signal comprises a vector signal.

14. (Original) The system of claim 12 wherein the first or second gesture signal comprises an on-screen signal.

15. (Currently Amended) The system of claim 12 wherein the drive module comprises a drive module for generating [[an]] a dynamic interaction parameter from a difference between the first gesture signal and the second gesture signal.

16. (Currently Amended) The system of claim 12 wherein the drive module comprises a drive module for generating [[an]] a dynamic interaction parameter using the first gesture signal and the second gesture signal and a physical model.

17. (Currently Amended) The system of claim 12 wherein the drive module comprises a drive module for generating [[an]] a dynamic interaction parameter using the first gesture signal and the second gesture signal and an animation.

18. (Currently Amended) The system of claim 12 wherein the drive module comprises a drive module for receiving a first device sensor signal, receiving a second device sensor signal, and generating [[an]] a dynamic interaction parameter using the first gesture signal and the second gesture signal and the first device sensor signal and the second device sensor signal.

19. (Original) The system of claim 12 wherein the first device sensor signal or the second device sensor signal comprises an accelerometer signal.

20. (Original) The system of claim 12 wherein the first device sensor signal or the second device sensor signal comprises a gyroscope signal.

21. (Original) The system of claim 12 wherein the first device sensor signal or the second device sensor signal comprises an ambient signal.

22. (Original) The system of claim 12 wherein the first device sensor signal or the second device sensor signal comprises a virtual sensor signal.

23. (Currently Amended) A non-transitory computer readable medium having instructions stored thereon that, when executed by a processor, causes the processor to produce a haptic effect, the instructions comprising:

- receiving a first gesture signal;
- receiving a second gesture signal;
- generating [[an]] a dynamic interaction parameter using the first gesture signal and the second gesture signal; and

applying a drive signal to a haptic output device according to the dynamic interaction parameter.

24. (Currently Amended) The non-transitory computer readable medium of claim 23, wherein the first or second gesture signal comprises a vector signal.

25. (Currently Amended) The non-transitory computer readable medium of claim 23, wherein the first or second gesture signal comprises an on-screen signal.

26. (Currently Amended) The non-transitory computer readable medium of claim 23, wherein generating [[an]] a dynamic interaction parameter comprises generating [[an]] a dynamic interaction parameter from a difference between the first gesture signal and the second gesture signal.

27. (Currently Amended) The non-transitory computer readable medium of claim 23, wherein generating [[an]] a dynamic interaction parameter comprises generating [[an]] a dynamic interaction parameter using the first gesture signal and the second gesture signal and a physical model.

28. (Currently Amended) The non-transitory computer readable medium of claim 23, wherein generating [[an]] a dynamic interaction parameter comprises generating [[an]] a dynamic interaction parameter using the first gesture signal and the second gesture signal and an animation.

29. (Currently Amended) The non-transitory computer readable medium of claim 23, further comprising:

receiving a first device sensor signal;

receiving a second device sensor signal; and

wherein generating [[an]] a dynamic interaction parameter comprises generating [[an]] a dynamic interaction parameter using the first gesture signal and the second gesture signal and the first device sensor signal and the second device sensor signal.

30. (Currently Amended) The non-transitory computer readable medium of claim 23, wherein the first device sensor signal or the second device sensor signal comprises a signal selected from the list consisting of accelerometer, gyroscope, ambient, or virtual.

REMARKS

Reconsideration of this application as amended is respectfully requested. Claims 1-30 are pending and Claims 1, 4-7, 12, 15-18 and 23-30 are amended. No new matter is being added by way of this amendment.

TRACK 1 STATUS

Because the present application has been granted Track 1 status, the Examiner is respectfully requested to contact the undersigned by telephone before the next office action if such contact would further the examination of the present application.

REJECTION UNDER 35 U.S.C. § 101

The Examiner is rejecting Claims 23-33 under 35 U.S.C. § 101 as being directed to non-statutory subject matter. Applicants have amended Claims 23-30 to recite a non-transitory computer readable medium. Applicants respectfully submit that the invention according to amended Claims 23-30 is statutory subject matter and the rejection of the claims under 35 U.S.C. § 101 should be removed. Applicants note that Claims 31-33 are not pending in the present application.

REJECTION UNDER 35 U.S.C. § 102

The Examiner is rejecting Claims 1, 3, 5, 7-11, 14, 16, 18-22, 25, 27, and 29-30 under 35 U.S.C. 102(e) as being anticipated by Birnbaum et al., U. S. Patent App. No. 2010/0017489 (hereinafter "Birnbaum"). Applicants note that there is common inventorship between Birnbaum

and the present application and respectfully disagree. Applicants have amended Claims 1, 4-7, 12, 15-18 and 23-30 to recite a dynamic interaction parameter to produce haptic output.

As defined in the present application, a dynamic interaction parameter refers to a haptic effect that evolves over time as it responds to one or more input parameters (present application, paragraph [0027]). A dynamic interaction parameter can be any type of signal that is changing over time or reacting in real time, including a mapping schema which maps an input parameter onto a changing property of the effect signal (present application, paragraph [0028]). In the context of a dynamic interaction parameter, a mapping is a method to convert the sensed information into a haptic effect by modifying one or several haptic effect parameters (present application, paragraph [0028]). Based upon the one or more inputs from the one or more user gestures, a dynamic haptic effect is provided during the user gesture and continuously modified as determined by the dynamic interaction parameter (present application, paragraph [0060]). The dynamic haptic effect may speed up or slow down, increase or decrease in intensity, or change its pattern or duration, or change in any other way, in real-time according to such elements as the speed, direction, pressure, magnitude, or duration of the user gesture itself, or the speed, direction or duration of the user gesture initiated animation, or based on a changing property of a virtual object such as the number of times an image has been viewed (present application, paragraph [0060]). The effect of providing or modifying a dynamic haptic effect in real-time during and even after a user gesture is that no two gestures such as page turns or finger swipes will feel the same to the user (present application, paragraph [0060]). That is, the dynamic haptic effect will always be unique to the user gesture, thereby creating a greater sense connectedness to the device and a more nuanced and compelling user interface experience for the user as compared to a simple static haptic effect provided by a trigger event (present application, paragraph [0060]).

In contrast to the presently claimed invention which shares common inventorship with Birnbaum, Applicants respectfully submit that Birnbaum does not disclose or imply the use of a

dynamic interaction parameter to produce haptic output. Birnbaum describes systems and methods for haptic message transmission. For example, one disclosed method includes the steps of receiving a sensor signal from a sensor configured to sense a physical interaction with a messaging device, determining a virtual force based at least in part on the sensor signal, and applying the virtual force to a virtual message object within a virtual message environment (Birnbaum, paragraph [0004]). With the illustrative device, users can interact with the virtual message environment and/or virtual message objects by using the touch-screen and/or by manipulating the messaging device, for example, by rotating or shaking the device (Birnbaum, paragraph [0018]). The sensor detects the user's gesture and, based on this gesture, sends a sensor signal to the processor. The sensor may comprise: a gyroscope, an accelerometer, a GPS, or other sensor capable of detecting movement. The sensor may be configured to detect when a user moves or tilts the device (Birnbaum, paragraph [0019]). However, Birnbaum is silent with respect to a dynamic interaction parameter to produce haptic output as described and claimed in the present application.

An applicant is entitled to be his or her own lexicographer and may rebut the presumption that claim terms are to be given their ordinary and customary meaning by clearly setting forth a definition of the term that is different from its ordinary and customary meaning(s). MPEP § 2111.01(IV). Applicants respectfully submit that the definition of a dynamic interaction parameter in the specification and claims of the present application does not permit the Examiner to read the amended Claims 1, 3, 5, 7-11, 14, 16, 18-22, 25, 27, and 29-30 on to Birnbaum, and therefore the rejection under 35 U.S.C. § 102(e) has been overcome and should be removed.

REJECTION UNDER 35 U.S.C. § 103

The Examiner is rejecting Claims 2, 4, 6, 13, 15, 17, 24, 26 and 28 under 35 U.S.C. 103(a) as being unpatentable over Birnbaum in view of Westerman et al., U. S. Patent App. 2002/0015024 (hereinafter “Westerman”). Applicants respectfully disagree.

Birnbaum has been discussed above. Westerman describes gestures in the context of a method and apparatus for integrating manual input. For example, a method to capture coarse handwriting gestures without a stylus and without confusing them with pointing motions (Westerman, paragraph [0015]); producing gesture commands or multiple degree-of-freedom manipulation signals when the user slides two or more fingers across the surface (Westerman, paragraph [0043]); hand scaling or rotation gestures (Westerman, paragraph [0204]); enable three-dimensional manipulation with an intuitive gesture such as placing all five fingers on the surface, briefly tapping the palm heels on the surface, and finally resting the palm heels on the surface (Westerman, paragraph [0260]); one-shot command gestures (Westerman, paragraph [0291]); or a layout homing gesture (Westerman, paragraphs [0294-0296]). However, Westerman is silent with respect to a dynamic interaction parameter to produce haptic output as described and claimed in the present application.

Applicants respectfully submit that the definition of a dynamic interaction parameter in the specification and claims of the present application does not permit the Examiner to combine Birnbaum with Westerman to produce the invention of amended Claims 2, 4, 6, 13, 15, 17, 24, 26 and 28, and therefore one of ordinary skill in the art would not have been able to combine Birnbaum with Westerman to produce the presently claimed invention without undue experimentation and the rejection under 35 U.S.C. § 103(a) should be removed.

CONCLUSION

For at least the foregoing reasons, Applicants respectfully submit that the rejections have been overcome. Therefore, all pending claims are in condition for allowance, and reconsideration and allowance are requested.

Respectfully submitted,

IMMERSION CORPORATION

Dated: August 24, 2012

/Thomas A. Hassing/
Thomas A. Hassing
Reg. No. 36,159

30 Rio Robles
San Jose, CA 95134
(408) 467-1900

Electronic Acknowledgement Receipt

EFS ID:	13581716
Application Number:	13472698
International Application Number:	
Confirmation Number:	6404
Title of Invention:	METHOD AND APPARATUS FOR PRODUCING A DYNAMIC HAPTIC EFFECT
First Named Inventor/Applicant Name:	David BIRNBAUM
Customer Number:	103772
Filer:	Catherine C. Maresh/Dawn Rose
Filer Authorized By:	Catherine C. Maresh
Attorney Docket Number:	IMM389C1
Receipt Date:	24-AUG-2012
Filing Date:	16-MAY-2012
Time Stamp:	13:42:03
Application Type:	Utility under 35 USC 111(a)

Payment information:

Submitted with Payment	no
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File Listing:

Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
1	Amendment/Req. Reconsideration-After Non-Final Reject	IMM389C1Responseto2012-07-09OAFINAL.pdf	48665 <small>cd59eff8da745f52bef60abe0d004a393db3551e</small>	no	12

Warnings:

Information:

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New Applications Under 35 U.S.C. 111

If a new application is being filed and the application includes the necessary components for a filing date (see 37 CFR 1.53(b)-(d) and MPEP 506), a Filing Receipt (37 CFR 1.54) will be issued in due course and the date shown on this Acknowledgement Receipt will establish the filing date of the application.

National Stage of an International Application under 35 U.S.C. 371

If a timely submission to enter the national stage of an international application is compliant with the conditions of 35 U.S.C. 371 and other applicable requirements a Form PCT/DO/EO/903 indicating acceptance of the application as a national stage submission under 35 U.S.C. 371 will be issued in addition to the Filing Receipt, in due course.

New International Application Filed with the USPTO as a Receiving Office

If a new international application is being filed and the international application includes the necessary components for an international filing date (see PCT Article 11 and MPEP 1810), a Notification of the International Application Number and of the International Filing Date (Form PCT/RO/105) will be issued in due course, subject to prescriptions concerning national security, and the date shown on this Acknowledgement Receipt will establish the international filing date of the application.

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PATENT APPLICATION FEE DETERMINATION RECORD Substitute for Form PTO-875					Application or Docket Number 13/472,698		Filing Date 05/16/2012		<input type="checkbox"/> To be Mailed							
APPLICATION AS FILED – PART I																
(Column 1)			(Column 2)			SMALL ENTITY <input type="checkbox"/>		OR			OTHER THAN SMALL ENTITY					
FOR		NUMBER FILED	NUMBER EXTRA		RATE (\$)	FEE (\$)	OR		RATE (\$)	FEE (\$)						
<input type="checkbox"/> BASIC FEE (37 CFR 1.16(a), (b), or (c))		N/A	N/A		N/A				N/A							
<input type="checkbox"/> SEARCH FEE (37 CFR 1.16(k), (i), or (m))		N/A	N/A		N/A		OR		N/A							
<input type="checkbox"/> EXAMINATION FEE (37 CFR 1.16(o), (p), or (q))		N/A	N/A		N/A		OR		N/A							
TOTAL CLAIMS (37 CFR 1.16(i))		minus 20 =	*		X \$ =		OR		X \$ =							
INDEPENDENT CLAIMS (37 CFR 1.16(h))		minus 3 =	*		X \$ =		OR		X \$ =							
<input type="checkbox"/> APPLICATION SIZE FEE (37 CFR 1.16(s))		If the specification and drawings exceed 100 sheets of paper, the application size fee due is \$250 (\$125 for small entity) for each additional 50 sheets or fraction thereof. See 35 U.S.C. 41(a)(1)(G) and 37 CFR 1.16(s).														
<input type="checkbox"/> MULTIPLE DEPENDENT CLAIM PRESENT (37 CFR 1.16(j))																
* If the difference in column 1 is less than zero, enter "0" in column 2.																
APPLICATION AS AMENDED – PART II										SMALL ENTITY		OR		OTHER THAN SMALL ENTITY		
(Column 1)			(Column 2)			(Column 3)			RATE (\$)		ADDITIONAL FEE (\$)		RATE (\$)		ADDITIONAL FEE (\$)	
AMENDMENT	08/24/2012		CLAIMS REMAINING AFTER AMENDMENT		HIGHEST NUMBER PREVIOUSLY PAID FOR	PRESENT EXTRA	X \$ =		OR		X \$60=		0			
	Total (37 CFR 1.16(i))		* 30	Minus	** 30	= 0	X \$ =		OR		X \$250=		0			
	Independent (37 CFR 1.16(h))		* 3	Minus	***3	= 0			OR							
	<input type="checkbox"/> Application Size Fee (37 CFR 1.16(s))															
	<input type="checkbox"/> FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM (37 CFR 1.16(j))															
							TOTAL ADD'L FEE		OR		TOTAL ADD'L FEE		0			
AMENDMENT			CLAIMS REMAINING AFTER AMENDMENT		HIGHEST NUMBER PREVIOUSLY PAID FOR	PRESENT EXTRA	X \$ =		OR		X \$ =					
	Total (37 CFR 1.16(i))		*	Minus	**	=	X \$ =		OR		X \$ =					
	Independent (37 CFR 1.16(h))		*	Minus	***	=			OR							
	<input type="checkbox"/> Application Size Fee (37 CFR 1.16(s))															
	<input type="checkbox"/> FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM (37 CFR 1.16(j))															
							TOTAL ADD'L FEE		OR		TOTAL ADD'L FEE					
* If the entry in column 1 is less than the entry in column 2, write "0" in column 3.																
** If the "Highest Number Previously Paid For" IN THIS SPACE is less than 20, enter "20".																
*** If the "Highest Number Previously Paid For" IN THIS SPACE is less than 3, enter "3".																
The "Highest Number Previously Paid For" (Total or Independent) is the highest number found in the appropriate box in column 1.																
										Legal Instrument Examiner: /TRINA STEPTOE/						

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APPLICATION NUMBER	FILING OR 371(C) DATE	FIRST NAMED APPLICANT	ATTY. DOCKET NO./TITLE
13/472,698	05/16/2012	David BIRNBAUM	IMM389C1

CONFIRMATION NO. 6404

103772
Immersion Corporation
30 Rio Robles
San Jose, CA 95134

PUBLICATION NOTICE



Title:METHOD AND APPARATUS FOR PRODUCING A DYNAMIC HAPTIC EFFECT

Publication No.US-2012-0223880-A1

Publication Date:09/06/2012

NOTICE OF PUBLICATION OF APPLICATION

The above-identified application will be electronically published as a patent application publication pursuant to 37 CFR 1.211, et seq. The patent application publication number and publication date are set forth above.

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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
13/472,698	05/16/2012	David BIRNBAUM	IMM389C1	6404
103772	7590	11/28/2012	EXAMINER	
Immersion Corporation 30 Rio Robles San Jose, CA 95134			SITTA, GRANT	
			ART UNIT	PAPER NUMBER
			2694	
			MAIL DATE	DELIVERY MODE
			11/28/2012	PAPER

Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

DETAILED ACTION

Claim Rejections - 35 USC § 102

1. The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

A person shall be entitled to a patent unless –

(e) the invention was described in (1) an application for patent, published under section 122(b), by another filed in the United States before the invention by the applicant for patent or (2) a patent granted on an application for patent by another filed in the United States before the invention by the applicant for patent, except that an international application filed under the treaty defined in section 351(a) shall have the effects for purposes of this subsection of an application filed in the United States only if the international application designated the United States and was published under Article 21(2) of such treaty in the English language.

2. Claims 1, 3, 5, 7-11, 14, 16, 18-22, 25, 27, and 29-30 are rejected under 35 U.S.C. 102(e) as being anticipated by Birnbaum et al 2010/0017489, hereinafter Birnbaum.

3. In regards to claim 1, Birnbaum teaches a method of producing a haptic effect comprising (abstract):

receiving a first gesture signal [0032, 0074-0076];

receiving a second gesture signal (fig. 1 (114) “sensors”);

generating a dynamic [0069-0070] (fig. 3 (309)s) interaction parameter using the first gesture signal and the second gesture signal ([0032-0033] for example tilt and acceleration) ; and Examiner notes, [0030] of the current specification that defines a “gesture”. A simple gesture may be a touch, or “finger on” gesture and lifting the “finger off”, could be a second gesture. Therefore, a simple touch and release is two gestures.

applying a drive signal to a haptic actuator according to the dynamic interaction parameter [0036] (fig. 1 (118)).

4. In regards to claim 12, Birnbaum teaches a haptic effect enabled system comprising (abstract):

a haptic actuator [0032, 0074-0076];

a drive module electronically coupled to the actuator for receiving a first gesture signal (fig. 1 (114) "sensors");

receiving a second gesture signal, and generating a dynamic [0069-0070] (fig. 3 (309)s) interaction parameter using the first gesture signal and the second gesture signal ([0032-0033] for example tilt and acceleration) and

a drive circuit electronically coupled to the drive module and the actuator for applying a drive signal to the actuator according to the dynamic interaction parameter [0036] (fig. 1 (118)).

5. In regards to claim 23, Birnbaum teaches a non-transitory computer readable medium having instructions stored thereon that, when executed by a processor, causes the processor to produce a haptic effect, the instructions comprising (abstract):

receiving a first gesture signal [0032, 0074-0076];

receiving a second gesture signal (fig. 1 (114) "sensors");

generating a dynamic [0069-0070] (fig. 3 (309)s) interaction parameter using the first gesture signal and the second gesture signal ([0031-0033] for example tilt and acceleration) and

applying a drive signal to a haptic actuator according to the dynamic interaction parameter [0036] (fig. 1 (118)).

6. In regards to claims 3, 14, and 25 Birnbaum teaches the method of claim 1 wherein the first or second gesture signal comprises an on-screen signal (fig. 5a and 5b (520 and 530))

7. In regards to claim 5, 16, and 27 Birnbaum fails to teach the method of claim 1 wherein generating a dynamic interaction parameter comprises generating a dynamic interaction parameter using the first gesture signal and the second gesture signal and a physical model [0025].

8. In regards to claims 7, 18 and 29, Birnbaum teaches the method of claim 1 further comprising (abstract):

receiving a first device sensor signal [0030];

receiving a second device sensor signal (fig. 3b 302); and

wherein generating a dynamic interaction parameter comprises generating a dynamic interaction parameter using the first gesture signal and the second gesture

signal and the first device sensor signal and the second device sensor signal [0029-0032].

9. In regards to claims 8, 19, and 30 Birnbaum teaches the method of claim 1 wherein the first device sensor signal or the second device sensor signal comprises an accelerometer signal [0019].

10. In regards to claim 9, and 20 Birnbaum teaches the method of claim 1 wherein the first device sensor signal or the second device sensor signal comprises a gyroscope signal.[0019]

11. In regards to claim 10 and 21 Birnbaum teaches the method of claim 1 wherein the first device sensor signal or the second device sensor signal comprises an ambient signal.[0019]

12. In regards to claim 11 and 22 Birnbaum teaches the method of claim 1 wherein the first device sensor signal or the second device sensor signal comprises a virtual sensor signal [0019].

Claim Rejections - 35 USC § 103

13. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

Art Unit: 2694

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

14. The factual inquiries set forth in *Graham v. John Deere Co.*, 383 U.S. 1, 148

USPQ 459 (1966), that are applied for establishing a background for determining

obviousness under 35 U.S.C. 103(a) are summarized as follows:

1. Determining the scope and contents of the prior art.
2. Ascertaining the differences between the prior art and the claims at issue.
3. Resolving the level of ordinary skill in the pertinent art.
4. Considering objective evidence present in the application indicating obviousness or nonobviousness.

15. Claims 2,4, 6, 13, 15, 17, 24, 26 and 28 are rejected under 35 U.S.C. 103(a) as

being unpatentable over Birnbaum in view of Westerman et al (2002/0015024)

hereinafter, Westerman.

16. In regards to claims 2, 13, and 24 Birnbaum fails to teach the method of claim 1

wherein the first or second gesture signal comprises a vector signal.

However, Westerman teaches wherein the first or second gesture signal comprises a vector signal [0041-0042, 180, 203-205, 208, 233, 257, and 261].

It would have been obvious to one of ordinary skill in the art to modify the sensing means of Birnbaum to further include wherein the first or second gesture signal comprises a vector signal as taught by Westerman in order to determine roll, tilt, and direction [0261].

17. In regards to claim 4, 15, and 26 Birnbaum fails to teach the method of claim 1 wherein generating a dynamic interaction parameter comprises generating a dynamic interaction parameter from a difference between the first gesture signal and the second gesture signal.

However, Westerman teaches wherein generating a dynamic interaction parameter comprises generating a dynamic interaction parameter from a difference between the first gesture signal and the second gesture signal [00261].

It would have been obvious to one of ordinary skill in the art to modify the sensing means of Birnbaum to further include herein generating a dynamic interaction parameter comprises generating a dynamic interaction parameter from a difference between the first gesture signal and the second gesture signal as taught by Westerman in order to determine roll, tilt, and direction [0261].

18. In regards to claim 6, 17, and 28 Birnbaum fails to teach the method of claim 1 wherein generating a dynamic interaction parameter comprises generating a dynamic interaction parameter using the first gesture signal and the second gesture signal and an animation.

However, Westerman teaches wherein generating a dynamic interaction parameter comprises generating a dynamic interaction parameter using the first gesture signal and the second gesture signal and an animation (fig. 13 (201-208)).

It would have been obvious to one of ordinary skill to modify the interaction parameter of Birnbaum to use wherein generating a dynamic interaction parameter

comprises generating a dynamic interaction parameter using the first gesture signal and the second gesture signal and an animation as taught by Westerman in order to provide interaction of hand contacts [00128-00129].

Response to Arguments

1. Applicant's arguments filed 8/24/2012 have been fully considered but they are not persuasive.

MPEP 2111 III states, III. "PLAIN MEANING" REFERS TO THE ORDINARY AND CUSTOMARY MEANING GIVEN TO THE TERM BY THOSE OF ORDINARY SKILL IN THE ART. "[T]he ordinary and customary meaning of a claim term is the meaning that the term would have to a person of ordinary skill in the art in question at the time of the invention, i.e., as of the effective filing date of the patent application." Phillips v. AWH Corp., 415 F.3d 1303, 1313, 75 USPQ2d 1321, 1326 (Fed. Cir. 2005) (en banc); Sunrace Roots Enter. Co. v. SRAM Corp., 336 F.3d 1298, 1302, 67 USPQ2d 1438, 1441 (Fed. Cir. 2003); Brookhill-Wilk 1, LLC v. Intuitive Surgical, Inc., 334 F.3d 1294, 1298 67 USPQ2d 1132, 1136 (Fed. Cir. 2003)("In the absence of an express intent to impart a novel meaning to the claim terms, the words are presumed to take on the ordinary and customary meanings attributed to them by those of ordinary skill in the art.")

2. Applicant contends that a dynamic interaction parameter refers to a haptic effect that evolves over times as it responds to one or more input parameters (see [0027]).

3. Para [0027] states:

[0027] As described below, a dynamic haptic effect refers to a haptic effect that evolves over time as it responds to one or more input parameters. Dynamic haptic effects are haptic or vibrotactile effects displayed on haptic devices to represent a change in state of a given input signal. The input signal can be a signal captured by sensors on the device with haptic feedback, such as position, acceleration, pressure, orientation, or proximity, or signals captured by other devices and sent to the haptic device to influence the generation of the haptic effect.

Examiner would interpret the dynamic as modifying the haptic effect and not the input parameters and certainly not defining an “interaction parameter.” As a result, examiner would contend that “dynamic interaction parameter” is not expressly defined in the specification and in the absence of an express intent to impart a novel meaning to the claim terms, the words are presumed to take on the ordinary and customary meanings attributed to them by those of ordinary skill in the art.

Therefore, as an example, Birnbaum is said to teach a dynamic interaction parameter in fig. 5a and fig. 5b. Birnbaum engages a virtual object (520) by first touching, i.e., a first gesture, and a second gesture is illustrated in the dragging in the direction of the arrow in fig. 5b (530). The dynamic interaction parameter is the changing signals, i.e., differences between a touch and a drag; these changing interaction parameters produce with respect to their haptic outputs over a time period.

Conclusion

Applicant's amendment necessitated the new ground(s) of rejection presented in this Office action. Accordingly, **THIS ACTION IS MADE FINAL**. See MPEP

§ 706.07(a). Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).


A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is filed within TWO MONTHS of the mailing date of this final action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the date of this final action.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to GRANT SITTA whose telephone number is (571)270-1542. The examiner can normally be reached on M-F 9-6.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Alexander Beck can be reached on 571-272-7765. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

/Grant D Sitta/
Primary Examiner, Art Unit 2694

Search Notes 	Application/Control No. 13472698	Applicant(s)/Patent Under Reexamination BIRNBAUM ET AL.
	Examiner GRANT SITTA	Art Unit 2629

SEARCHED			
Class	Subclass	Date	Examiner
345	173	7/5/2012	GS
345	173	11/26/2012	GS

SEARCH NOTES		
Search Notes	Date	Examiner
Searched EAST (USPGPUB, USPAT, USOCR, FPRS, EPO, JPO, DERWENT, IBM)	7/5/2012	GS
Searched EAST (USPGPUB, USPAT, USOCR, FPRS, EPO, JPO, DERWENT, IBM)	11/26/2012	GS

INTERFERENCE SEARCH			
Class	Subclass	Date	Examiner

	/GRANT SITTA/ Primary Examiner. Art Unit 2629
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EAST Search History

EAST Search History (Prior Art)

Ref #	Hits	Search Query	DBs	Default Operator	Plurals	Time Stamp
L1	1	"20100017489"	US-PGPUB; USPAT	OR	OFF	2012/11/26 11:05
L2	1	"13472698"	US-PGPUB; USPAT	OR	OFF	2012/11/26 11:07
L3	48	((DAVID) near2 (BIRNBAUM)).INV.	US-PGPUB; USPAT	OR	OFF	2012/11/26 11:18
L4	69	((JUAN) near2 (CRUZ-HERNANDEZ)).INV.	US-PGPUB; USPAT	OR	OFF	2012/11/26 11:19
L5	132	((DANNY) near2 (GRANT)).INV.	US-PGPUB; USPAT	OR	OFF	2012/11/26 11:19
L6	12	((CHRIS) near2 (ULLRICH)).INV.	US-PGPUB; USPAT	OR	OFF	2012/11/26 11:19
L7	1048	dynamic same gesture	US-PGPUB; USPAT	OR	OFF	2012/11/26 11:19
L8	432	dynamic same gesture and "345"/\$5.ccls.	US-PGPUB; USPAT	OR	OFF	2012/11/26 11:22
L9	159	("4641349" | "4843568" | "5148477" | "5454043" | "5548659" | "5570113" | "5577179" | "5581276" | "5594469").PN. OR ("6072494").URPN.	US-PGPUB; USPAT; USOCR	OR	OFF	2012/11/26 11:59
L10	323	("20020015024" "20020118848" "20030006974" "20030076301" "20030076303" "20030076306" "20030095095" "20030095096" "20030098858" "20030206202" "20030234768" "20030234770" "20040227736" "20040263484" "20050007349" "20050012723" "20050052425" "20050083307" "20050104867" "20050110768" "20050146511" "20060022955" "20060022956" "20060026521" "20060026535" "20060026536" "20060032680" "20060033724" "20060053387" "20060066582" "20060085757" "20060097991" "20060197753" "3333160" "3541541" "3662105" "3798370" "4246452" "4550221" "4672364" "4672558" "4692809" "4695827" "4733222" "4734685" "4746770" "4771276" "4788384" "4806846" "4898555" "4914624" "4968877" "5003519" "5017030" "5178477" "5189403" "5194862" "5224861" "5241308" "5252951" "5281966" "5305017" "5345543" "5376948" "5398310" "5442742" "5463388" "5463696" "5483261" "5488204" "5495077" "5513309" "5523775"	US-PGPUB; USPAT; USOCR	OR	OFF	2012/11/26 12:00

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L13	958	(dynamic chang\$4) same haptic and "345"/\$5.ccls.	US-PGPUB; USPAT; USOCR	OR	OFF	2012/11/26 12:07
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S3	119	((DANNY) near2 (GRANT)).INV.	US-PGPUB; USPAT	OR	OFF	2012/06/29 11:18
S4	8	((CHRIS) near2 (ULLRICH)).INV.	US-PGPUB; USPAT	OR	OFF	2012/06/29 11:18
S5	3555	345/156.ccls.	USPAT	OR	OFF	2012/06/29 11:18
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EAST Search History

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S12	260	dynamic near3 haptic	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2012/06/29 14:08
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EAST Search History

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S22	1385803	first same second same signal	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2012/07/05 10:26

EAST Search History

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S26	7	combin\$4 same sensor same haptic and 345/173.ccls.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2012/07/05 10:37
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EAST Search History


"20090154138" "20090284397"	FPRS;		
"20100134431" "20100137033"	EPO; JPO;		
"20100141587").PN.	DERWENT;		
	IBM_TDB		

EAST Search History (Interference)

< This search history is empty >

11/ 26/ 2012 12:09:29 PM

C:\ Users\ gsitta\ Documents\ EAST\ Workspaces\ 13472698.wsp

Index of Claims 	Application/Control No. 13472698	Applicant(s)/Patent Under Reexamination BIRNBAUM ET AL.
	Examiner GRANT SITTA	Art Unit 2629

✓	Rejected
=	Allowed

-	Cancelled
÷	Restricted

N	Non-Elected
I	Interference

A	Appeal
O	Objected

Claims renumbered in the same order as presented by applicant
 CPA
 T.D.
 R.1.47

CLAIM		DATE							
Final	Original	07/05/2012	11/26/2012						
	1	✓	✓						
	2	✓	✓						
	3	✓	✓						
	4	✓	✓						
	5	✓	✓						
	6	✓	✓						
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	27	✓	✓						
	28	✓	✓						
	29	✓	✓						
	30	✓	✓						

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Application of:)	
)	
David Birnbaum et al.	)	Examiner: Sitta, Grant
)	
Application No. 13/472,698	)	Art Unit: 2629
)	
Filed: May 16, 2012)	
	)	Confirmation No. 6404
For: METHOD AND APPARATUS FOR)	
PRODUCING A DYNAMIC HAPTIC)	
EFFECT)	
)	

Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

AMENDMENT AND RESPONSE UNDER 37 CFR § 1.116

Sir:

In response to the Office Action mailed November 28, 2012, Applicants respectfully request the Examiner enter the following amendments and consider the following remarks.

CERTIFICATE OF ELECTRONIC FILING

I hereby certify that this correspondence is being deposited via electronic filing through the United States Patent and Trademark Electronic Filing System on:

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(Signature of person mailing paper)

_____ December 10, 2012 _____
Date

AMENDMENTS TO THE CLAIMS

1. (Currently Amended) A method of producing a haptic effect comprising:
receiving a first gesture signal;
receiving a second gesture signal;
generating a dynamic interaction parameter representing a haptic effect that evolves over time as it responds to one or more input parameters using the first gesture signal and the second gesture signal; and
applying a drive signal to a haptic output device for continuously modifying the haptic effect according to the dynamic interaction parameter.
2. (Original) The method of claim 1 wherein the first or second gesture signal comprises a vector signal.
3. (Original) The method of claim 1 wherein the first or second gesture signal comprises an on-screen signal.
4. (Previously presented) The method of claim 1 wherein generating a dynamic interaction parameter comprises generating a dynamic interaction parameter from a difference between the first gesture signal and the second gesture signal.
5. (Previously presented) The method of claim 1 wherein generating a dynamic interaction parameter comprises generating a dynamic interaction parameter using the first gesture signal and the second gesture signal and a physical model.

6. (Previously presented) The method of claim 1 wherein generating a dynamic interaction parameter comprises generating a dynamic interaction parameter using the first gesture signal and the second gesture signal and an animation.

7. (Previously presented) The method of claim 1 further comprising:
receiving a first device sensor signal;
receiving a second device sensor signal; and
wherein generating a dynamic interaction parameter comprises generating a dynamic interaction parameter using the first gesture signal and the second gesture signal and the first device sensor signal and the second device sensor signal.

8. (Original) The method of claim 1 wherein the first device sensor signal or the second device sensor signal comprises an accelerometer signal.

9. (Original) The method of claim 1 wherein the first device sensor signal or the second device sensor signal comprises a gyroscope signal.

10. (Original) The method of claim 1 wherein the first device sensor signal or the second device sensor signal comprises an ambient signal.

11. (Original) The method of claim 1 wherein the first device sensor signal or the second device sensor signal comprises a virtual sensor signal.

12. (Currently Amended) A haptic effect enabled system comprising:
a haptic output device;

a drive module electronically coupled to the haptic output device for receiving a first gesture signal, receiving a second gesture signal, and generating a dynamic interaction parameter representing a haptic effect that evolves over time as it responds to one or more input parameters using the first gesture signal and the second gesture signal; and

a drive circuit electronically coupled to the drive module and the haptic output device for applying a drive signal to the haptic output device for continuously modifying the haptic effect according to the dynamic interaction parameter.

13. (Original) The system of claim 12 wherein the first or second gesture signal comprises a vector signal.

14. (Original) The system of claim 12 wherein the first or second gesture signal comprises an on-screen signal.

15. (Previously presented) The system of claim 12 wherein the drive module comprises a drive module for generating a dynamic interaction parameter from a difference between the first gesture signal and the second gesture signal.

16. (Previously presented) The system of claim 12 wherein the drive module comprises a drive module for generating a dynamic interaction parameter using the first gesture signal and the second gesture signal and a physical model.

17. (Previously presented) The system of claim 12 wherein the drive module comprises a drive module for generating a dynamic interaction parameter using the first gesture signal and the second gesture signal and an animation.

18. (Previously presented) The system of claim 12 wherein the drive module comprises a drive module for receiving a first device sensor signal, receiving a second device sensor signal, and generating a dynamic interaction parameter using the first gesture signal and the second gesture signal and the first device sensor signal and the second device sensor signal.

19. (Original) The system of claim 12 wherein the first device sensor signal or the second device sensor signal comprises an accelerometer signal.

20. (Original) The system of claim 12 wherein the first device sensor signal or the second device sensor signal comprises a gyroscope signal.

21. (Original) The system of claim 12 wherein the first device sensor signal or the second device sensor signal comprises an ambient signal.

22. (Original) The system of claim 12 wherein the first device sensor signal or the second device sensor signal comprises a virtual sensor signal.

23. (Currently Amended) A non-transitory computer readable medium having instructions stored thereon that, when executed by a processor, causes the processor to produce a haptic effect, the instructions comprising:

receiving a first gesture signal;

receiving a second gesture signal;

generating a dynamic interaction parameter representing a haptic effect that evolves over time as it responds to one or more input parameters using the first gesture signal and the second gesture signal; and

applying a drive signal to a haptic output device for continuously modifying the haptic effect according to the dynamic interaction parameter.

24. (Previously presented) The non-transitory computer readable medium of claim 23, wherein the first or second gesture signal comprises a vector signal.

25. (Previously presented) The non-transitory computer readable medium of claim 23, wherein the first or second gesture signal comprises an on-screen signal.

26. (Previously presented) The non-transitory computer readable medium of claim 23, wherein generating a dynamic interaction parameter comprises generating a dynamic interaction parameter from a difference between the first gesture signal and the second gesture signal.

27. (Previously presented) The non-transitory computer readable medium of claim 23, wherein generating a dynamic interaction parameter comprises generating a dynamic interaction parameter using the first gesture signal and the second gesture signal and a physical model.

28. (Previously presented) The non-transitory computer readable medium of claim 23, wherein generating a dynamic interaction parameter comprises generating a dynamic interaction parameter using the first gesture signal and the second gesture signal and an animation.

29. (Previously presented) The non-transitory computer readable medium of claim 23, further comprising:

receiving a first device sensor signal;

receiving a second device sensor signal; and

wherein generating a dynamic interaction parameter comprises generating a dynamic interaction parameter using the first gesture signal and the second gesture signal and the first device sensor signal and the second device sensor signal.

30. (Previously presented) The non-transitory computer readable medium of claim 23, wherein the first device sensor signal or the second device sensor signal comprises a signal selected from the list consisting of accelerometer, gyroscope, ambient, or virtual.

REMARKS

Reconsideration of this application as amended is respectfully requested. Claims 1-30 are pending and Claims 1, 12 and 23 are amended. No new matter is being added by way of this amendment.

REJECTION UNDER 35 U.S.C. § 102

The Examiner is rejecting Claims 1, 3, 5, 7-12, 14, 16, 18-23, 25, 27, and 29-30 under 35 U.S.C. 102(e) as being anticipated by Birnbaum et al., U. S. Patent App. No. 2010/0017489 (hereinafter "Birnbaum"). Applicants respectfully disagree. Applicants have amended Claims 1, 12 and 23 to recite a dynamic interaction parameter representing a haptic effect that evolves over time as it responds to one or more input parameters to produce haptic output for continuously modifying the haptic effect according to the dynamic interaction parameter. Support for this amendment may be found in the published application at least in paragraphs [0027] and [0060].

As previously discussed in the response filed August 24, 2012, Applicants respectfully submit that Birnbaum does not disclose or imply the use of a dynamic interaction parameter representing a haptic effect that evolves over time as it responds to one or more input parameters to produce haptic output for continuously modifying the haptic effect according to the dynamic interaction parameter, because Birnbaum is silent with respect to a dynamic interaction parameter as claimed in the presently amended application. Therefore, Applicants respectfully submit that currently amended Claims 1, 12 and 23 distinguish over Birnbaum and the rejection under 35 U.S.C. § 102(e) should be removed.

Because Claims 3, 5, 7-12, 14, 16, 18-23, 25, 27, and 29-30 depend from amended Claims 1, 12 and 23, they inherit all of the limitations of the independent claims. Therefore, Applicants respectfully submit that Claims 3, 5, 7-12, 14, 16, 18-23, 25, 27, and 29-30

distinguish over Birnbaum for at least the same reasons as described above for amended Claims 1, 12 and 23, and the rejection under 35 U.S.C. § 102(e) should be removed.

REJECTION UNDER 35 U.S.C. § 103

The Examiner is rejecting Claims 2, 4, 6, 13, 15, 17, 24, 26 and 28 under 35 U.S.C. 103(a) as being unpatentable over Birnbaum in view of Westerman et al., U. S. Patent App. 2002/0015024 (hereinafter “Westerman”). Applicants respectfully disagree.

Birnbaum has been discussed above. As previously discussed in the response filed August 24, 2012, Applicants respectfully submit that Westerman does not disclose or imply the use of a dynamic interaction parameter representing a haptic effect that evolves over time as it responds to one or more input parameters to produce haptic output for continuously modifying the haptic effect according to the dynamic interaction parameter, because Westerman is silent with respect to a dynamic interaction parameter as claimed in the presently amended application.

Because Claims 2, 4, 6, 13, 15, 17, 24, 26 and 28 depend from amended Claims 1, 12 and 23, they inherit all of the limitations of the independent claims. Therefore, Applicants respectfully submit that one of ordinary skill in the art would not have been able to combine Birnbaum with Westerman to produce the presently claimed invention without undue experimentation and the rejection of Claims 2, 4, 6, 13, 15, 17, 24, 26 and 28 under 35 U.S.C. § 103(a) should be removed.

CONCLUSION

For at least the foregoing reasons, Applicants respectfully submit that the rejections have been overcome. Therefore, all pending claims are in condition for allowance, and reconsideration and allowance are requested.

Respectfully submitted,

IMMERSION CORPORATION

Dated: December 10, 2012

/Thomas A. Hassing/
Thomas A. Hassing
Reg. No. 36,159

30 Rio Robles
San Jose, CA 95134
(408) 467-1900

Electronic Acknowledgement Receipt

EFS ID:	14421968
Application Number:	13472698
International Application Number:	
Confirmation Number:	6404
Title of Invention:	METHOD AND APPARATUS FOR PRODUCING A DYNAMIC HAPTIC EFFECT
First Named Inventor/Applicant Name:	David BIRNBAUM
Customer Number:	103772
Filer:	Catherine C. Maresh/Dawn Rose
Filer Authorized By:	Catherine C. Maresh
Attorney Docket Number:	IMM389C1
Receipt Date:	10-DEC-2012
Filing Date:	16-MAY-2012
Time Stamp:	12:24:35
Application Type:	Utility under 35 USC 111(a)

Payment information:

Submitted with Payment	no
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File Listing:

Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
1	Amendment After Final	IMM389C1Responseto2012-11-28OAFINAL.pdf	39926 <small>20b56ef2419732f9945d5bdf3f0cabd50f533407</small>	no	10

Warnings:

Information:

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New Applications Under 35 U.S.C. 111

If a new application is being filed and the application includes the necessary components for a filing date (see 37 CFR 1.53(b)-(d) and MPEP 506), a Filing Receipt (37 CFR 1.54) will be issued in due course and the date shown on this Acknowledgement Receipt will establish the filing date of the application.

National Stage of an International Application under 35 U.S.C. 371

If a timely submission to enter the national stage of an international application is compliant with the conditions of 35 U.S.C. 371 and other applicable requirements a Form PCT/DO/EO/903 indicating acceptance of the application as a national stage submission under 35 U.S.C. 371 will be issued in addition to the Filing Receipt, in due course.

New International Application Filed with the USPTO as a Receiving Office

If a new international application is being filed and the international application includes the necessary components for an international filing date (see PCT Article 11 and MPEP 1810), a Notification of the International Application Number and of the International Filing Date (Form PCT/RO/105) will be issued in due course, subject to prescriptions concerning national security, and the date shown on this Acknowledgement Receipt will establish the international filing date of the application.

Under the Paperwork Reduction Act of 1995, no persons are required to respond to a collection of information unless it displays a valid OMB control number.

PATENT APPLICATION FEE DETERMINATION RECORD Substitute for Form PTO-875					Application or Docket Number 13/472,698		Filing Date 05/16/2012		<input type="checkbox"/> To be Mailed		
APPLICATION AS FILED – PART I											
(Column 1)			(Column 2)			SMALL ENTITY <input type="checkbox"/>		OR		OTHER THAN SMALL ENTITY	
FOR		NUMBER FILED	NUMBER EXTRA		RATE (\$)	FEE (\$)	OR		RATE (\$)	FEE (\$)	
<input type="checkbox"/> BASIC FEE (37 CFR 1.16(a), (b), or (c))		N/A	N/A		N/A				N/A		
<input type="checkbox"/> SEARCH FEE (37 CFR 1.16(k), (i), or (m))		N/A	N/A		N/A		N/A				
<input type="checkbox"/> EXAMINATION FEE (37 CFR 1.16(o), (p), or (q))		N/A	N/A		N/A		N/A				
TOTAL CLAIMS (37 CFR 1.16(i))		minus 20 =	*		X \$ =		OR		X \$ =		
INDEPENDENT CLAIMS (37 CFR 1.16(h))		minus 3 =	*		X \$ =		OR		X \$ =		
<input type="checkbox"/> APPLICATION SIZE FEE (37 CFR 1.16(s))		If the specification and drawings exceed 100 sheets of paper, the application size fee due is \$250 (\$125 for small entity) for each additional 50 sheets or fraction thereof. See 35 U.S.C. 41(a)(1)(G) and 37 CFR 1.16(s).									
<input type="checkbox"/> MULTIPLE DEPENDENT CLAIM PRESENT (37 CFR 1.16(j))											
* If the difference in column 1 is less than zero, enter "0" in column 2.											
APPLICATION AS AMENDED – PART II											
(Column 1)			(Column 2)			SMALL ENTITY		OR		OTHER THAN SMALL ENTITY	
AMENDMENT	12/10/2012	CLAIMS REMAINING AFTER AMENDMENT		HIGHEST NUMBER PREVIOUSLY PAID FOR	PRESENT EXTRA	RATE (\$)	ADDITIONAL FEE (\$)	OR		RATE (\$)	ADDITIONAL FEE (\$)
	Total (37 CFR 1.16(i))	* 30	Minus	** 30	= 0	X \$ =				X \$62=	0
	Independent (37 CFR 1.16(h))	* 3	Minus	***3	= 0	X \$ =		X \$250=	0		
	<input type="checkbox"/> Application Size Fee (37 CFR 1.16(s))										
	<input type="checkbox"/> FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM (37 CFR 1.16(j))										
						TOTAL ADD'L FEE	OR		TOTAL ADD'L FEE	0	
AMENDMENT		CLAIMS REMAINING AFTER AMENDMENT		HIGHEST NUMBER PREVIOUSLY PAID FOR	PRESENT EXTRA	RATE (\$)	ADDITIONAL FEE (\$)	OR		RATE (\$)	ADDITIONAL FEE (\$)
	Total (37 CFR 1.16(i))	*	Minus	**	=	X \$ =				X \$ =	
	Independent (37 CFR 1.16(h))	*	Minus	***	=	X \$ =		X \$ =			
	<input type="checkbox"/> Application Size Fee (37 CFR 1.16(s))										
	<input type="checkbox"/> FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM (37 CFR 1.16(j))										
						TOTAL ADD'L FEE	OR		TOTAL ADD'L FEE		
* If the entry in column 1 is less than the entry in column 2, write "0" in column 3.										Legal Instrument Examiner: /DELEACHES YOUNG/	
** If the "Highest Number Previously Paid For" IN THIS SPACE is less than 20, enter "20".											
*** If the "Highest Number Previously Paid For" IN THIS SPACE is less than 3, enter "3".											
The "Highest Number Previously Paid For" (Total or Independent) is the highest number found in the appropriate box in column 1.											

This collection of information is required by 37 CFR 1.16. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.14. This collection is estimated to take 12 minutes to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. **SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.**

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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
13/472,698	05/16/2012	David BIRNBAUM	IMM389C1	6404
103772	7590	12/12/2012	EXAMINER	
Immersion Corporation 30 Rio Robles San Jose, CA 95134			SITTA, GRANT	
			ART UNIT	PAPER NUMBER
			2694	
			MAIL DATE	DELIVERY MODE
			12/12/2012	PAPER

Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

Applicant-Initiated Interview Summary	Application No. 13/472,698	Applicant(s) BIRNBAUM ET AL.	
	Examiner GRANT SITTA	Art Unit 2694	

All participants (applicant, applicant's representative, PTO personnel):

(1) GRANT SITTA. (3) Jeffrey Leng.
(2) Thomas Hassing. (4) _____.

Date of Interview: 10 December 2012.

Type: Telephonic Video Conference
 Personal [copy given to: applicant applicant's representative]

Exhibit shown or demonstration conducted: Yes No.
If Yes, brief description: _____.

Issues Discussed 101 112 102 103 Others
(For each of the checked box(es) above, please describe below the issue and detailed description of the discussion)

Claim(s) discussed: 1-30.

Identification of prior art discussed: Birnbaum and Westerman.

Substance of Interview
(For each issue discussed, provide a detailed description and indicate if agreement was reached. Some topics may include: identification or clarification of a reference or a portion thereof, claim interpretation, proposed amendments, arguments of any applied references etc...)

Discussed proposed claim amendments and arguments, provided in agenda attached to the current interview summary, that appear to overcome the art as applied .

Applicant recordation instructions: The formal written reply to the last Office action must include the substance of the interview. (See MPEP section 713.04). If a reply to the last Office action has already been filed, applicant is given a non-extendable period of the longer of one month or thirty days from this interview date, or the mailing date of this interview summary form, whichever is later, to file a statement of the substance of the interview

Examiner recordation instructions: Examiners must summarize the substance of any interview of record. A complete and proper recordation of the substance of an interview should include the items listed in MPEP 713.04 for complete and proper recordation including the identification of the general thrust of each argument or issue discussed, a general indication of any other pertinent matters discussed regarding patentability and the general results or outcome of the interview, to include an indication as to whether or not agreement was reached on the issues raised.

Attachment

/Grant D Sitta/ Primary Examiner, Art Unit 2694	
--	--

Summary of Record of Interview Requirements

Manual of Patent Examining Procedure (MPEP), Section 713.04, Substance of Interview Must be Made of Record

A complete written statement as to the substance of any face-to-face, video conference, or telephone interview with regard to an application must be made of record in the application whether or not an agreement with the examiner was reached at the interview.

Title 37 Code of Federal Regulations (CFR) § 1.133 Interviews

Paragraph (b)

In every instance where reconsideration is requested in view of an interview with an examiner, a complete written statement of the reasons presented at the interview as warranting favorable action must be filed by the applicant. An interview does not remove the necessity for reply to Office action as specified in §§ 1.111, 1.135. (35 U.S.C. 132)

37 CFR §1.2 Business to be transacted in writing.

All business with the Patent or Trademark Office should be transacted in writing. The personal attendance of applicants or their attorneys or agents at the Patent and Trademark Office is unnecessary. The action of the Patent and Trademark Office will be based exclusively on the written record in the Office. No attention will be paid to any alleged oral promise, stipulation, or understanding in relation to which there is disagreement or doubt.

The action of the Patent and Trademark Office cannot be based exclusively on the written record in the Office if that record is itself incomplete through the failure to record the substance of interviews.

It is the responsibility of the applicant or the attorney or agent to make the substance of an interview of record in the application file, unless the examiner indicates he or she will do so. It is the examiner's responsibility to see that such a record is made and to correct material inaccuracies which bear directly on the question of patentability.

Examiners must complete an Interview Summary Form for each interview held where a matter of substance has been discussed during the interview by checking the appropriate boxes and filling in the blanks. Discussions regarding only procedural matters, directed solely to restriction requirements for which interview recordation is otherwise provided for in Section 812.01 of the Manual of Patent Examining Procedure, or pointing out typographical errors or unreadable script in Office actions or the like, are excluded from the interview recordation procedures below. Where the substance of an interview is completely recorded in an Examiners Amendment, no separate Interview Summary Record is required.

The Interview Summary Form shall be given an appropriate Paper No., placed in the right hand portion of the file, and listed on the "Contents" section of the file wrapper. In a personal interview, a duplicate of the Form is given to the applicant (or attorney or agent) at the conclusion of the interview. In the case of a telephone or video-conference interview, the copy is mailed to the applicant's correspondence address either with or prior to the next official communication. If additional correspondence from the examiner is not likely before an allowance or if other circumstances dictate, the Form should be mailed promptly after the interview rather than with the next official communication.

The Form provides for recordation of the following information:

- Application Number (Series Code and Serial Number)
- Name of applicant
- Name of examiner
- Date of interview
- Type of interview (telephonic, video-conference, or personal)
- Name of participant(s) (applicant, attorney or agent, examiner, other PTO personnel, etc.)
- An indication whether or not an exhibit was shown or a demonstration conducted
- An identification of the specific prior art discussed
- An indication whether an agreement was reached and if so, a description of the general nature of the agreement (may be by attachment of a copy of amendments or claims agreed as being allowable). Note: Agreement as to allowability is tentative and does not restrict further action by the examiner to the contrary.
- The signature of the examiner who conducted the interview (if Form is not an attachment to a signed Office action)

It is desirable that the examiner orally remind the applicant of his or her obligation to record the substance of the interview of each case. It should be noted, however, that the Interview Summary Form will not normally be considered a complete and proper recordation of the interview unless it includes, or is supplemented by the applicant or the examiner to include, all of the applicable items required below concerning the substance of the interview.

A complete and proper recordation of the substance of any interview should include at least the following applicable items:

- 1) A brief description of the nature of any exhibit shown or any demonstration conducted,
- 2) an identification of the claims discussed,
- 3) an identification of the specific prior art discussed,
- 4) an identification of the principal proposed amendments of a substantive nature discussed, unless these are already described on the Interview Summary Form completed by the Examiner,
- 5) a brief identification of the general thrust of the principal arguments presented to the examiner,
(The identification of arguments need not be lengthy or elaborate. A verbatim or highly detailed description of the arguments is not required. The identification of the arguments is sufficient if the general nature or thrust of the principal arguments made to the examiner can be understood in the context of the application file. Of course, the applicant may desire to emphasize and fully describe those arguments which he or she feels were or might be persuasive to the examiner.)
- 6) a general indication of any other pertinent matters discussed, and
- 7) if appropriate, the general results or outcome of the interview unless already described in the Interview Summary Form completed by the examiner.

Examiners are expected to carefully review the applicant's record of the substance of an interview. If the record is not complete and accurate, the examiner will give the applicant an extendable one month time period to correct the record.

Examiner to Check for Accuracy

If the claims are allowable for other reasons of record, the examiner should send a letter setting forth the examiner's version of the statement attributed to him or her. If the record is complete and accurate, the examiner should place the indication, "Interview Record OK" on the paper recording the substance of the interview along with the date and the examiner's initials.

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Application of:)	
)	
David Birnbaum et al.	)	Examiner: Sitta, Grant
)	
Application No. 13/472,698	)	Art Unit: 2629
)	
Filed: May 16, 2012)	
	)	Confirmation No. 6404
For: METHOD AND APPARATUS FOR)	
PRODUCING A DYNAMIC HAPTIC)	
EFFECT)	

Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

AMENDMENT AND RESPONSE UNDER 37 CFR § 1.116

Sir:

In response to the Office Action mailed November 28, 2012, Applicants respectfully request the Examiner enter the following amendments and consider the following remarks.

CERTIFICATE OF ELECTRONIC FILING

I hereby certify that this correspondence is being deposited via electronic filing through the United States Patent and Trademark Electronic Filing System on:

December xx, 2012
Date of Deposit

Dawn Rose
(Type or print name of person mailing paper)

/Dawn Rose/
(Signature of person mailing paper)

December xx, 2012
Date

AMENDMENTS TO THE CLAIMS

1. (Currently Amended) A method of producing a haptic effect comprising:
receiving a first gesture signal;
receiving a second gesture signal;
generating a dynamic interaction parameter representing a haptic effect that evolves over time as it responds to one or more input parameters using the first gesture signal and the second gesture signal; and
applying a drive signal to a haptic output device for continuously modifying the haptic effect according to the dynamic interaction parameter.
2. (Original) The method of claim 1 wherein the first or second gesture signal comprises a vector signal.
3. (Original) The method of claim 1 wherein the first or second gesture signal comprises an on-screen signal.
4. (Previously presented) The method of claim 1 wherein generating a dynamic interaction parameter comprises generating a dynamic interaction parameter from a difference between the first gesture signal and the second gesture signal.
5. (Previously presented) The method of claim 1 wherein generating a dynamic interaction parameter comprises generating a dynamic interaction parameter using the first gesture signal and the second gesture signal and a physical model.

6. (Previously presented) The method of claim 1 wherein generating a dynamic interaction parameter comprises generating a dynamic interaction parameter using the first gesture signal and the second gesture signal and an animation.

7. (Previously presented) The method of claim 1 further comprising:
receiving a first device sensor signal;
receiving a second device sensor signal; and
wherein generating a dynamic interaction parameter comprises generating a dynamic interaction parameter using the first gesture signal and the second gesture signal and the first device sensor signal and the second device sensor signal.

8. (Original) The method of claim 1 wherein the first device sensor signal or the second device sensor signal comprises an accelerometer signal.

9. (Original) The method of claim 1 wherein the first device sensor signal or the second device sensor signal comprises a gyroscope signal.

10. (Original) The method of claim 1 wherein the first device sensor signal or the second device sensor signal comprises an ambient signal.

11. (Original) The method of claim 1 wherein the first device sensor signal or the second device sensor signal comprises a virtual sensor signal.

12. (Currently Amended) A haptic effect enabled system comprising:
a haptic output device;

a drive module electronically coupled to the haptic output device for receiving a first gesture signal, receiving a second gesture signal, and generating a dynamic interaction parameter representing a haptic effect that evolves over time as it responds to one or more input parameters using the first gesture signal and the second gesture signal; and

a drive circuit electronically coupled to the drive module and the haptic output device for applying a drive signal to the haptic output device for continuously modifying the haptic effect according to the dynamic interaction parameter.

13. (Original) The system of claim 12 wherein the first or second gesture signal comprises a vector signal.

14. (Original) The system of claim 12 wherein the first or second gesture signal comprises an on-screen signal.

15. (Previously presented) The system of claim 12 wherein the drive module comprises a drive module for generating a dynamic interaction parameter from a difference between the first gesture signal and the second gesture signal.

16. (Previously presented) The system of claim 12 wherein the drive module comprises a drive module for generating a dynamic interaction parameter using the first gesture signal and the second gesture signal and a physical model.

17. (Previously presented) The system of claim 12 wherein the drive module comprises a drive module for generating a dynamic interaction parameter using the first gesture signal and the second gesture signal and an animation.

18. (Previously presented) The system of claim 12 wherein the drive module comprises a drive module for receiving a first device sensor signal, receiving a second device sensor signal, and generating a dynamic interaction parameter using the first gesture signal and the second gesture signal and the first device sensor signal and the second device sensor signal.

19. (Original) The system of claim 12 wherein the first device sensor signal or the second device sensor signal comprises an accelerometer signal.

20. (Original) The system of claim 12 wherein the first device sensor signal or the second device sensor signal comprises a gyroscope signal.

21. (Original) The system of claim 12 wherein the first device sensor signal or the second device sensor signal comprises an ambient signal.

22. (Original) The system of claim 12 wherein the first device sensor signal or the second device sensor signal comprises a virtual sensor signal.

23. (Currently Amended) A non-transitory computer readable medium having instructions stored thereon that, when executed by a processor, causes the processor to produce a haptic effect, the instructions comprising:

receiving a first gesture signal;

receiving a second gesture signal;

generating a dynamic interaction parameter representing a haptic effect that evolves over time as it responds to one or more input parameters using the first gesture signal and the second gesture signal; and

applying a drive signal to a haptic output device for continuously modifying the haptic effect according to the dynamic interaction parameter.

24. (Previously presented) The non-transitory computer readable medium of claim 23, wherein the first or second gesture signal comprises a vector signal.

25. (Previously presented) The non-transitory computer readable medium of claim 23, wherein the first or second gesture signal comprises an on-screen signal.

26. (Previously presented) The non-transitory computer readable medium of claim 23, wherein generating a dynamic interaction parameter comprises generating a dynamic interaction parameter from a difference between the first gesture signal and the second gesture signal.

27. (Previously presented) The non-transitory computer readable medium of claim 23, wherein generating a dynamic interaction parameter comprises generating a dynamic interaction parameter using the first gesture signal and the second gesture signal and a physical model.

28. (Previously presented) The non-transitory computer readable medium of claim 23, wherein generating a dynamic interaction parameter comprises generating a dynamic interaction parameter using the first gesture signal and the second gesture signal and an animation.

29. (Previously presented) The non-transitory computer readable medium of claim 23, further comprising:

receiving a first device sensor signal;

receiving a second device sensor signal; and

wherein generating a dynamic interaction parameter comprises generating a dynamic interaction parameter using the first gesture signal and the second gesture signal and the first device sensor signal and the second device sensor signal.

30. (Previously presented) The non-transitory computer readable medium of claim 23, wherein the first device sensor signal or the second device sensor signal comprises a signal selected from the list consisting of accelerometer, gyroscope, ambient, or virtual.

REMARKS

Reconsideration of this application as amended is respectfully requested. Claims 1-30 are pending and Claims 1, 12 and 23 are amended. No new matter is being added by way of this amendment.

REJECTION UNDER 35 U.S.C. § 102

The Examiner is rejecting Claims 1, 3, 5, 7-12, 14, 16, 18-23, 25, 27, and 29-30 under 35 U.S.C. 102(e) as being anticipated by Birnbaum et al., U. S. Patent App. No. 2010/0017489 (hereinafter "Birnbaum"). Applicants respectfully disagree. Applicants have amended Claims 1, 12 and 23 to recite a dynamic interaction parameter representing a haptic effect that evolves over time as it responds to one or more input parameters to produce haptic output for continuously modifying the haptic effect according to the dynamic interaction parameter. Support for this amendment may be found in the published application at least in paragraphs [0027] and [0060].

As previously discussed in the response filed August 24, 2012, Applicants respectfully submit that Birnbaum does not disclose or imply the use of a dynamic interaction parameter representing a haptic effect that evolves over time as it responds to one or more input parameters to produce haptic output for continuously modifying the haptic effect according to the dynamic interaction parameter, because Birnbaum is silent with respect to a dynamic interaction parameter as claimed in the presently amended application. Therefore, Applicants respectfully submit that currently amended Claims 1, 12 and 23 distinguish over Birnbaum and the rejection under 35 U.S.C. § 102(e) should be removed.

Because Claims 3, 5, 7-12, 14, 16, 18-23, 25, 27, and 29-30 depend from amended Claims 1, 12 and 23, they inherit all of the limitations of the independent claims. Therefore, Applicants respectfully submit that Claims 3, 5, 7-12, 14, 16, 18-23, 25, 27, and 29-30

distinguish over Birnbaum for at least the same reasons as described above for amended Claims 1, 12 and 23, and the rejection under 35 U.S.C. § 102(e) should be removed.

REJECTION UNDER 35 U.S.C. § 103

The Examiner is rejecting Claims 2, 4, 6, 13, 15, 17, 24, 26 and 28 under 35 U.S.C. 103(a) as being unpatentable over Birnbaum in view of Westerman et al., U. S. Patent App. 2002/0015024 (hereinafter “Westerman”). Applicants respectfully disagree.

Birnbaum has been discussed above. As previously discussed in the response filed August 24, 2012, Applicants respectfully submit that Westerman does not disclose or imply the use of a dynamic interaction parameter representing a haptic effect that evolves over time as it responds to one or more input parameters to produce haptic output for continuously modifying the haptic effect according to the dynamic interaction parameter, because Westerman is silent with respect to a dynamic interaction parameter as claimed in the presently amended application.

Because Claims 2, 4, 6, 13, 15, 17, 24, 26 and 28 depend from amended Claims 1, 12 and 23, they inherit all of the limitations of the independent claims. Therefore, Applicants respectfully submit that one of ordinary skill in the art would not have been able to combine Birnbaum with Westerman to produce the presently claimed invention without undue experimentation and the rejection of Claims 2, 4, 6, 13, 15, 17, 24, 26 and 28 under 35 U.S.C. § 103(a) should be removed.

CONCLUSION

For at least the foregoing reasons, Applicants respectfully submit that the rejections have been overcome. Therefore, all pending claims are in condition for allowance, and reconsideration and allowance are requested.

Respectfully submitted,
IMMERSION CORPORATION

Dated: December xx, 2012

/Thomas A. Hassing/
Thomas A. Hassing
Reg. No. 36,159

30 Rio Robles
San Jose, CA 95134
(408) 467-1900



UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
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Table with 5 columns: APPLICATION NO., FILING DATE, FIRST NAMED INVENTOR, ATTORNEY DOCKET NO., CONFIRMATION NO. Includes application details for David BIRNBAUM and examiner SITTA, GRANT.

Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

Notice of References Cited	Application/Control No. 13/472,698	Applicant(s)/Patent Under Reexamination BIRNBAUM ET AL.	
	Examiner GRANT SITTA	Art Unit 2694	Page 1 of 1

U.S. PATENT DOCUMENTS

*	Document Number Country Code-Number-Kind Code	Date MM-YYYY	Name	Classification
*	A US-2002/0044132	04-2002	Fish, Daniel E.	345/156
*	B US-8,279,193	10-2012	Birnbaum et al.	345/173
	C US-			
	D US-			
	E US-			
	F US-			
	G US-			
	H US-			
	I US-			
	J US-			
	K US-			
	L US-			
	M US-			

FOREIGN PATENT DOCUMENTS

*	Document Number Country Code-Number-Kind Code	Date MM-YYYY	Country	Name	Classification
	N				
	O				
	P				
	Q				
	R				
	S				
	T				

NON-PATENT DOCUMENTS

*	Include as applicable: Author, Title Date, Publisher, Edition or Volume, Pertinent Pages)
U	
V	
W	
X	

*A copy of this reference is not being furnished with this Office action. (See MPEP § 707.05(a).)
Dates in MM-YYYY format are publication dates. Classifications may be US or foreign.

Advisory Action Before the Filing of an Appeal Brief	Application No. 13/472,698	Applicant(s) BIRNBAUM ET AL.
	Examiner GRANT SITTA	Art Unit 2694

--The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

THE REPLY FILED 12 December 2012 FAILS TO PLACE THIS APPLICATION IN CONDITION FOR ALLOWANCE.

NO NOTICE OF APPEAL FILED

1. The reply was filed after a final rejection. No Notice of Appeal has been filed. To avoid abandonment of this application, applicant must timely file one of the following replies: (1) an amendment, affidavit, or other evidence, which places the application in condition for allowance; (2) a Notice of Appeal (with appeal fee) in compliance with 37 CFR 41.31; or (3) a Request for Continued Examination (RCE) in compliance with 37 CFR 1.114 if this is a utility or plant application. Note that RCEs are not permitted in design applications. The reply must be filed within one of the following time periods:
- a) The period for reply expires _____ months from the mailing date of the final rejection.
- b) The period for reply expires on: (1) the mailing date of this Advisory Action; or (2) the date set forth in the final rejection, whichever is later. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the mailing date of the final rejection.
- c) A prior Advisory Action was mailed more than 3 months after the mailing date of the final rejection in response to a first after-final reply filed within 2 months of the mailing date of the final rejection. The current period for reply expires _____ months from the mailing date of the prior *Advisory Action* or SIX MONTHS from the mailing date of the final rejection, whichever is earlier.
- Examiner Note:* If box 1 is checked, check either box (a), (b) or (c). ONLY CHECK BOX (b) WHEN THIS ADVISORY ACTION IS THE FIRST RESPONSE TO APPLICANT'S FIRST AFTER-FINAL REPLY WHICH WAS FILED WITHIN TWO MONTHS OF THE FINAL REJECTION. ONLY CHECK BOX (c) IN THE LIMITED SITUATION SET FORTH UNDER BOX (c). See MPEP 706.07(f).

Extensions of time may be obtained under 37 CFR 1.136(a). The date on which the petition under 37 CFR 1.136(a) and the appropriate extension fee have been filed is the date for purposes of determining the period of extension and the corresponding amount of the fee. The appropriate extension fee under 37 CFR 1.17(a) is calculated from: (1) the expiration date of the shortened statutory period for reply originally set in the final Office action; or (2) as set forth in (b) or (c) above, if checked. Any reply received by the Office later than three months after the mailing date of the final rejection, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

NOTICE OF APPEAL

2. The Notice of Appeal was filed on _____. A brief in compliance with 37 CFR 41.37 must be filed within two months of the date of filing the Notice of Appeal (37 CFR 41.37(a)), or any extension thereof (37 CFR 41.37(e)), to avoid dismissal of the appeal. Since a Notice of Appeal has been filed, any reply must be filed within the time period set forth in 37 CFR 41.37(a).

AMENDMENTS

3. The proposed amendments filed after a final rejection, but prior to the date of filing a brief, will not be entered because
- a) They raise new issues that would require further consideration and/or search (see NOTE below);
- b) They raise the issue of new matter (see NOTE below);
- c) They are not deemed to place the application in better form for appeal by materially reducing or simplifying the issues for appeal; and/or
- d) They present additional claims without canceling a corresponding number of finally rejected claims.
- NOTE: See Continuation Sheet. (See 37 CFR 1.116 and 41.33(a)).
4. The amendments are not in compliance with 37 CFR 1.121. See attached Notice of Non-Compliant Amendment (PTOL-324).
5. Applicant's reply has overcome the following rejection(s): _____.
6. Newly proposed or amended claim(s) _____ would be allowable if submitted in a separate, timely filed amendment canceling the non-allowable claim(s).
7. For purposes of appeal, the proposed amendment(s): (a) will not be entered, or (b) will be entered, and an explanation of how the new or amended claims would be rejected is provided below or appended.

AFFIDAVIT OR OTHER EVIDENCE

8. The affidavit or other evidence filed after final action, but before or on the date of filing a Notice of Appeal will not be entered because applicant failed to provide a showing of good and sufficient reasons why the affidavit or other evidence is necessary and was not earlier presented. See 37 CFR 1.116(e).
9. The affidavit or other evidence filed after the date of filing the Notice of Appeal, but prior to the date of filing a brief, will not be entered because the affidavit or other evidence failed to overcome all rejections under appeal and/or appellant fails to provide a showing of good and sufficient reasons why it is necessary and was not earlier presented. See 37 CFR 41.33(d)(1).
10. The affidavit or other evidence is entered. An explanation of the status of the claims after entry is below or attached.

REQUEST FOR RECONSIDERATION/OTHER

11. The request for reconsideration has been considered but does NOT place the application in condition for allowance because:
Please review Fish 2002/0044132 [0012-0018] with respect to the dynamic haptic feedback.
12. Note the attached Information *Disclosure Statement(s)*. (PTO/SB/08) Paper No(s). _____
13. Other: Notice of References Cited and Search History.

STATUS OF CLAIMS

14. The status of the claim(s) is (or will be) as follows:
- Claim(s) allowed: .
- Claim(s) objected to: .
- Claim(s) rejected: .
- Claim(s) withdrawn from consideration: .

/Grant D Sitta/
Primary Examiner, Art Unit 2694

Continuation of 3. NOTE: The proposed amendments would require further search and/or consideration.

Receipt date: 12/10/2012

13472698 - GAU: 2694

Atty. Docket No. IMM389C1
DO NOT ENTER: /G.S./

PATENT

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Application of:)	
)	
David Birnbaum et al.	)	Examiner: Sitta, Grant
)	
Application No. 13/472,698	)	Art Unit: 2629
)	
Filed: May 16, 2012)	
	)	Confirmation No. 6404
For: METHOD AND APPARATUS FOR)	
PRODUCING A DYNAMIC HAPTIC)	
EFFECT)	
)	

Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

AMENDMENT AND RESPONSE UNDER 37 CFR § 1.116

Sir:

In response to the Office Action mailed November 28, 2012, Applicants respectfully request the Examiner enter the following amendments and consider the following remarks.

CERTIFICATE OF ELECTRONIC FILING

I hereby certify that this correspondence is being deposited via electronic filing through the United States Patent and Trademark Electronic Filing System on:

_____ December 10, 2012 _____
Date of Deposit

_____ Dawn Rose _____
(Type or print name of person mailing paper)

_____ /Dawn Rose/ _____
(Signature of person mailing paper)

_____ December 10, 2012 _____
Date

INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)	Application Number	13472698
	Filing Date	2012-05-16
	First Named Inventor	BIRNBAUM
	Art Unit	2629
	Examiner Name	Sitta, Grant
	Attorney Docket Number	IMM389C1

U.S. PATENTS						Remove
Examiner Initial*	Cite No	Patent Number	Kind Code ¹	Issue Date	Name of Patentee or Applicant of cited Document	Pages, Columns, Lines where Relevant Passages or Relevant Figures Appear
	1	6061004		2000-05-09	Rosenberg	

If you wish to add additional U.S. Patent citation information please click the Add button. Add

U.S. PATENT APPLICATION PUBLICATIONS						Remove
Examiner Initial*	Cite No	Publication Number	Kind Code ¹	Publication Date	Name of Patentee or Applicant of cited Document	Pages, Columns, Lines where Relevant Passages or Relevant Figures Appear
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FOREIGN PATENT DOCUMENTS								Remove
Examiner Initial*	Cite No	Foreign Document Number ³	Country Code ² j	Kind Code ⁴	Publication Date	Name of Patentee or Applicant of cited Document	Pages, Columns, Lines where Relevant Passages or Relevant Figures Appear	T ⁵
	1	WO 2010/088477 A1			2010-08-05	Birnbaum et al.		<input type="checkbox"/>

If you wish to add additional Foreign Patent Document citation information please click the Add button. Add

NON-PATENT LITERATURE DOCUMENTS			Remove
Examiner Initials*	Cite No	Include name of the author (in CAPITAL LETTERS), title of the article (when appropriate), title of the item (book, magazine, journal, serial, symposium, catalog, etc), date, pages(s), volume-issue number(s), publisher, city and/or country where published.	T ⁵

INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)	Application Number	13472698
	Filing Date	2012-05-16
	First Named Inventor	BIRNBAUM
	Art Unit	2629
	Examiner Name	Sitta, Grant
	Attorney Docket Number	IMM389C1

	1		<input type="checkbox"/>
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If you wish to add additional non-patent literature document citation information please click the Add button **Add**

EXAMINER SIGNATURE

Examiner Signature		Date Considered	
--------------------	--	-----------------	--

*EXAMINER: Initial if reference considered, whether or not citation is in conformance with MPEP 609. Draw line through a citation if not in conformance and not considered. Include copy of this form with next communication to applicant.

¹ See Kind Codes of USPTO Patent Documents at www.USPTO.GOV or MPEP 901.04. ² Enter office that issued the document, by the two-letter code (WIPO Standard ST.3). ³ For Japanese patent documents, the indication of the year of the reign of the Emperor must precede the serial number of the patent document. ⁴ Kind of document by the appropriate symbols as indicated on the document under WIPO Standard ST.16 if possible. ⁵ Applicant is to place a check mark here if English language translation is attached.

INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)	Application Number	13472698
	Filing Date	2012-05-16
	First Named Inventor	BIRNBAUM
	Art Unit	2629
	Examiner Name	Sitta, Grant
	Attorney Docket Number	IMM389C1

CERTIFICATION STATEMENT

Please see 37 CFR 1.97 and 1.98 to make the appropriate selection(s):

That each item of information contained in the information disclosure statement was first cited in any communication from a foreign patent office in a counterpart foreign application not more than three months prior to the filing of the information disclosure statement. See 37 CFR 1.97(e)(1).

OR

That no item of information contained in the information disclosure statement was cited in a communication from a foreign patent office in a counterpart foreign application, and, to the knowledge of the person signing the certification after making reasonable inquiry, no item of information contained in the information disclosure statement was known to any individual designated in 37 CFR 1.56(c) more than three months prior to the filing of the information disclosure statement. See 37 CFR 1.97(e)(2).

See attached certification statement.

The fee set forth in 37 CFR 1.17 (p) has been submitted herewith.

A certification statement is not submitted herewith.

SIGNATURE

A signature of the applicant or representative is required in accordance with CFR 1.33, 10.18. Please see CFR 1.4(d) for the form of the signature.

Signature	/Thomas A. Hassing/	Date (YYYY-MM-DD)	2013-01-23
Name/Print	Thomas A. Hassing	Registration Number	36,159

This collection of information is required by 37 CFR 1.97 and 1.98. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.14. This collection is estimated to take 1 hour to complete, including gathering, preparing and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. **DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.**

Privacy Act Statement

The Privacy Act of 1974 (P.L. 93-579) requires that you be given certain information in connection with your submission of the attached form related to a patent application or patent. Accordingly, pursuant to the requirements of the Act, please be advised that: (1) the general authority for the collection of this information is 35 U.S.C. 2(b)(2); (2) furnishing of the information solicited is voluntary; and (3) the principal purpose for which the information is used by the U.S. Patent and Trademark Office is to process and/or examine your submission related to a patent application or patent. If you do not furnish the requested information, the U.S. Patent and Trademark Office may not be able to process and/or examine your submission, which may result in termination of proceedings or abandonment of the application or expiration of the patent.

The information provided by you in this form will be subject to the following routine uses:

1. The information on this form will be treated confidentially to the extent allowed under the Freedom of Information Act (5 U.S.C. 552) and the Privacy Act (5 U.S.C. 552a). Records from this system of records may be disclosed to the Department of Justice to determine whether the Freedom of Information Act requires disclosure of these records.
2. A record from this system of records may be disclosed, as a routine use, in the course of presenting evidence to a court, magistrate, or administrative tribunal, including disclosures to opposing counsel in the course of settlement negotiations.
3. A record in this system of records may be disclosed, as a routine use, to a Member of Congress submitting a request involving an individual, to whom the record pertains, when the individual has requested assistance from the Member with respect to the subject matter of the record.
4. A record in this system of records may be disclosed, as a routine use, to a contractor of the Agency having need for the information in order to perform a contract. Recipients of information shall be required to comply with the requirements of the Privacy Act of 1974, as amended, pursuant to 5 U.S.C. 552a(m).
5. A record related to an International Application filed under the Patent Cooperation Treaty in this system of records may be disclosed, as a routine use, to the International Bureau of the World Intellectual Property Organization, pursuant to the Patent Cooperation Treaty.
6. A record in this system of records may be disclosed, as a routine use, to another federal agency for purposes of National Security review (35 U.S.C. 181) and for review pursuant to the Atomic Energy Act (42 U.S.C. 218(c)).
7. A record from this system of records may be disclosed, as a routine use, to the Administrator, General Services, or his/her designee, during an inspection of records conducted by GSA as part of that agency's responsibility to recommend improvements in records management practices and programs, under authority of 44 U.S.C. 2904 and 2906. Such disclosure shall be made in accordance with the GSA regulations governing inspection of records for this purpose, and any other relevant (i.e., GSA or Commerce) directive. Such disclosure shall not be used to make determinations about individuals.
8. A record from this system of records may be disclosed, as a routine use, to the public after either publication of the application pursuant to 35 U.S.C. 122(b) or issuance of a patent pursuant to 35 U.S.C. 151. Further, a record may be disclosed, subject to the limitations of 37 CFR 1.14, as a routine use, to the public if the record was filed in an application which became abandoned or in which the proceedings were terminated and which application is referenced by either a published application, an application open to public inspections or an issued patent.
9. A record from this system of records may be disclosed, as a routine use, to a Federal, State, or local law enforcement agency, if the USPTO becomes aware of a violation or potential violation of law or regulation.

Electronic Patent Application Fee Transmittal

Application Number:	13472698			
Filing Date:	16-May-2012			
Title of Invention:	METHOD AND APPARATUS FOR PRODUCING A DYNAMIC HAPTIC EFFECT			
First Named Inventor/Applicant Name:	David BIRNBAUM			
Filer:	Catherine C. Maresh/Dawn Rose			
Attorney Docket Number:	IMM389C1			
Filed as Large Entity				
Utility under 35 USC 111(a) Filing Fees				
Description	Fee Code	Quantity	Amount	Sub-Total in USD(\$)
Basic Filing:				
Pages:				
Claims:				
Miscellaneous-Filing:				
Petition:				
Patent-Appeals-and-Interference:				
Post-Allowance-and-Post-Issuance:				
Extension-of-Time:				

Description	Fee Code	Quantity	Amount	Sub-Total in USD(\$)
Miscellaneous:				
Submission- Information Disclosure Stmt	1806	1	180	180
Total in USD (\$)				180

Electronic Acknowledgement Receipt

EFS ID:	14770196
Application Number:	13472698
International Application Number:	
Confirmation Number:	6404
Title of Invention:	METHOD AND APPARATUS FOR PRODUCING A DYNAMIC HAPTIC EFFECT
First Named Inventor/Applicant Name:	David BIRNBAUM
Customer Number:	103772
Filer:	Catherine C. Maresh/Dawn Rose
Filer Authorized By:	Catherine C. Maresh
Attorney Docket Number:	IMM389C1
Receipt Date:	23-JAN-2013
Filing Date:	16-MAY-2012
Time Stamp:	14:58:12
Application Type:	Utility under 35 USC 111(a)

Payment information:

Submitted with Payment	yes
Payment Type	Electronic Funds Transfer
Payment was successfully received in RAM	\$180
RAM confirmation Number	1466
Deposit Account	
Authorized User	

File Listing:

Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
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1	Information Disclosure Statement (IDS) Form (SB08)	IMM389C1IDS.pdf	612203	no	4
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Warnings:					
Information:					
2	Fee Worksheet (SB06)	fee-info.pdf	30526	no	2
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Warnings:					
Information:					
Total Files Size (in bytes):				642729	
<p>This Acknowledgement Receipt evidences receipt on the noted date by the USPTO of the indicated documents, characterized by the applicant, and including page counts, where applicable. It serves as evidence of receipt similar to a Post Card, as described in MPEP 503.</p> <p><u>New Applications Under 35 U.S.C. 111</u> If a new application is being filed and the application includes the necessary components for a filing date (see 37 CFR 1.53(b)-(d) and MPEP 506), a Filing Receipt (37 CFR 1.54) will be issued in due course and the date shown on this Acknowledgement Receipt will establish the filing date of the application.</p> <p><u>National Stage of an International Application under 35 U.S.C. 371</u> If a timely submission to enter the national stage of an international application is compliant with the conditions of 35 U.S.C. 371 and other applicable requirements a Form PCT/DO/EO/903 indicating acceptance of the application as a national stage submission under 35 U.S.C. 371 will be issued in addition to the Filing Receipt, in due course.</p> <p><u>New International Application Filed with the USPTO as a Receiving Office</u> If a new international application is being filed and the international application includes the necessary components for an international filing date (see PCT Article 11 and MPEP 1810), a Notification of the International Application Number and of the International Filing Date (Form PCT/RO/105) will be issued in due course, subject to prescriptions concerning national security, and the date shown on this Acknowledgement Receipt will establish the international filing date of the application.</p>					

Doc code: RCEX

Doc description: Request for Continued Examination (RCE)

PTO/SB/30EFS (07-09)

Approved for use through 07/31/2012. OMB 0651-0031

U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE

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REQUEST FOR CONTINUED EXAMINATION(RCE)TRANSMITTAL (Submitted Only via EFS-Web)

Application Number	13472698	Filing Date	2012-05-16	Docket Number (if applicable)	IMM389C1	Art Unit	2694
First Named Inventor	David Birnbaum			Examiner Name	Sitta, Grant		

This is a Request for Continued Examination (RCE) under 37 CFR 1.114 of the above-identified application.
Request for Continued Examination (RCE) practice under 37 CFR 1.114 does not apply to any utility or plant application filed prior to June 8, 1995, or to any design application. The Instruction Sheet for this form is located at WWW.USPTO.GOV

SUBMISSION REQUIRED UNDER 37 CFR 1.114

Note: If the RCE is proper, any previously filed unentered amendments and amendments enclosed with the RCE will be entered in the order in which they were filed unless applicant instructs otherwise. If applicant does not wish to have any previously filed unentered amendment(s) entered, applicant must request non-entry of such amendment(s).

Previously submitted. If a final Office action is outstanding, any amendments filed after the final Office action may be considered as a submission even if this box is not checked.

Consider the arguments in the Appeal Brief or Reply Brief previously filed on _____

Other _____

Enclosed

Amendment/Reply

Information Disclosure Statement (IDS)

Affidavit(s)/ Declaration(s)

Other _____

MISCELLANEOUS

Suspension of action on the above-identified application is requested under 37 CFR 1.103(c) for a period of months _____
(Period of suspension shall not exceed 3 months; Fee under 37 CFR 1.17(i) required)

Other _____

FEES

The RCE fee under 37 CFR 1.17(e) is required by 37 CFR 1.114 when the RCE is filed.

The Director is hereby authorized to charge any underpayment of fees, or credit any overpayments, to Deposit Account No _____

SIGNATURE OF APPLICANT, ATTORNEY, OR AGENT REQUIRED

Patent Practitioner Signature

Applicant Signature

Doc code: RCEX

Doc description: Request for Continued Examination (RCE)

PTO/SB/30EFS (07-09)

Approved for use through 07/31/2012. OMB 0651-0031

U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE

Under the Paperwork Reduction Act of 1995, no persons are required to respond to a collection of information unless it contains a valid OMB control number.

Signature of Registered U.S. Patent Practitioner			
Signature	/Thomas A. Hassing/	Date (YYYY-MM-DD)	2013-01-24
Name	Thomas A. Hassing	Registration Number	36159

This collection of information is required by 37 CFR 1.114. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.11 and 1.14. This collection is estimated to take 12 minutes to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450.

If you need assistance in completing the form, call 1-800-PTO-9199 and select option 2.

Privacy Act Statement

The Privacy Act of 1974 (P.L. 93-579) requires that you be given certain information in connection with your submission of the attached form related to a patent application or patent. Accordingly, pursuant to the requirements of the Act, please be advised that: (1) the general authority for the collection of this information is 35 U.S.C. 2(b)(2); (2) furnishing of the information solicited is voluntary; and (3) the principal purpose for which the information is used by the U.S. Patent and Trademark Office is to process and/or examine your submission related to a patent application or patent. If you do not furnish the requested information, the U.S. Patent and Trademark Office may not be able to process and/or examine your submission, which may result in termination of proceedings or abandonment of the application or expiration of the patent.

The information provided by you in this form will be subject to the following routine uses:

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3. A record in this system of records may be disclosed, as a routine use, to a Member of Congress submitting a request involving an individual, to whom the record pertains, when the individual has requested assistance from the Member with respect to the subject matter of the record.
4. A record in this system of records may be disclosed, as a routine use, to a contractor of the Agency having need for the information in order to perform a contract. Recipients of information shall be required to comply with the requirements of the Privacy Act of 1974, as amended, pursuant to 5 U.S.C. 552a(m).
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6. A record in this system of records may be disclosed, as a routine use, to another federal agency for purposes of National Security review (35 U.S.C. 181) and for review pursuant to the Atomic Energy Act (42 U.S.C. 218(c)).
7. A record from this system of records may be disclosed, as a routine use, to the Administrator, General Services, or his/her designee, during an inspection of records conducted by GSA as part of that agency's responsibility to recommend improvements in records management practices and programs, under authority of 44 U.S.C. 2904 and 2906. Such disclosure shall be made in accordance with the GSA regulations governing inspection of records for this purpose, and any other relevant (i.e., GSA or Commerce) directive. Such disclosure shall not be used to make determinations about individuals.
8. A record from this system of records may be disclosed, as a routine use, to the public after either publication of the application pursuant to 35 U.S.C. 122(b) or issuance of a patent pursuant to 35 U.S.C. 151. Further, a record may be disclosed, subject to the limitations of 37 CFR 1.14, as a routine use, to the public if the record was filed in an application which became abandoned or in which the proceedings were terminated and which application is referenced by either a published application, an application open to public inspections or an issued patent.
9. A record from this system of records may be disclosed, as a routine use, to a Federal, State, or local law enforcement agency, if the USPTO becomes aware of a violation or potential violation of law or regulation.

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Application of:)	
)	
David Birnbaum et al.	)	Examiner: Sitta, Grant
)	
Application No. 13/472,698	)	Art Unit: 2694
)	
Filed: May 16, 2012)	
	)	Confirmation No. 6404
For: METHOD AND APPARATUS FOR)	
PRODUCING A DYNAMIC HAPTIC)	
EFFECT)	

Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

AMENDMENT AND RESPONSE

Sir:

In response to the Advisory Action mailed December 20, 2012, Applicants respectfully request the Examiner enter the following amendments and consider the following remarks.

CERTIFICATE OF ELECTRONIC FILING

I hereby certify that this correspondence is being deposited via electronic filing through the United States Patent and Trademark Electronic Filing System on:

January 24, 2013
Date of Deposit

Dawn Rose
(Type or print name of person mailing paper)

/Dawn Rose/
(Signature of person mailing paper)

January 24, 2013
Date

AMENDMENTS TO THE CLAIMS

1. (Currently Amended) A method of producing a haptic effect comprising:
receiving a first gesture signal;
receiving a second gesture signal;
generating a dynamic interaction parameter representing a haptic effect that evolves over time as it responds to one or more input parameters using a mapping schema to map an input parameter onto a changing property of the haptic effect according to the first gesture signal and the second gesture signal; and
applying a drive signal to a haptic output device for continuously modifying the haptic effect according to the dynamic interaction parameter.

2. (Original) The method of claim 1 wherein the first or second gesture signal comprises a vector signal.

3. (Original) The method of claim 1 wherein the first or second gesture signal comprises an on-screen signal.

4. (Previously presented) The method of claim 1 wherein generating a dynamic interaction parameter comprises generating a dynamic interaction parameter from a difference between the first gesture signal and the second gesture signal.

5. (Previously presented) The method of claim 1 wherein generating a dynamic interaction parameter comprises generating a dynamic interaction parameter using the first gesture signal and the second gesture signal and a physical model.

6. (Previously presented) The method of claim 1 wherein generating a dynamic interaction parameter comprises generating a dynamic interaction parameter using the first gesture signal and the second gesture signal and an animation.

7. (Previously presented) The method of claim 1 further comprising:
receiving a first device sensor signal;
receiving a second device sensor signal; and
wherein generating a dynamic interaction parameter comprises generating a dynamic interaction parameter using the first gesture signal and the second gesture signal and the first device sensor signal and the second device sensor signal.

8. (Original) The method of claim 1 wherein the first device sensor signal or the second device sensor signal comprises an accelerometer signal.

9. (Original) The method of claim 1 wherein the first device sensor signal or the second device sensor signal comprises a gyroscope signal.

10. (Original) The method of claim 1 wherein the first device sensor signal or the second device sensor signal comprises an ambient signal.

11. (Original) The method of claim 1 wherein the first device sensor signal or the second device sensor signal comprises a virtual sensor signal.

12. (Currently Amended) A haptic effect enabled system comprising:
a haptic output device;

a drive module electronically coupled to the haptic output device for receiving a first gesture signal, receiving a second gesture signal, and generating a dynamic interaction parameter representing a haptic effect that evolves over time as it responds to one or more input parameters using a mapping schema to map an input parameter onto a changing property of the haptic effect according to the first gesture signal and the second gesture signal; and

a drive circuit electronically coupled to the drive module and the haptic output device for applying a drive signal to the haptic output device for continuously modifying the haptic effect according to the dynamic interaction parameter.

13. (Original) The system of claim 12 wherein the first or second gesture signal comprises a vector signal.

14. (Original) The system of claim 12 wherein the first or second gesture signal comprises an on-screen signal.

15. (Previously presented) The system of claim 12 wherein the drive module comprises a drive module for generating a dynamic interaction parameter from a difference between the first gesture signal and the second gesture signal.

16. (Previously presented) The system of claim 12 wherein the drive module comprises a drive module for generating a dynamic interaction parameter using the first gesture signal and the second gesture signal and a physical model.

17. (Previously presented) The system of claim 12 wherein the drive module comprises a drive module for generating a dynamic interaction parameter using the first gesture signal and the second gesture signal and an animation.

18. (Previously presented) The system of claim 12 wherein the drive module comprises a drive module for receiving a first device sensor signal, receiving a second device sensor signal, and generating a dynamic interaction parameter using the first gesture signal and the second gesture signal and the first device sensor signal and the second device sensor signal.

19. (Original) The system of claim 12 wherein the first device sensor signal or the second device sensor signal comprises an accelerometer signal.

20. (Original) The system of claim 12 wherein the first device sensor signal or the second device sensor signal comprises a gyroscope signal.

21. (Original) The system of claim 12 wherein the first device sensor signal or the second device sensor signal comprises an ambient signal.

22. (Original) The system of claim 12 wherein the first device sensor signal or the second device sensor signal comprises a virtual sensor signal.

23. (Currently Amended) A non-transitory computer readable medium having instructions stored thereon that, when executed by a processor, causes the processor to produce a haptic effect, the instructions comprising:

receiving a first gesture signal;

receiving a second gesture signal;

generating a dynamic interaction parameter representing a haptic effect that evolves over time as it responds to one or more input parameters using a mapping schema to map an input parameter onto a changing property of the haptic effect according to the first gesture signal and the second gesture signal; and

applying a drive signal to a haptic output device for continuously modifying the haptic effect according to the dynamic interaction parameter.

24. (Previously presented) The non-transitory computer readable medium of claim 23, wherein the first or second gesture signal comprises a vector signal.

25. (Previously presented) The non-transitory computer readable medium of claim 23, wherein the first or second gesture signal comprises an on-screen signal.

26. (Previously presented) The non-transitory computer readable medium of claim 23, wherein generating a dynamic interaction parameter comprises generating a dynamic interaction parameter from a difference between the first gesture signal and the second gesture signal.

27. (Previously presented) The non-transitory computer readable medium of claim 23, wherein generating a dynamic interaction parameter comprises generating a dynamic interaction parameter using the first gesture signal and the second gesture signal and a physical model.

28. (Previously presented) The non-transitory computer readable medium of claim 23, wherein generating a dynamic interaction parameter comprises generating a dynamic interaction parameter using the first gesture signal and the second gesture signal and an animation.

29. (Previously presented) The non-transitory computer readable medium of claim 23, further comprising:

receiving a first device sensor signal;

receiving a second device sensor signal; and

wherein generating a dynamic interaction parameter comprises generating a dynamic interaction parameter using the first gesture signal and the second gesture signal and the first device sensor signal and the second device sensor signal.

30. (Previously presented) The non-transitory computer readable medium of claim 23, wherein the first device sensor signal or the second device sensor signal comprises a signal selected from the list consisting of accelerometer, gyroscope, ambient, or virtual.

REMARKS

Reconsideration of this application as amended is respectfully requested. Claims 1-30 are pending and Claims 1, 12 and 23 are amended. No new matter is being added by way of this amendment.

ADVISORY ACTION

In the Advisory Action mailed December 20, 2012, the Examiner did not enter the proposed amendments from Applicants' response under 37 CFR § 1.116 dated December 10, 2012. The Examiner further cited Daniel E. Fish, U. S. Patent App. 2002/0044132 (hereinafter "Fish") with respect to dynamic haptic feedback.

REJECTION UNDER 35 U.S.C. § 102

The Examiner is rejecting Claims 1, 3, 5, 7-12, 14, 16, 18-23, 25, 27, and 29-30 under 35 U.S.C. 102(e) as being anticipated by Birnbaum et al., U. S. Patent App. No. 2010/0017489 (hereinafter "Birnbaum"). Applicants respectfully disagree. Applicants have amended Claims 1, 12 and 23 to recite a dynamic interaction parameter representing a haptic effect that evolves over time as it responds to one or more input parameters using a mapping schema to map an input parameter onto a changing property of the haptic effect in order to produce haptic output for continuously modifying the haptic effect according to the dynamic interaction parameter. Support for this amendment may be found in the published application at least in paragraphs [0027], [0028] and [0060].

As previously discussed in the response filed August 24, 2012, Applicants respectfully submit that Birnbaum does not disclose or imply the use of a dynamic interaction parameter

representing a haptic effect that evolves over time as it responds to one or more input parameters using a mapping schema to map an input parameter onto a changing property of the haptic effect in order to produce haptic output for continuously modifying the haptic effect according to the dynamic interaction parameter, because Birnbaum is silent with respect to a dynamic interaction parameter as claimed in the presently amended application. Therefore, Applicants respectfully submit that currently amended Claims 1, 12 and 23 distinguish over Birnbaum and the rejection under 35 U.S.C. § 102(e) should be removed.

Because Claims 3, 5, 7-12, 14, 16, 18-23, 25, 27, and 29-30 depend from amended Claims 1, 12 and 23, they inherit all of the limitations of the independent claims. Therefore, Applicants respectfully submit that Claims 3, 5, 7-12, 14, 16, 18-23, 25, 27, and 29-30 distinguish over Birnbaum for at least the same reasons as described above for amended Claims 1, 12 and 23, and the rejection under 35 U.S.C. § 102(e) should be removed.

Applicants note that Fish does not disclose or imply using a mapping schema to map an input parameter onto a changing property of the haptic effect.

REJECTION UNDER 35 U.S.C. § 103

The Examiner is rejecting Claims 2, 4, 6, 13, 15, 17, 24, 26 and 28 under 35 U.S.C. 103(a) as being unpatentable over Birnbaum in view of Westerman et al., U. S. Patent App. 2002/0015024 (hereinafter “Westerman”). Applicants respectfully disagree.

Birnbaum has been discussed above. As previously discussed in the response filed August 24, 2012, Applicants respectfully submit that Westerman does not disclose or imply the use of a dynamic interaction parameter representing a haptic effect that evolves over time as it responds to one or more input parameters using a mapping schema to map an input parameter onto a changing property of the haptic effect in order to produce haptic output for continuously

modifying the haptic effect according to the dynamic interaction parameter, because Westerman is silent with respect to a dynamic interaction parameter as claimed in the presently amended application.

Because Claims 2, 4, 6, 13, 15, 17, 24, 26 and 28 depend from amended Claims 1, 12 and 23, they inherit all of the limitations of the independent claims. Therefore, Applicants respectfully submit that one of ordinary skill in the art would not have been able to combine Birnbaum with Westerman to produce the presently claimed invention without undue experimentation and the rejection of Claims 2, 4, 6, 13, 15, 17, 24, 26 and 28 under 35 U.S.C. § 103(a) should be removed.

CONCLUSION

For at least the foregoing reasons, Applicants respectfully submit that the rejections have been overcome. Therefore, all pending claims are in condition for allowance, and reconsideration and allowance are requested.

Respectfully submitted,

IMMERSION CORPORATION

Dated: January 24, 2013

/Thomas A. Hassing/
Thomas A. Hassing
Reg. No. 36,159

30 Rio Robles
San Jose, CA 95134
(408) 467-1900

Electronic Patent Application Fee Transmittal

Application Number:	13472698			
Filing Date:	16-May-2012			
Title of Invention:	METHOD AND APPARATUS FOR PRODUCING A DYNAMIC HAPTIC EFFECT			
First Named Inventor/Applicant Name:	David BIRNBAUM			
Filer:	Catherine C. Maresh/Dawn Rose			
Attorney Docket Number:	IMM389C1			
Filed as Large Entity				
Utility under 35 USC 111(a) Filing Fees				
Description	Fee Code	Quantity	Amount	Sub-Total in USD(\$)
Basic Filing:				
Pages:				
Claims:				
Miscellaneous-Filing:				
Petition:				
Patent-Appeals-and-Interference:				
Post-Allowance-and-Post-Issuance:				
Extension-of-Time:				

Description	Fee Code	Quantity	Amount	Sub-Total in USD(\$)
Miscellaneous:				
Request for continued examination	1801	1	930	930
Total in USD (\$)				930

Electronic Acknowledgement Receipt

EFS ID:	14779471
Application Number:	13472698
International Application Number:	
Confirmation Number:	6404
Title of Invention:	METHOD AND APPARATUS FOR PRODUCING A DYNAMIC HAPTIC EFFECT
First Named Inventor/Applicant Name:	David BIRNBAUM
Customer Number:	103772
Filer:	Catherine C. Maresh/Dawn Rose
Filer Authorized By:	Catherine C. Maresh
Attorney Docket Number:	IMM389C1
Receipt Date:	24-JAN-2013
Filing Date:	16-MAY-2012
Time Stamp:	12:48:35
Application Type:	Utility under 35 USC 111(a)

Payment information:

Submitted with Payment	yes
Payment Type	Electronic Funds Transfer
Payment was successfully received in RAM	\$930
RAM confirmation Number	13334
Deposit Account	
Authorized User	

File Listing:

Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
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1	Request for Continued Examination (RCE)	IMM389C1RCE.pdf	700034	no	3
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Warnings:					
Information:					
2	Amendment After Final	IMM389C1Responseto2012-12-20AAFINAL.pdf	42246	no	10
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Warnings:					
Information:					
3	Fee Worksheet (SB06)	fee-info.pdf	30577	no	2
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Warnings:					
Information:					
Total Files Size (in bytes):			772857		
<p>This Acknowledgement Receipt evidences receipt on the noted date by the USPTO of the indicated documents, characterized by the applicant, and including page counts, where applicable. It serves as evidence of receipt similar to a Post Card, as described in MPEP 503.</p> <p><u>New Applications Under 35 U.S.C. 111</u> If a new application is being filed and the application includes the necessary components for a filing date (see 37 CFR 1.53(b)-(d) and MPEP 506), a Filing Receipt (37 CFR 1.54) will be issued in due course and the date shown on this Acknowledgement Receipt will establish the filing date of the application.</p> <p><u>National Stage of an International Application under 35 U.S.C. 371</u> If a timely submission to enter the national stage of an international application is compliant with the conditions of 35 U.S.C. 371 and other applicable requirements a Form PCT/DO/EO/903 indicating acceptance of the application as a national stage submission under 35 U.S.C. 371 will be issued in addition to the Filing Receipt, in due course.</p> <p><u>New International Application Filed with the USPTO as a Receiving Office</u> If a new international application is being filed and the international application includes the necessary components for an international filing date (see PCT Article 11 and MPEP 1810), a Notification of the International Application Number and of the International Filing Date (Form PCT/RO/105) will be issued in due course, subject to prescriptions concerning national security, and the date shown on this Acknowledgement Receipt will establish the international filing date of the application.</p>					

INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)	Application Number		13472698	
	Filing Date		2012-05-16	
	First Named Inventor	David Birnbaum		
	Art Unit	2694		
	Examiner Name	Sitta, Grant		
	Attorney Docket Number	IMM389C1		

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Examiner Initial*	Cite No	Patent Number	Kind Code ¹	Issue Date	Name of Patentee or Applicant of cited Document	Pages, Columns, Lines where Relevant Passages or Relevant Figures Appear	
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	1	WO 97/20305			1997-06-05	Tremblay, et al.		<input type="checkbox"/>

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Examiner Initials*	Cite No	Include name of the author (in CAPITAL LETTERS), title of the article (when appropriate), title of the item (book, magazine, journal, serial, symposium, catalog, etc), date, pages(s), volume-issue number(s), publisher, city and/or country where published.					T ⁵

INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)	Application Number	13472698
	Filing Date	2012-05-16
	First Named Inventor	David Birnbaum
	Art Unit	2694
	Examiner Name	Sitta, Grant
	Attorney Docket Number	IMM389C1

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EXAMINER SIGNATURE

Examiner Signature		Date Considered	
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*EXAMINER: Initial if reference considered, whether or not citation is in conformance with MPEP 609. Draw line through a citation if not in conformance and not considered. Include copy of this form with next communication to applicant.

¹ See Kind Codes of USPTO Patent Documents at www.USPTO.GOV or MPEP 901.04. ² Enter office that issued the document, by the two-letter code (WIPO Standard ST.3). ³ For Japanese patent documents, the indication of the year of the reign of the Emperor must precede the serial number of the patent document. ⁴ Kind of document by the appropriate symbols as indicated on the document under WIPO Standard ST.16 if possible. ⁵ Applicant is to place a check mark here if English language translation is attached.

INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)	Application Number	13472698
	Filing Date	2012-05-16
	First Named Inventor	David Birnbaum
	Art Unit	2694
	Examiner Name	Sitta, Grant
	Attorney Docket Number	IMM389C1

CERTIFICATION STATEMENT

Please see 37 CFR 1.97 and 1.98 to make the appropriate selection(s):

That each item of information contained in the information disclosure statement was first cited in any communication from a foreign patent office in a counterpart foreign application not more than three months prior to the filing of the information disclosure statement. See 37 CFR 1.97(e)(1).

OR

That no item of information contained in the information disclosure statement was cited in a communication from a foreign patent office in a counterpart foreign application, and, to the knowledge of the person signing the certification after making reasonable inquiry, no item of information contained in the information disclosure statement was known to any individual designated in 37 CFR 1.56(c) more than three months prior to the filing of the information disclosure statement. See 37 CFR 1.97(e)(2).

See attached certification statement.

The fee set forth in 37 CFR 1.17 (p) has been submitted herewith.

A certification statement is not submitted herewith.

SIGNATURE

A signature of the applicant or representative is required in accordance with CFR 1.33, 10.18. Please see CFR 1.4(d) for the form of the signature.

Signature	/Thomas A. Hassing/	Date (YYYY-MM-DD)	2013-02-21
Name/Print	Thomas A. Hassing	Registration Number	36,159

This collection of information is required by 37 CFR 1.97 and 1.98. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.14. This collection is estimated to take 1 hour to complete, including gathering, preparing and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. **DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.**

Privacy Act Statement

The Privacy Act of 1974 (P.L. 93-579) requires that you be given certain information in connection with your submission of the attached form related to a patent application or patent. Accordingly, pursuant to the requirements of the Act, please be advised that: (1) the general authority for the collection of this information is 35 U.S.C. 2(b)(2); (2) furnishing of the information solicited is voluntary; and (3) the principal purpose for which the information is used by the U.S. Patent and Trademark Office is to process and/or examine your submission related to a patent application or patent. If you do not furnish the requested information, the U.S. Patent and Trademark Office may not be able to process and/or examine your submission, which may result in termination of proceedings or abandonment of the application or expiration of the patent.

The information provided by you in this form will be subject to the following routine uses:

1. The information on this form will be treated confidentially to the extent allowed under the Freedom of Information Act (5 U.S.C. 552) and the Privacy Act (5 U.S.C. 552a). Records from this system of records may be disclosed to the Department of Justice to determine whether the Freedom of Information Act requires disclosure of these records.
2. A record from this system of records may be disclosed, as a routine use, in the course of presenting evidence to a court, magistrate, or administrative tribunal, including disclosures to opposing counsel in the course of settlement negotiations.
3. A record in this system of records may be disclosed, as a routine use, to a Member of Congress submitting a request involving an individual, to whom the record pertains, when the individual has requested assistance from the Member with respect to the subject matter of the record.
4. A record in this system of records may be disclosed, as a routine use, to a contractor of the Agency having need for the information in order to perform a contract. Recipients of information shall be required to comply with the requirements of the Privacy Act of 1974, as amended, pursuant to 5 U.S.C. 552a(m).
5. A record related to an International Application filed under the Patent Cooperation Treaty in this system of records may be disclosed, as a routine use, to the International Bureau of the World Intellectual Property Organization, pursuant to the Patent Cooperation Treaty.
6. A record in this system of records may be disclosed, as a routine use, to another federal agency for purposes of National Security review (35 U.S.C. 181) and for review pursuant to the Atomic Energy Act (42 U.S.C. 218(c)).
7. A record from this system of records may be disclosed, as a routine use, to the Administrator, General Services, or his/her designee, during an inspection of records conducted by GSA as part of that agency's responsibility to recommend improvements in records management practices and programs, under authority of 44 U.S.C. 2904 and 2906. Such disclosure shall be made in accordance with the GSA regulations governing inspection of records for this purpose, and any other relevant (i.e., GSA or Commerce) directive. Such disclosure shall not be used to make determinations about individuals.
8. A record from this system of records may be disclosed, as a routine use, to the public after either publication of the application pursuant to 35 U.S.C. 122(b) or issuance of a patent pursuant to 35 U.S.C. 151. Further, a record may be disclosed, subject to the limitations of 37 CFR 1.14, as a routine use, to the public if the record was filed in an application which became abandoned or in which the proceedings were terminated and which application is referenced by either a published application, an application open to public inspections or an issued patent.
9. A record from this system of records may be disclosed, as a routine use, to a Federal, State, or local law enforcement agency, if the USPTO becomes aware of a violation or potential violation of law or regulation.

Electronic Patent Application Fee Transmittal

Application Number:	13472698			
Filing Date:	16-May-2012			
Title of Invention:	METHOD AND APPARATUS FOR PRODUCING A DYNAMIC HAPTIC EFFECT			
First Named Inventor/Applicant Name:	David BIRNBAUM			
Filer:	Catherine C. Maresh/Dawn Rose			
Attorney Docket Number:	IMM389C1			
Filed as Large Entity				
Utility under 35 USC 111(a) Filing Fees				
Description	Fee Code	Quantity	Amount	Sub-Total in USD(\$)
Basic Filing:				
Pages:				
Claims:				
Miscellaneous-Filing:				
Petition:				
Patent-Appeals-and-Interference:				
Post-Allowance-and-Post-Issuance:				
Extension-of-Time:				

Description	Fee Code	Quantity	Amount	Sub-Total in USD(\$)
Miscellaneous:				
Submission- Information Disclosure Stmt	1806	1	180	180
Total in USD (\$)				180

Electronic Acknowledgement Receipt

EFS ID:	15013142
Application Number:	13472698
International Application Number:	
Confirmation Number:	6404
Title of Invention:	METHOD AND APPARATUS FOR PRODUCING A DYNAMIC HAPTIC EFFECT
First Named Inventor/Applicant Name:	David BIRNBAUM
Customer Number:	103772
Filer:	Catherine C. Maresh/Dawn Rose
Filer Authorized By:	Catherine C. Maresh
Attorney Docket Number:	IMM389C1
Receipt Date:	21-FEB-2013
Filing Date:	16-MAY-2012
Time Stamp:	12:48:19
Application Type:	Utility under 35 USC 111(a)

Payment information:

Submitted with Payment	yes
Payment Type	Electronic Funds Transfer
Payment was successfully received in RAM	\$180
RAM confirmation Number	14068
Deposit Account	
Authorized User	

File Listing:

Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
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1	Information Disclosure Statement (IDS) Form (SB08)	imm389c1ds.pdf	612145	no	4
			9f12073fc1d9f39ed4c82e22053cca1e2ecff72a		
Warnings:					
Information:					
A U.S. Patent Number Citation or a U.S. Publication Number Citation is required in the Information Disclosure Statement (IDS) form for autoloading of data into USPTO systems. You may remove the form to add the required data in order to correct the Informational Message if you are citing U.S. References. If you chose not to include U.S. References, the image of the form will be processed and be made available within the Image File Wrapper (IFW) system. However, no data will be extracted from this form. Any additional data such as Foreign Patent Documents or Non Patent Literature will be manually reviewed and keyed into USPTO systems.					
2	Fee Worksheet (SB06)	fee-info.pdf	30525	no	2
			8b4a795eceb4b2e016472fae109d9abe550c79a9		
Warnings:					
Information:					
Total Files Size (in bytes):			642670		
<p>This Acknowledgement Receipt evidences receipt on the noted date by the USPTO of the indicated documents, characterized by the applicant, and including page counts, where applicable. It serves as evidence of receipt similar to a Post Card, as described in MPEP 503.</p> <p><u>New Applications Under 35 U.S.C. 111</u> If a new application is being filed and the application includes the necessary components for a filing date (see 37 CFR 1.53(b)-(d) and MPEP 506), a Filing Receipt (37 CFR 1.54) will be issued in due course and the date shown on this Acknowledgement Receipt will establish the filing date of the application.</p> <p><u>National Stage of an International Application under 35 U.S.C. 371</u> If a timely submission to enter the national stage of an international application is compliant with the conditions of 35 U.S.C. 371 and other applicable requirements a Form PCT/DO/EO/903 indicating acceptance of the application as a national stage submission under 35 U.S.C. 371 will be issued in addition to the Filing Receipt, in due course.</p> <p><u>New International Application Filed with the USPTO as a Receiving Office</u> If a new international application is being filed and the international application includes the necessary components for an international filing date (see PCT Article 11 and MPEP 1810), a Notification of the International Application Number and of the International Filing Date (Form PCT/RO/105) will be issued in due course, subject to prescriptions concerning national security, and the date shown on this Acknowledgement Receipt will establish the international filing date of the application.</p>					



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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
13/472,698	05/16/2012	David BIRNBAUM	IMM389C1	6404
103772	7590	06/18/2013	EXAMINER	
Immersion Corporation 30 Rio Robles San Jose, CA 95134			SITTA, GRANT	
			ART UNIT	PAPER NUMBER
			2694	
			MAIL DATE	DELIVERY MODE
			06/18/2013	PAPER

Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

Office Action Summary	Application No. 13/472,698	Applicant(s) BIRNBAUM ET AL.	
	Examiner GRANT SITTA	Art Unit 2694	AIA (First Inventor to File) Status No

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) Responsive to communication(s) filed on 24 January 2013.
 A declaration(s)/affidavit(s) under **37 CFR 1.130(b)** was/were filed on _____.
- 2a) This action is **FINAL**. 2b) This action is non-final.
- 3) An election was made by the applicant in response to a restriction requirement set forth during the interview on _____; the restriction requirement and election have been incorporated into this action.
- 4) Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 5) Claim(s) 1-30 is/are pending in the application.
5a) Of the above claim(s) _____ is/are withdrawn from consideration.
- 6) Claim(s) _____ is/are allowed.
- 7) Claim(s) 1-30 is/are rejected.
- 8) Claim(s) _____ is/are objected to.
- 9) Claim(s) _____ are subject to restriction and/or election requirement.

* If any claims have been determined allowable, you may be eligible to benefit from the **Patent Prosecution Highway** program at a participating intellectual property office for the corresponding application. For more information, please see http://www.uspto.gov/patents/init_events/pph/index.jsp or send an inquiry to PPHfeedback@uspto.gov.

Application Papers

- 10) The specification is objected to by the Examiner.
- 11) The drawing(s) filed on 16 May 2012 is/are: a) accepted or b) objected to by the Examiner.
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

Priority under 35 U.S.C. § 119

- 12) Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

Certified copies:

- a) All b) Some * c) None of the:
1. Certified copies of the priority documents have been received.
 2. Certified copies of the priority documents have been received in Application No. _____.
 3. Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Interim copies:

- a) All b) Some c) None of the: Interim copies of the priority documents have been received.

Attachment(s)

- 1) Notice of References Cited (PTO-892)
- 2) Information Disclosure Statement(s) (PTO/SB/08)
Paper No(s)/Mail Date 2/21/2013, 1/23/2013
- 3) Interview Summary (PTO-413)
Paper No(s)/Mail Date. _____
- 4) Other: _____

DETAILED ACTION

Claim Rejections - 35 USC § 103

1. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

2. The factual inquiries set forth in *Graham v. John Deere Co.*, 383 U.S. 1, 148 USPQ 459 (1966), that are applied for establishing a background for determining obviousness under 35 U.S.C. 103(a) are summarized as follows:

1. Determining the scope and contents of the prior art.
2. Ascertaining the differences between the prior art and the claims at issue.
3. Resolving the level of ordinary skill in the pertinent art.
4. Considering objective evidence present in the application indicating obviousness or nonobviousness.

3. Claims 1,-3, 5, 7-14, 16, 18-25, 27 and 29-30 are rejected under 35 U.S.C. 103(a) as being unpatentable over Birnbaum et al 2010/0017489, hereinafter Birnbaum further in view of Rosenberg et al (6,278,439) hereinafter, Rosendberg.

1. In regards to claim 1, Birnbaum teaches a method of producing a haptic effect comprising (abstract):

receiving a first gesture signal [0032, 0074-0076];

receiving a second gesture signal (fig. 1 (114) "sensors");

generating a dynamic [0069-0070] (fig. 3 (309)s) interaction parameter using the first gesture signal and the second gesture signal ([0032-0033] for example tilt and acceleration) ; and Examiner notes, [0030] of the current specification that defines a "gesture". A simple gesture may be a touch, or "finger on" gesture and lifting the "finger off", could be a second gesture. Therefore, a simple touch and release is two gestures.

applying a drive signal to a haptic actuator according to the dynamic interaction parameter [0036] (fig. 1 (118)).

Birnbaum fails to teach a haptic effect that evolves over time as it responds to one or more input parameters using a mapping schema to map an input parameter onto a changing property of the haptic effect

applying a drive signal to a haptic output device for continuously modifying the haptic effect according to the dynamic interaction parameter.

However, Rosenberg teaches a haptic effect that evolves over time as it responds to one or more input parameters (fig. 5 (204) and (206)) and (208)) using a mapping schema to map an input parameter onto a changing property of the haptic effect (col. 15-16, lines 54-47)

applying a drive signal to a haptic output device for continuously modifying the haptic effect according to the dynamic interaction parameter (col. 3, lines 36-55, col. 12-14, 65 "condition" related sensations, or "effect" related sensations).

It would have been obvious to one of ordinary skill in the art to modify the haptic device of Birnbaum to further include a haptic effect that evolves over time as it responds to one or more input parameters using a mapping schema to map an input

parameter onto a changing property of the haptic effect applying a drive signal to a haptic output device for continuously modifying the haptic effect according to the dynamic interaction parameter as taught by Rosenberg in order to provide an impulse-shaped force signal that is used to provide feel sensations to a user manipulating a force feedback device. The force signal includes an impulse of high magnitude and a steady-state force following the impulse, which provides a realistic sensation of constant force without having to continuously output a high magnitude force. That is, the present invention advantageously manipulates only those variables (impulse and steady state) of the force signal that have a significant impact on the perception of the user, reducing the complexity of the required hardware and minimizing the computational burden of representing diverse feel sensations. In addition, the local processor technology reduces the computational burden from the host processor. Furthermore, the overlapping of data in force signal transmissions reduces the computation burden of checking for errors and handshaking with a sending device. These improvements allow a computer system to provide accurate and realistic force feedback using a low-cost force feedback device and is thus ideal for the mass market of home computer systems.

2. In regards to claim 12, Birnbaum teaches a haptic effect enabled system comprising (abstract):

a haptic actuator [0032, 0074-0076];

a drive module electronically coupled to the actuator for receiving a first gesture signal (fig. 1 (114) "sensors");

receiving a second gesture signal, and generating a dynamic [0069-0070] (fig. 3 (309)s) interaction parameter using the first gesture signal and the second gesture signal ([0032-0033] for example tilt and acceleration) and

a drive circuit electronically coupled to the drive module and the actuator for applying a drive signal to the actuator according to the dynamic interaction parameter [0036] (fig. 1 (118)).

Birnbaum fails to teach a haptic effect that evolves over time as it responds to one or more input parameters using a mapping schema to map an input parameter onto a changing property of the haptic effect

applying a drive signal to a haptic output device for continuously modifying the haptic effect according to the dynamic interaction parameter.

However, Rosenberg teaches a haptic effect that evolves over time as it responds to one or more input parameters (fig. 5 (204) and (206)) and (208)) using a mapping schema to map an input parameter onto a changing property of the haptic effect (col. 15-16, lines 54-47)

applying a drive signal to a haptic output device for continuously modifying the haptic effect according to the dynamic interaction parameter (col. 3, lines 36-55, col. 12-14, 65 "condition" related sensations, or "effect" related sensations).

It would have been obvious to one of ordinary skill in the art to modify the haptic device of Birnbaum to further include a haptic effect that evolves over time as it

responds to one or more input parameters using a mapping schema to map an input parameter onto a changing property of the haptic effect applying a drive signal to a haptic output device for continuously modifying the haptic effect according to the dynamic interaction parameter as taught by Rosenberg in order to provide an impulse-shaped force signal that is used to provide feel sensations to a user manipulating a force feedback device. The force signal includes an impulse of high magnitude and a steady-state force following the impulse, which provides a realistic sensation of constant force without having to continuously output a high magnitude force. That is, the present invention advantageously manipulates only those variables (impulse and steady state) of the force signal that have a significant impact on the perception of the user, reducing the complexity of the required hardware and minimizing the computational burden of representing diverse feel sensations. In addition, the local processor technology reduces the computational burden from the host processor. Furthermore, the overlapping of data in force signal transmissions reduces the computation burden of checking for errors and handshaking with a sending device. These improvements allow a computer system to provide accurate and realistic force feedback using a low-cost force feedback device and is thus ideal for the mass market of home computer systems.

3. In regards to claim 23, Birnbaum teaches a non-transitory computer readable medium having instructions stored thereon that, when executed by a processor, causes the processor to produce a haptic effect, the instructions comprising (abstract):

receiving a first gesture signal [0032, 0074-0076];

receiving a second gesture signal (fig. 1 (114) "sensors");
generating a dynamic [0069-0070] (fig. 3 (309)s) interaction parameter using the first gesture signal and the second gesture signal ([0031-0033] for example tilt and acceleration) and

applying a drive signal to a haptic actuator according to the dynamic interaction parameter [0036] (fig. 1 (118)).

Birnbaum fails to teach a haptic effect that evolves over time as it responds to one or more input parameters using a mapping schema to map an input parameter onto a changing property of the haptic effect

applying a drive signal to a haptic output device for continuously modifying the haptic effect according to the dynamic interaction parameter.

However, Rosenberg teaches a haptic effect that evolves over time as it responds to one or more input parameters (fig. 5 (204) and (206)) and (208)) using a mapping schema to map an input parameter onto a changing property of the haptic effect (col. 15-16, lines 54-47)

applying a drive signal to a haptic output device for continuously modifying the haptic effect according to the dynamic interaction parameter (col. 3, lines 36-55, col. 12-14, 65 "condition" related sensations, or "effect" related sensations).

It would have been obvious to one of ordinary skill in the art to modify the haptic device of Birnbaum to further include a haptic effect that evolves over time as it responds to one or more input parameters using a mapping schema to map an input parameter onto a changing property of the haptic effect applying a drive signal to a

haptic output device for continuously modifying the haptic effect according to the dynamic interaction parameter as taught by Rosenberg in order to provide an impulse-shaped force signal that is used to provide feel sensations to a user manipulating a force feedback device. The force signal includes an impulse of high magnitude and a steady-state force following the impulse, which provides a realistic sensation of constant force without having to continuously output a high magnitude force. That is, the present invention advantageously manipulates only those variables (impulse and steady state) of the force signal that have a significant impact on the perception of the user, reducing the complexity of the required hardware and minimizing the computational burden of representing diverse feel sensations. In addition, the local processor technology reduces the computational burden from the host processor. Furthermore, the overlapping of data in force signal transmissions reduces the computation burden of checking for errors and handshaking with a sending device. These improvements allow a computer system to provide accurate and realistic force feedback using a low-cost force feedback device and is thus ideal for the mass market of home computer systems.

4. In regards to claims 2, 13, and 24 Birnbaum as modified by Rosenberg teaches wherein the first or second gesture signal comprises a vector signal (col. 17-18, lines 65-14 Rosenberg).

5. In regards to claims 3, 14, and 25 Birnbaum as modified by Rosenberg teaches the method of claim 1 wherein the first or second gesture signal comprises an on-screen signal (fig. 5a and 5b (520 and 530) Rosenberg)

6. In regards to claim 5, 16, and 27 Birnbaum as modified by Rosenberg teaches the method of claim 1 wherein generating a dynamic interaction parameter comprises generating a dynamic interaction parameter using the first gesture signal and the second gesture signal and a physical model [0025] Birnbaum.

7. In regards to claims 7, 18 and 29, Birnbaum as modified by Rosenberg teaches the method of claim 1 further comprising (abstract):

receiving a first device sensor signal [0030]; Birnbaum

receiving a second device sensor signal (fig. 3b 302 Birnbaum); and

wherein generating a dynamic interaction parameter comprises generating a dynamic interaction parameter using the first gesture signal and the second gesture signal and the first device sensor signal and the second device sensor signal [0029-0032] Birnbaum.

8. In regards to claims 8, 19, and 30 Birnbaum as modified by Rosenberg teaches the method of claim 1 wherein the first device sensor signal or the second device sensor signal comprises an accelerometer signal [0019].

9. In regards to claim 9, and 20 Birnbaum as modified by Rosenberg teaches the method of claim 1 wherein the first device sensor signal or the second device sensor signal comprises a gyroscope signal.[0019] Birnbaum

10. In regards to claim 10 and 21 Birnbaum as modified by Rosenberg teaches the method of claim 1 wherein the first device sensor signal or the second device sensor signal comprises an ambient signal.[0019] Birnbaum

11. In regards to claim 11 and 22 Birnbaum as modified by Rosenberg teaches the method of claim 1 wherein the first device sensor signal or the second device sensor signal comprises a virtual sensor signal [0019]. Birnbaum

12. Claims 4, 6, 15, 17, 26 and 28 are rejected under 35 U.S.C. 103(a) as being unpatentable over Birnbaum and Rosenberg in view of Westerman et al (2002/0015024) hereinafter, Westerman.

13. In regards to claim 4, 15, and 26 Birnbaum fails to teach the method of claim 1 wherein generating a dynamic interaction parameter comprises generating a dynamic interaction parameter from a difference between the first gesture signal and the second gesture signal.

However, Westerman teaches wherein generating a dynamic interaction parameter comprises generating a dynamic interaction parameter from a difference between the first gesture signal and the second gesture signal [00261].

It would have been obvious to one of ordinary skill in the art to modify the sensing means of Birnbaum to further include herein generating a dynamic interaction parameter comprises generating a dynamic interaction parameter from a difference between the first gesture signal and the second gesture signal as taught by Westerman in order to determine roll, tilt, and direction [0261].

14. In regards to claim 6, 17, and 28 Birnbaum fails to teach the method of claim 1 wherein generating a dynamic interaction parameter comprises generating a dynamic interaction parameter using the first gesture signal and the second gesture signal and an animation.

However, Westerman teaches wherein generating a dynamic interaction parameter comprises generating a dynamic interaction parameter using the first gesture signal and the second gesture signal and an animation (fig. 13 (201-208)).

It would have been obvious to one of ordinary skill to modify the interaction parameter of Birnbaum to use wherein generating a dynamic interaction parameter comprises generating a dynamic interaction parameter using the first gesture signal and the second gesture signal and an animation as taught by Westerman in order to provide interaction of hand contacts [00128-00129].

Response to Arguments

Applicant's arguments with respect to claims 1-30 have been considered but are moot because the arguments do not apply to any of the references being used in the current rejection.

Conclusion

Any inquiry concerning this communication or earlier communications from the examiner should be directed to GRANT SITTA whose telephone number is (571)270-1542. The examiner can normally be reached on M-F 9-6.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Alexander Beck can be reached on 571-272-7765. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

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Art Unit: 2694

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/G. S./
Primary Examiner, Art Unit 2694

Notice of References Cited	Application/Control No. 13/472,698	Applicant(s)/Patent Under Reexamination BIRNBAUM ET AL.	
	Examiner GRANT SITTA	Art Unit 2694	Page 1 of 1

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*	Document Number Country Code-Number-Kind Code	Date MM-YYYY	Name	Classification
*	A US-6,278,439	08-2001	Rosenberg et al.	345/157
	B US-			
	C US-			
	D US-			
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	F US-			
	G US-			
	H US-			
	I US-			
	J US-			
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FOREIGN PATENT DOCUMENTS

*	Document Number Country Code-Number-Kind Code	Date MM-YYYY	Country	Name	Classification
	N				
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Search Notes 	Application/Control No. 13472698	Applicant(s)/Patent Under Reexamination BIRNBAUM ET AL.
	Examiner GRANT SITTA	Art Unit 2629

CPC- SEARCHED		
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CPC COMBINATION SETS - SEARCHED		
Symbol	Date	Examiner

US CLASSIFICATION SEARCHED			
Class	Subclass	Date	Examiner
345	173	7/5/2012	GS
345	173	11/26/2012	GS
345	173	6/12/2013	GS

SEARCH NOTES		
Search Notes	Date	Examiner
Searched EAST (USPGPUB, USPAT, USOCR, FPRS, EPO, JPO, DERWENT, IBM)	7/5/2012	GS
Searched EAST (USPGPUB, USPAT, USOCR, FPRS, EPO, JPO, DERWENT, IBM)	11/26/2012	GS
Searched EAST (USPGPUB, USPAT, USOCR, FPRS, EPO, JPO, DERWENT, IBM)	6/12/2013	GS
Investor Search	6/12/2013	GS

INTERFERENCE SEARCH			
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Receipt date: 02/21/2013

13472698 - GAI: 2694

Doc code: IDS

Doc description: Information Disclosure Statement (IDS) Filed

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INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)	Application Number	13472698
	Filing Date	2012-05-16
	First Named Inventor	David Birnbaum
	Art Unit	2694
	Examiner Name	Sitta, Grant
	Attorney Docket Number	IMM389C1

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INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)	Application Number		13472698	13472698 - GAU: 2694
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	First Named Inventor	David Birnbaum		
	Art Unit	2694		
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	Filing Date	2012-05-16	
	First Named Inventor	David Birnbaum	
	Art Unit	2694	
	Examiner Name	Sitta, Grant	
	Attorney Docket Number	IMM389C1	

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Please see 37 CFR 1.97 and 1.98 to make the appropriate selection(s):

That each item of information contained in the information disclosure statement was first cited in any communication from a foreign patent office in a counterpart foreign application not more than three months prior to the filing of the information disclosure statement. See 37 CFR 1.97(e)(1).

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See attached certification statement.

The fee set forth in 37 CFR 1.17 (p) has been submitted herewith.

A certification statement is not submitted herewith.

SIGNATURE

A signature of the applicant or representative is required in accordance with CFR 1.33, 10.18. Please see CFR 1.4(d) for the form of the signature.

Signature	/Thomas A. Hassing/	Date (YYYY-MM-DD)	2013-02-21
Name/Print	Thomas A. Hassing	Registration Number	36,159

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EAST Search History

EAST Search History (Prior Art)

Ref #	Hits	Search Query	DBs	Default Operator	Plurals	Time Stamp
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S1	42	((DAVID) near2 (BIRNBAUM)).INV.	US-PGPUB; USPAT	OR	OFF	2012/06/29 11:18
S2	61	((JUAN) near2 (CRUZ- HERNANDEZ)).INV.	US-PGPUB; USPAT	OR	OFF	2012/06/29 11:18
S3	119	((DANNY) near2 (GRANT)).INV.	US-PGPUB; USPAT	OR	OFF	2012/06/29 11:18
S4	8	((CHRIS) near2 (ULLRICH)).INV.	US-PGPUB; USPAT	OR	OFF	2012/06/29 11:18
S5	3555	345/156.ccls.	USPAT	OR	OFF	2012/06/29 11:18
S6	0	"13472698"	USPAT	OR	OFF	2012/06/29 11:26

EAST Search History

S7	0	"13472698"		US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2012/06/29 11:26
S8	244	"20010035854" | "20020044132" | "20020177471" | "20030063128" | "20030100969" | "20030162595" | "20030206202" | "20040002902" | "20050057528" | "20050179617" | "20050212760" | "20050245302" | "20060022952" | "20060026536" | "20060061545" | "20060097991" | "20060119586" | "20060181510" | "20060192760" | "20060197752" | "20060255683" | "20060256074" | "20060279476" | "20060279542" | "20060284849" | "20070066283" | "20070139366" | "20070150826" | "20070152984" | "20070247429" | "20070247442" | "20070265096" | "20070279392" | "20080024459" | "20080055277" | "20080060856" | "20080068334" | "20080088580" | "20080111788" | "20080180406" | "20080216001" | "20080287147" | "20080300055" | "20080303782" | "20090002328" | "20090079550" | "20090085878" | "20090109007" | "20090128503" | "20090137269" | "20090166098" | "20090167508" | "20090167509" | "20090167704" | "20090250267" | "20090256817" | "20090270046" | "20090315830" | "20100013653" | "20100013761" | "20100017489" | "20100017759" | "20100045619" | "20100127819" | "20100149134" | "20100156818" | "20100214243" | "20100231539" | "20100245254" | "20100265208" | "20100313124" | "20100328053" | "20110021272" | "20110025609" | "20110043454" | "20110043527" | "20110102340" | "20110105103" | "20110109588" | "20110138277" | "20110264491" | "20120068957" | "20120081276" | "20120105333" | "5666499" | "5825308" | "6088019" | "6100874" | "6166723" | "6211861" | "6252579" | "6300936" | "6337678" | "6429846" | "6448977" | "6717573" | "6819312" | "7024625" | "7084854" | "7088342" | "7205978" | "7336260" | "7446456" | "7456823" | "7468573" | "7528508" | "7554246" | "7592999" | "7663604" | "7755607" | "7808488" | "7821498" | "7825903" | "7890863" | "7920131" | "7924144" | "7969288" | "7973769" | "7978181" | "7982588" | "7982720" | "8004492" | "8031181" | "8035623" | "8059105" | "8098235" | "RE42064").PN.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2012/06/29 11:27	

EAST Search History

S9	1	"12522397"	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2012/06/29 12:25
S10	0	345/173.ccls. and electrode same thickness	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2012/06/29 12:58
S11	23800	first same gesture same second gesture	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2012/06/29 13:31
S12	260	dynamic near3 haptic	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2012/06/29 14:08
S13	162	S12 and "345"/\$5.ccls.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2012/06/29 14:09
S14	4	"11863741"	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2012/06/29 14:10
S15	14	("20020044132" | "20060026536" | "20060119586" | "20060197752" | "20080180406" | "20080216001" | "20090256817" | "20100149134" | "20100265208" | "20100313124" | "20100328053" | "20110043527" | "6337678" | "6819312").PN. OR ("8098235").URPN.	US-PGPUB; USPAT; USOCR	OR	OFF	2012/06/29 14:11
S16	2	"11487873"	US-PGPUB; USPAT; USOCR	OR	OFF	2012/06/29 14:22
S17	0	"13092484"	USPAT	OR	OFF	2012/07/05 08:37
S18	1	"13092484"	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT;	OR	OFF	2012/07/05 08:37

EAST Search History

			IBM_TDB			
S19	908	345/173.ccls. and vector	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2012/07/05 08:56
S20	450	345/173.ccls. and vector and difference	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2012/07/05 08:59
S21	94	345/173.ccls. and vector same difference	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2012/07/05 08:59
S22	1385803	first same second same signal	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2012/07/05 10:26
S23	590	first same second same signal same haptic	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2012/07/05 10:26
S24	42	((DAVID) near2 (BIRNBAUM)).INV.	US-PGPUB; USPAT	OR	OFF	2012/07/05 10:30
S25	77	first same second same signal same haptic and 345/173.ccls.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2012/07/05 10:37
S26	7	combin\$4 same sensor same haptic and 345/173.ccls.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2012/07/05 10:37
S27	13	"1240947"	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2012/07/05 10:38
S28	1	"12240947"	US-PGPUB;	OR	OFF	2012/07/05

EAST Search History

			USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB			10:38
S29	1	"12334285"	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2012/07/05 10:40
S30	3	"20050264530"	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2012/07/05 12:14
S31	0	"13498866"	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2012/07/05 12:15
S32	22	("20050243069" | "20060061542" | "20060132458" | "20070029172" | "20070236959" | "20080150767" | "20090154138" | "20090284397" | "20100134431" | "20100137033" | "20100141587").PN.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2012/07/05 12:34
S33	1	"20100017489"	US-PGPUB; USPAT	OR	OFF	2012/11/26 11:05
S34	1	"13472698"	US-PGPUB; USPAT	OR	OFF	2012/11/26 11:07
S35	48	((DAVID) near2 (BI RNBAUM)).INV.	US-PGPUB; USPAT	OR	OFF	2012/11/26 11:18
S36	69	((JUAN) near2 (CRUZ- HERNANDEZ)).INV.	US-PGPUB; USPAT	OR	OFF	2012/11/26 11:19
S37	132	((DANNY) near2 (GRANT)).INV.	US-PGPUB; USPAT	OR	OFF	2012/11/26 11:19
S38	12	((CHRIS) near2 (ULLRICH)).INV.	US-PGPUB; USPAT	OR	OFF	2012/11/26 11:19
S39	1048	dynamic same gesture	US-PGPUB; USPAT	OR	OFF	2012/11/26 11:19
S40	432	dynamic same gesture and "345"/\$5.ccls.	US-PGPUB; USPAT	OR	OFF	2012/11/26 11:22
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S44	3046	(dynamic chang\$4) same haptic	US-PGPUB; USPAT; USOCR	OR	OFF	2012/11/26 12:07
S45	958	(dynamic chang\$4) same haptic and "345"/\$5.ccls.	US-PGPUB; USPAT; USOCR	OR	OFF	2012/11/26 12:07
S46	219	(dynamic chang\$4) same haptic and "345"/173.ccls.	US-PGPUB; USPAT; USOCR	OR	OFF	2012/11/26 12:07
S47	123	("20020030663" "20020033795" "20020149561" "20020149570" "20030016211" "20030030628" "20030058265" "20030067449" "20030071795" "20030128191" "20050007342" "20050128186" "20060033703" "20060109254" "20060109256" "4023290" "4101884" "4108164" "4127752" "4242823" "4414537" "4414984" "4550221" "4557275" "4581491" "4584625" "4692756" "4715235" "4757453" "4758165" "4772205" "4791416" "4821030" "4871992" "4885565" "4926879" "5035242" "5121091" "5143505" "5159159" "5165897" "5175459" "5212473" "5223658" "5237327" "5245245" "5262777" "5316017" "5321762" "5334893" "5355148" "5376948" "5389849" "5437607" "5440183" "5521336" "5562707" "5580251" "5638060" "5650704" "5719561" "5729249" "5767457" "5835080" "5887995" "5889236" "5896076" "5917906" "5942733" "5943044" "5945772" "5952806" "5977867" "5982304" "5986643" "5988902" "6008800" "6061004" "6067081" "6072475" "6118435" "6140987" "6147422" "6147674" "6171191" "6219032" "6239790" "6243080" "6256011" "6262717" "6326901" "6337678" "6388655" "6404107" "6414674" "6415138" "6429846" "6445284" "6469695" "6473069" "6509892" "6518958" "6529122" "6535201" "6610936" "6628195" "6636202" "6639581" "6639582" "6647145" "6697043" "6710518" "6822635" "6834373" "6854573" "7009595" "7113177" "7151528" "7161580" "7175642").PN. OR ("7825903").URPN.	US-PGPUB; USPAT; USOCR	OR	OFF	2012/11/26 12:07
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S53	874	lcd same leakage near3 current	US-PGPUB; USPAT; USOCR	OR	OFF	2012/11/26 13:10
S54	122	lcd same leakage near3 current same (amorphous same silicon)	US-PGPUB; USPAT; USOCR	OR	OFF	2012/11/26 13:10
S55	3	"7768611"	US-PGPUB; USPAT; USOCR	OR	OFF	2012/11/26 13:14
S56	1	"13472698"	US-PGPUB; USPAT	OR	OFF	2012/12/07 12:23
S57	1	"20100017489"	US-PGPUB; USPAT	OR	OFF	2012/12/07 12:32
S58	1	"20020015024"	US-PGPUB; USPAT	OR	OFF	2012/12/07 12:32
S59	0	(continuous\$4 same (chang\$4	US-PGPUB;	OR	OFF	2012/12/13

		modify\$4)) same (haptic)	USPAT			10:10
S60	0	(continuous\$4 same (chang\$4 modify\$4)) same (haptic)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2012/12/13 10:11
S61	3301	((chang\$4 modify\$4)) same (haptic)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2012/12/13 10:11
S62	1233	((chang\$4 modify\$4)) same (haptic) same feed\$1back	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2012/12/13 10:11
S63	591	((chang\$4 modify\$4)) same (haptic) same feed\$1back and dynamic	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2012/12/13 10:12
S64	259	((chang\$4 modify\$4)) same (haptic) same feed\$1back and dynamic and "345"/\$5.ccls.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2012/12/13 10:13
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EAST Search History

		("8254603").URPN.				
S77	48	((DAVID) near2 (BIRNBAUM)).INV.	US-PGPUB; USPAT	OR	OFF	2012/12/13 11:40
S78	69	((JUAN) near2 (CRUZ- HERNANDEZ)).INV.	US-PGPUB; USPAT	OR	OFF	2012/12/13 11:40
S79	134	((DANNY) near2 (GRANT)).INV.	US-PGPUB; USPAT	OR	OFF	2012/12/13 11:40
S80	12	((CHRIS) near2 (ULLRICH)).INV.	US-PGPUB; USPAT	OR	OFF	2012/12/13 11:40
S81	49	"6278439"	US-PGPUB; USPAT	OR	OFF	2013/06/07 08:52
S82	1	"13472698"	US-PGPUB; USPAT	OR	OFF	2013/06/07 09:38

EAST Search History (Interference)

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6/ 7/ 2013 10:31:55 AM

C:\Users\gsitta\Documents\EAST\Workspaces\13472698.wsp

Receipt date: 01/23/2013

13472698 - GAI: 2694

Doc code: IDS

Doc description: Information Disclosure Statement (IDS) Filed

Approved for use through 07/31/2012. OMB 0651-0031

U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE

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INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)	Application Number		13472698	
	Filing Date		2012-05-16	
	First Named Inventor	BIRNBAUM		
	Art Unit	2629		
	Examiner Name	Sitta, Grant		
	Attorney Docket Number	IMM389C1		

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Examiner Initial*	Cite No	Patent Number	Kind Code ¹	Issue Date	Name of Patentee or Applicant of cited Document	Pages, Columns, Lines where Relevant Passages or Relevant Figures Appear
	1	6061004		2000-05-09	Rosenberg	

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	1	WO 2010/088477 A1			2010-08-05	Birnbaum et al.		<input type="checkbox"/>

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INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)	Application Number		13472698	13472698 - GAU: 2694
	Filing Date		2012-05-16	
	First Named Inventor	BIRNBAUM		
	Art Unit	2629		
	Examiner Name	Sitta, Grant		
	Attorney Docket Number	IMM389C1		

	1		<input type="checkbox"/>
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EXAMINER SIGNATURE

Examiner Signature	/Grant Sitta/	Date Considered	06/07/2013
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*EXAMINER: Initial if reference considered, whether or not citation is in conformance with MPEP 609. Draw line through a citation if not in conformance and not considered. Include copy of this form with next communication to applicant.

¹ See Kind Codes of USPTO Patent Documents at www.USPTO.GOV or MPEP 901.04. ² Enter office that issued the document, by the two-letter code (WIPO Standard ST.3). ³ For Japanese patent documents, the indication of the year of the reign of the Emperor must precede the serial number of the patent document. ⁴ Kind of document by the appropriate symbols as indicated on the document under WIPO Standard ST.16 if possible. ⁵ Applicant is to place a check mark here if English language translation is attached.

INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)	Application Number	13472698	13472698 - GAU: 2694
	Filing Date	2012-05-16	
	First Named Inventor	BIRNBAUM	
	Art Unit	2629	
	Examiner Name	Sitta, Grant	
	Attorney Docket Number	IMM389C1	

CERTIFICATION STATEMENT

Please see 37 CFR 1.97 and 1.98 to make the appropriate selection(s):

That each item of information contained in the information disclosure statement was first cited in any communication from a foreign patent office in a counterpart foreign application not more than three months prior to the filing of the information disclosure statement. See 37 CFR 1.97(e)(1).

OR

That no item of information contained in the information disclosure statement was cited in a communication from a foreign patent office in a counterpart foreign application, and, to the knowledge of the person signing the certification after making reasonable inquiry, no item of information contained in the information disclosure statement was known to any individual designated in 37 CFR 1.56(c) more than three months prior to the filing of the information disclosure statement. See 37 CFR 1.97(e)(2).

See attached certification statement.

The fee set forth in 37 CFR 1.17 (p) has been submitted herewith.

A certification statement is not submitted herewith.

SIGNATURE

A signature of the applicant or representative is required in accordance with CFR 1.33, 10.18. Please see CFR 1.4(d) for the form of the signature.

Signature	/Thomas A. Hassing/	Date (YYYY-MM-DD)	2013-01-23
Name/Print	Thomas A. Hassing	Registration Number	36,159

This collection of information is required by 37 CFR 1.97 and 1.98. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.14. This collection is estimated to take 1 hour to complete, including gathering, preparing and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. **DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.**


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9. A record from this system of records may be disclosed, as a routine use, to a Federal, State, or local law enforcement agency, if the USPTO becomes aware of a violation or potential violation of law or regulation.

ALL REFERENCES CONSIDERED EXCEPT WHERE LINED THROUGH. /G.S./

Index of Claims 	Application/Control No. 13472698	Applicant(s)/Patent Under Reexamination BIRNBAUM ET AL.
	Examiner GRANT SITTA	Art Unit 2629

✓	Rejected
=	Allowed

-	Cancelled
÷	Restricted

N	Non-Elected
I	Interference

A	Appeal
O	Objected

Claims renumbered in the same order as presented by applicant
 CPA
 T.D.
 R.1.47

CLAIM		DATE							
Final	Original	07/05/2012	11/26/2012	06/12/2013					
	1	✓	✓	✓					
	2	✓	✓	✓					
	3	✓	✓	✓					
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Table with 7 columns: APPLICATION NUMBER, FILING or 371(c) DATE, GRP ART UNIT, FIL FEE REC'D, ATTY. DOCKET NO, TOT CLAIMS, IND CLAIMS. Row 1: 13/472,698, 05/16/2012, 2694, 2150, IMM389C1, 30, 3

CONFIRMATION NO. 6404

CORRECTED FILING RECEIPT



103772
Immersion Corporation
30 Rio Robles
San Jose, CA 95134

Date Mailed: 07/05/2013

Receipt is acknowledged of this non-provisional patent application. The application will be taken up for examination in due course. Applicant will be notified as to the results of the examination. Any correspondence concerning the application must include the following identification information: the U.S. APPLICATION NUMBER, FILING DATE, NAME OF APPLICANT, and TITLE OF INVENTION. Fees transmitted by check or draft are subject to collection. Please verify the accuracy of the data presented on this receipt. If an error is noted on this Filing Receipt, please submit a written request for a Filing Receipt Correction. Please provide a copy of this Filing Receipt with the changes noted thereon. If you received a "Notice to File Missing Parts" for this application, please submit any corrections to this Filing Receipt with your reply to the Notice. When the USPTO processes the reply to the Notice, the USPTO will generate another Filing Receipt incorporating the requested corrections

Inventor(s)

David BIRNBAUM, San Jose, CA;
Juan Manuel CRUZ-HERNANDEZ, Montreal, CANADA;
Danny GRANT, Montreal, CANADA;
Chris ULLRICH, Ventura, CA;

Applicant(s)

David BIRNBAUM, San Jose, CA;
Juan Manuel CRUZ-HERNANDEZ, Montreal, CANADA;
Danny GRANT, Montreal, CANADA;
Chris ULLRICH, Ventura, CA;

Assignment For Published Patent Application

Immersion Corporation, San Jose, CA

Power of Attorney: The patent practitioners associated with Customer Number 103772

Domestic Priority data as claimed by applicant

This appln claims benefit of 61/599,145 02/15/2012

Foreign Applications for which priority is claimed (You may be eligible to benefit from the Patent Prosecution Highway program at the USPTO. Please see http://www.uspto.gov for more information.) - None.

Foreign application information must be provided in an Application Data Sheet in order to constitute a claim to foreign priority. See 37 CFR 1.55 and 1.76.

Permission to Access - A proper Authorization to Permit Access to Application by Participating Offices (PTO/SB/39 or its equivalent) has been received by the USPTO.

If Required, Foreign Filing License Granted: 05/25/2012

The country code and number of your priority application, to be used for filing abroad under the Paris Convention, is **US 13/472,698**

Projected Publication Date: Not Applicable

Non-Publication Request: No

Early Publication Request: Yes

Title

METHOD AND APPARATUS FOR PRODUCING A DYNAMIC HAPTIC EFFECT

Preliminary Class

345

Statement under 37 CFR 1.55 or 1.78 for AIA (First Inventor to File) Transition Applications:

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Since the rights granted by a U.S. patent extend only throughout the territory of the United States and have no effect in a foreign country, an inventor who wishes patent protection in another country must apply for a patent in a specific country or in regional patent offices. Applicants may wish to consider the filing of an international application under the Patent Cooperation Treaty (PCT). An international (PCT) application generally has the same effect as a regular national patent application in each PCT-member country. The PCT process **simplifies** the filing of patent applications on the same invention in member countries, but **does not result** in a grant of "an international patent" and does not eliminate the need of applicants to file additional documents and fees in countries where patent protection is desired.

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IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Application of:)	
)	
David Birnbaum et al.)	Examiner: Sitta, Grant
)	
Application No. 13/472,698	)	Art Unit: 2629
)	
Filed: May 16, 2012)	
	)	Confirmation No. 6404
For: METHOD AND APPARATUS FOR)	
PRODUCING A DYNAMIC HAPTIC)	
EFFECT)	
)	

Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

AMENDMENT AND RESPONSE UNDER 37 CFR § 1.111

Sir:

In response to the Office Action mailed June 18, 2013, Applicants respectfully request the Examiner enter the following amendments and consider the following remarks.

CERTIFICATE OF ELECTRONIC FILING

I hereby certify that this correspondence is being deposited via electronic filing through the United States Patent and Trademark Electronic Filing System on:

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(Signature of person mailing paper)

_____ September 17, 2013 _____
Date

AMENDMENTS TO THE CLAIMS

1. (Currently Amended) A method of producing a haptic effect comprising:
receiving a first gesture signal;
receiving a second gesture signal;
generating a dynamic interaction parameter representing a haptic effect that evolves over time as it responds to one or more input parameters using a mapping schema to map an input parameter onto a changing property of the haptic effect according to the first gesture signal and the second gesture signal;
using a method of synthesis of multiple additional gesture inputs or device sensor inputs to give greater precision to the dynamic interaction parameter; and
applying a drive signal to a haptic output device for continuously modifying the haptic effect according to the dynamic interaction parameter.

2. (Original) The method of claim 1 wherein the first or second gesture signal comprises a vector signal.

3. (Original) The method of claim 1 wherein the first or second gesture signal comprises an on-screen signal.

4. (Previously presented) The method of claim 1 wherein generating a dynamic interaction parameter comprises generating a dynamic interaction parameter from a difference between the first gesture signal and the second gesture signal.

5. (Previously presented) The method of claim 1 wherein generating a dynamic interaction parameter comprises generating a dynamic interaction parameter using the first gesture signal and the second gesture signal and a physical model.
6. (Previously presented) The method of claim 1 wherein generating a dynamic interaction parameter comprises generating a dynamic interaction parameter using the first gesture signal and the second gesture signal and an animation.
7. (Previously presented) The method of claim 1 further comprising:
 - receiving a first device sensor signal;
 - receiving a second device sensor signal; and
 - wherein generating a dynamic interaction parameter comprises generating a dynamic interaction parameter using the first gesture signal and the second gesture signal and the first device sensor signal and the second device sensor signal.
8. (Original) The method of claim 1 wherein the first device sensor signal or the second device sensor signal comprises an accelerometer signal.
9. (Original) The method of claim 1 wherein the first device sensor signal or the second device sensor signal comprises a gyroscope signal.
10. (Original) The method of claim 1 wherein the first device sensor signal or the second device sensor signal comprises an ambient signal.

11. (Original) The method of claim 1 wherein the first device sensor signal or the second device sensor signal comprises a virtual sensor signal.

12. (Currently Amended) A haptic effect enabled system comprising:

a haptic output device;

a drive module electronically coupled to the haptic output device for receiving a first gesture signal, receiving a second gesture signal, and generating a dynamic interaction parameter representing a haptic effect that evolves over time as it responds to one or more input parameters using a mapping schema to map an input parameter onto a changing property of the haptic effect according to the first gesture signal and the second gesture signal using a method of synthesis of multiple additional gesture inputs or device sensor inputs to give greater precision to the dynamic interaction parameter; and

a drive circuit electronically coupled to the drive module and the haptic output device for applying a drive signal to the haptic output device for continuously modifying the haptic effect according to the dynamic interaction parameter.

13. (Original) The system of claim 12 wherein the first or second gesture signal comprises a vector signal.

14. (Original) The system of claim 12 wherein the first or second gesture signal comprises an on-screen signal.

15. (Previously presented) The system of claim 12 wherein the drive module comprises a drive module for generating a dynamic interaction parameter from a difference between the first gesture signal and the second gesture signal.

16. (Previously presented) The system of claim 12 wherein the drive module comprises a drive module for generating a dynamic interaction parameter using the first gesture signal and the second gesture signal and a physical model.

17. (Previously presented) The system of claim 12 wherein the drive module comprises a drive module for generating a dynamic interaction parameter using the first gesture signal and the second gesture signal and an animation.

18. (Previously presented) The system of claim 12 wherein the drive module comprises a drive module for receiving a first device sensor signal, receiving a second device sensor signal, and generating a dynamic interaction parameter using the first gesture signal and the second gesture signal and the first device sensor signal and the second device sensor signal.

19. (Original) The system of claim 12 wherein the first device sensor signal or the second device sensor signal comprises an accelerometer signal.

20. (Original) The system of claim 12 wherein the first device sensor signal or the second device sensor signal comprises a gyroscope signal.

21. (Original) The system of claim 12 wherein the first device sensor signal or the second device sensor signal comprises an ambient signal.

22. (Original) The system of claim 12 wherein the first device sensor signal or the second device sensor signal comprises a virtual sensor signal.

23. (Currently Amended) A non-transitory computer readable medium having instructions stored thereon that, when executed by a processor, causes the processor to produce a haptic effect, the instructions comprising:

receiving a first gesture signal;

receiving a second gesture signal;

generating a dynamic interaction parameter representing a haptic effect that evolves over time as it responds to one or more input parameters using a mapping schema to map an input parameter onto a changing property of the haptic effect according to the first gesture signal and the second gesture signal;

using a method of synthesis of multiple additional gesture inputs or device sensor inputs to give greater precision to the dynamic interaction parameter; and

applying a drive signal to a haptic output device for continuously modifying the haptic effect according to the dynamic interaction parameter.

24. (Previously presented) The non-transitory computer readable medium of claim 23, wherein the first or second gesture signal comprises a vector signal.

25. (Previously presented) The non-transitory computer readable medium of claim 23, wherein the first or second gesture signal comprises an on-screen signal.

26. (Previously presented) The non-transitory computer readable medium of claim 23, wherein generating a dynamic interaction parameter comprises generating a dynamic interaction parameter from a difference between the first gesture signal and the second gesture signal.

27. (Previously presented) The non-transitory computer readable medium of claim 23, wherein generating a dynamic interaction parameter comprises generating a dynamic interaction parameter using the first gesture signal and the second gesture signal and a physical model.

28. (Previously presented) The non-transitory computer readable medium of claim 23, wherein generating a dynamic interaction parameter comprises generating a dynamic interaction parameter using the first gesture signal and the second gesture signal and an animation.

29. (Previously presented) The non-transitory computer readable medium of claim 23, further comprising:

receiving a first device sensor signal;

receiving a second device sensor signal; and

wherein generating a dynamic interaction parameter comprises generating a dynamic interaction parameter using the first gesture signal and the second gesture signal and the first device sensor signal and the second device sensor signal.

30. (Previously presented) The non-transitory computer readable medium of claim 23, wherein the first device sensor signal or the second device sensor signal comprises a signal selected from the list consisting of accelerometer, gyroscope, ambient, or virtual.

REMARKS

Reconsideration of this application as amended is respectfully requested. Claims 1-30 are pending and Claims 1, 12 and 23 are amended. No new matter is being added by way of this amendment. Applicants thank the Examiner for removing the previous §102 and §103 rejections.

REJECTIONS UNDER 35 U.S.C. § 103

The Examiner is rejecting Claims 1, 3, 5, 7-14, 16, 18-25, 27 and 29-30 under 35 U.S.C. §103(a) as being unpatentable over Birnbaum et al., U. S. Patent App. No. 2010/0017489 (hereinafter “Birnbaum”) in view of Rosenberg et al., U. S. Pat. No. 6,278,439 (hereinafter “Rosenberg”). Applicants respectfully disagree.

Applicants have amended Claims 1, 12 and 23 to recite using a method of synthesis of multiple additional gesture inputs or device sensor inputs to give greater precision to the dynamic interaction parameter. Support for this amendment may be found in the published application at least in paragraph [0079] and in TABLE 2.

Applicants respectfully submit that neither Birnbaum nor Rosenberg disclose or imply using a method of synthesis of multiple additional gesture inputs or device sensor inputs to give greater precision to the dynamic interaction parameter, because Birnbaum and Rosenberg both are silent with respect to using haptic methods of synthesis and both are silent with respect to providing greater precision for a haptic dynamic interaction parameter. Therefore, one of ordinary skill in the art would not have been able to combine Birnbaum with Rosenberg to produce the invention of currently amended Claims 1, 12 and 23, and the rejection under 35 U.S.C. § 103(a) should be removed.

Because Claims 3, 5, 7-11, 13-14, 16, 18-22, 24-25, 27 and 29-30 depend from amended Claims 1, 12 and 23, they inherit all of the limitations of the independent claims. Therefore,

Applicants respectfully submit that at least for the same reasons given above for amended Claims, 1, 12 and 23, one of ordinary skill in the art would not have been able to combine Birnbaum with Rosenberg to produce the invention of Claims 3, 5, 7-11, 13-14, 16, 18-22, 24-25, 27 and 29-30, and the rejection under 35 U.S.C. § 103(a) should be removed.

The Examiner is rejecting Claims 4, 6, 15, 17, 26 and 28 under 35 U.S.C. §103(a) as being unpatentable over Birnbaum and Rosenberg in view of Westerman et al., U. S. Pat. App. No. 2002/0015024 (hereinafter “Westerman”). Applicants respectfully disagree.

Applicants have discussed Birnbaum and Rosenberg above. Because Claims 4, 6, 15, 17, 26 and 28 depend from amended Claims 1, 12 and 23, they inherit all of the limitations of the independent claims. Applicants respectfully submit that Westerman does not disclose or imply using a method of synthesis of multiple additional gesture inputs or device sensor inputs to give greater precision to the dynamic interaction parameter, because Westerman is silent with respect to using haptic methods of synthesis and silent with respect to providing greater precision for a haptic dynamic interaction parameter. Therefore, one of ordinary skill in the art would not have been able to combine Birnbaum with Rosenberg in view of Westerman to produce the invention of Claims 4, 6, 15, 17, 26 and 28, and the rejection under 35 U.S.C. § 103(a) should be removed.

CONCLUSION

For at least the foregoing reasons, Applicants respectfully submit that the rejections have been overcome. Therefore, all pending claims are in condition for allowance, and reconsideration and allowance are requested.

Respectfully submitted,

IMMERSION CORPORATION

Dated: September 17, 2013

/Thomas A. Hassing/
Thomas A. Hassing
Reg. No. 36,159

30 Rio Robles
San Jose, CA 95134
(408) 467-1900

Atty. Docket No. IMM389C1

PATENT

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Application of:

David Birnbaum, et al.

Examiner: Sitta, Grant

Application No. 13/472,698

Art Unit: 2629

Filed: May 16, 2012

Confirmation No. 6404

For: METHOD AND APPARATUS FOR
PRODUCING A DYNAMIC HAPTIC
EFFECT

Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

AUTHORIZATION TO CHARGE DEPOSIT ACCOUNT

Sir:

All of the fees for the above-identified application are being paid via EFS-Web. Please charge any additional fees or credit any over payments to Immersion Deposit Account Number 501815.

Respectfully submitted,

IMMERSION CORPORATION

Dated: September 17, 2013

/Thomas A. Hassing/

Thomas A. Hassing

Reg No. 36,159

30 Rio Robles
San Jose, CA 95134
(408) 467-1900

Electronic Acknowledgement Receipt

EFS ID:	16877661
Application Number:	13472698
International Application Number:	
Confirmation Number:	6404
Title of Invention:	METHOD AND APPARATUS FOR PRODUCING A DYNAMIC HAPTIC EFFECT
First Named Inventor/Applicant Name:	David BIRNBAUM
Customer Number:	103772
Filer:	Thomas Hassing/Dawn Rose
Filer Authorized By:	Thomas Hassing
Attorney Docket Number:	IMM389C1
Receipt Date:	17-SEP-2013
Filing Date:	16-MAY-2012
Time Stamp:	16:04:03
Application Type:	Utility under 35 USC 111(a)

Payment information:

Submitted with Payment	no
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File Listing:

Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
1	Amendment/Req. Reconsideration-After Non-Final Reject	IMM389C1Responseto2013-06-18OAFINAL.pdf	40965 <small>62bbe2cb078c39a7aff7273a6f97e99d313f98a</small>	no	10

Warnings:

Information:

2	Miscellaneous Incoming Letter	TomsAuthorizationtochargede positaccont.pdf	65848 7b87d69879048a88a71fd9fd7cfab5530c4a 9cbc	no	1
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Warnings:

Information:

Total Files Size (in bytes):	106813
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This Acknowledgement Receipt evidences receipt on the noted date by the USPTO of the indicated documents, characterized by the applicant, and including page counts, where applicable. It serves as evidence of receipt similar to a Post Card, as described in MPEP 503.

New Applications Under 35 U.S.C. 111

If a new application is being filed and the application includes the necessary components for a filing date (see 37 CFR 1.53(b)-(d) and MPEP 506), a Filing Receipt (37 CFR 1.54) will be issued in due course and the date shown on this Acknowledgement Receipt will establish the filing date of the application.

National Stage of an International Application under 35 U.S.C. 371

If a timely submission to enter the national stage of an international application is compliant with the conditions of 35 U.S.C. 371 and other applicable requirements a Form PCT/DO/EO/903 indicating acceptance of the application as a national stage submission under 35 U.S.C. 371 will be issued in addition to the Filing Receipt, in due course.

New International Application Filed with the USPTO as a Receiving Office

If a new international application is being filed and the international application includes the necessary components for an international filing date (see PCT Article 11 and MPEP 1810), a Notification of the International Application Number and of the International Filing Date (Form PCT/RO/105) will be issued in due course, subject to prescriptions concerning national security, and the date shown on this Acknowledgement Receipt will establish the international filing date of the application.



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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
13/472,698	05/16/2012	David BIRNBAUM	IMM389C1	6404
103772	7590	11/06/2013	EXAMINER	
Immersion Corporation 30 Rio Robles San Jose, CA 95134			SITTA, GRANT	
			ART UNIT	PAPER NUMBER
			2622	
			MAIL DATE	DELIVERY MODE
			11/06/2013	PAPER

Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

Applicant-Initiated Interview Summary	Application No. 13/472,698	Applicant(s) BIRNBAUM ET AL.	
	Examiner GRANT SITTA	Art Unit 2622	

All participants (applicant, applicant's representative, PTO personnel):

(1) GRANT SITTA. (3) Jeff Lang.
(2) Thomas Hassing. (4) Manuel Cruz.

Date of Interview: 22 October 2013.

Type: Telephonic Video Conference
 Personal [copy given to: applicant applicant's representative]

Exhibit shown or demonstration conducted: Yes No.
If Yes, brief description: haptic devices that provided haptic response to a video and interaction with a user.

Issues Discussed 101 112 102 103 Others
(For each of the checked box(es) above, please describe below the issue and detailed description of the discussion)

Claim(s) discussed: 1.

Identification of prior art discussed: Birnbaum and Rosenberg.

Substance of Interview
(For each issue discussed, provide a detailed description and indicate if agreement was reached. Some topics may include: identification or clarification of a reference or a portion thereof, claim interpretation, proposed amendments, arguments of any applied references etc...)

Discussed amendments/remarks as filed on 9/17/2013. No agreement was reached. .

Applicant recordation instructions: The formal written reply to the last Office action must include the substance of the interview. (See MPEP section 713.04). If a reply to the last Office action has already been filed, applicant is given a non-extendable period of the longer of one month or thirty days from this interview date, or the mailing date of this interview summary form, whichever is later, to file a statement of the substance of the interview

Examiner recordation instructions: Examiners must summarize the substance of any interview of record. A complete and proper recordation of the substance of an interview should include the items listed in MPEP 713.04 for complete and proper recordation including the identification of the general thrust of each argument or issue discussed, a general indication of any other pertinent matters discussed regarding patentability and the general results or outcome of the interview, to include an indication as to whether or not agreement was reached on the issues raised.

Attachment

/Grant D Sitta/
Primary Examiner, Art Unit 2622

Summary of Record of Interview Requirements

Manual of Patent Examining Procedure (MPEP), Section 713.04, Substance of Interview Must be Made of Record

A complete written statement as to the substance of any face-to-face, video conference, or telephone interview with regard to an application must be made of record in the application whether or not an agreement with the examiner was reached at the interview.

Title 37 Code of Federal Regulations (CFR) § 1.133 Interviews

Paragraph (b)

In every instance where reconsideration is requested in view of an interview with an examiner, a complete written statement of the reasons presented at the interview as warranting favorable action must be filed by the applicant. An interview does not remove the necessity for reply to Office action as specified in §§ 1.111, 1.135. (35 U.S.C. 132)

37 CFR §1.2 Business to be transacted in writing.

All business with the Patent or Trademark Office should be transacted in writing. The personal attendance of applicants or their attorneys or agents at the Patent and Trademark Office is unnecessary. The action of the Patent and Trademark Office will be based exclusively on the written record in the Office. No attention will be paid to any alleged oral promise, stipulation, or understanding in relation to which there is disagreement or doubt.

The action of the Patent and Trademark Office cannot be based exclusively on the written record in the Office if that record is itself incomplete through the failure to record the substance of interviews.

It is the responsibility of the applicant or the attorney or agent to make the substance of an interview of record in the application file, unless the examiner indicates he or she will do so. It is the examiner's responsibility to see that such a record is made and to correct material inaccuracies which bear directly on the question of patentability.

Examiners must complete an Interview Summary Form for each interview held where a matter of substance has been discussed during the interview by checking the appropriate boxes and filling in the blanks. Discussions regarding only procedural matters, directed solely to restriction requirements for which interview recordation is otherwise provided for in Section 812.01 of the Manual of Patent Examining Procedure, or pointing out typographical errors or unreadable script in Office actions or the like, are excluded from the interview recordation procedures below. Where the substance of an interview is completely recorded in an Examiners Amendment, no separate Interview Summary Record is required.

The Interview Summary Form shall be given an appropriate Paper No., placed in the right hand portion of the file, and listed on the "Contents" section of the file wrapper. In a personal interview, a duplicate of the Form is given to the applicant (or attorney or agent) at the conclusion of the interview. In the case of a telephone or video-conference interview, the copy is mailed to the applicant's correspondence address either with or prior to the next official communication. If additional correspondence from the examiner is not likely before an allowance or if other circumstances dictate, the Form should be mailed promptly after the interview rather than with the next official communication.

The Form provides for recordation of the following information:

- Application Number (Series Code and Serial Number)
- Name of applicant
- Name of examiner
- Date of interview
- Type of interview (telephonic, video-conference, or personal)
- Name of participant(s) (applicant, attorney or agent, examiner, other PTO personnel, etc.)
- An indication whether or not an exhibit was shown or a demonstration conducted
- An identification of the specific prior art discussed
- An indication whether an agreement was reached and if so, a description of the general nature of the agreement (may be by attachment of a copy of amendments or claims agreed as being allowable). Note: Agreement as to allowability is tentative and does not restrict further action by the examiner to the contrary.
- The signature of the examiner who conducted the interview (if Form is not an attachment to a signed Office action)

It is desirable that the examiner orally remind the applicant of his or her obligation to record the substance of the interview of each case. It should be noted, however, that the Interview Summary Form will not normally be considered a complete and proper recordation of the interview unless it includes, or is supplemented by the applicant or the examiner to include, all of the applicable items required below concerning the substance of the interview.

A complete and proper recordation of the substance of any interview should include at least the following applicable items:

- 1) A brief description of the nature of any exhibit shown or any demonstration conducted,
- 2) an identification of the claims discussed,
- 3) an identification of the specific prior art discussed,
- 4) an identification of the principal proposed amendments of a substantive nature discussed, unless these are already described on the Interview Summary Form completed by the Examiner,
- 5) a brief identification of the general thrust of the principal arguments presented to the examiner,
(The identification of arguments need not be lengthy or elaborate. A verbatim or highly detailed description of the arguments is not required. The identification of the arguments is sufficient if the general nature or thrust of the principal arguments made to the examiner can be understood in the context of the application file. Of course, the applicant may desire to emphasize and fully describe those arguments which he or she feels were or might be persuasive to the examiner.)
- 6) a general indication of any other pertinent matters discussed, and
- 7) if appropriate, the general results or outcome of the interview unless already described in the Interview Summary Form completed by the examiner.

Examiners are expected to carefully review the applicant's record of the substance of an interview. If the record is not complete and accurate, the examiner will give the applicant an extendable one month time period to correct the record.

Examiner to Check for Accuracy

If the claims are allowable for other reasons of record, the examiner should send a letter setting forth the examiner's version of the statement attributed to him or her. If the record is complete and accurate, the examiner should place the indication, "Interview Record OK" on the paper recording the substance of the interview along with the date and the examiner's initials.



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Table with 5 columns: APPLICATION NO., FILING DATE, FIRST NAMED INVENTOR, ATTORNEY DOCKET NO., CONFIRMATION NO. Includes application details for David BIRNBAUM and examiner SITTA, GRANT.

Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

Office Action Summary	Application No. 13/472,698	Applicant(s) BIRNBAUM ET AL.	
	Examiner GRANT SITTA	Art Unit 2622	AIA (First Inventor to File) Status No

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTHS FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) Responsive to communication(s) filed on 9/17/2013.
 A declaration(s)/affidavit(s) under **37 CFR 1.130(b)** was/were filed on _____.
- 2a) This action is **FINAL**. 2b) This action is non-final.
- 3) An election was made by the applicant in response to a restriction requirement set forth during the interview on _____; the restriction requirement and election have been incorporated into this action.
- 4) Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims*

- 5) Claim(s) 1-30 is/are pending in the application.
5a) Of the above claim(s) _____ is/are withdrawn from consideration.
- 6) Claim(s) _____ is/are allowed.
- 7) Claim(s) 1-30 is/are rejected.
- 8) Claim(s) _____ is/are objected to.
- 9) Claim(s) _____ are subject to restriction and/or election requirement.

* If any claims have been determined allowable, you may be eligible to benefit from the **Patent Prosecution Highway** program at a participating intellectual property office for the corresponding application. For more information, please see http://www.uspto.gov/patents/init_events/pph/index.jsp or send an inquiry to PPHfeedback@uspto.gov.

Application Papers

- 10) The specification is objected to by the Examiner.
- 11) The drawing(s) filed on _____ is/are: a) accepted or b) objected to by the Examiner.
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

Priority under 35 U.S.C. § 119

- 12) Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

Certified copies:

- a) All b) Some** c) None of the:
1. Certified copies of the priority documents have been received.
 2. Certified copies of the priority documents have been received in Application No. _____.
 3. Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

** See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

- 1) Notice of References Cited (PTO-892)
- 2) Information Disclosure Statement(s) (PTO/SB/08a and/or PTO/SB/08b)
Paper No(s)/Mail Date _____.
- 3) Interview Summary (PTO-413)
Paper No(s)/Mail Date. _____.
- 4) Other: _____.

1. The present application is being examined under the pre-AIA first to invent provisions.

DETAILED ACTION

Claim Rejections - 35 USC § 103

1. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

2. The factual inquiries set forth in *Graham v. John Deere Co.*, 383 U.S. 1, 148 USPQ 459 (1966), that are applied for establishing a background for determining obviousness under 35 U.S.C. 103(a) are summarized as follows:

1. Determining the scope and contents of the prior art.
2. Ascertaining the differences between the prior art and the claims at issue.
3. Resolving the level of ordinary skill in the pertinent art.
4. Considering objective evidence present in the application indicating obviousness or nonobviousness.

3. Claims 1,-3, 5, 7-14, 16, 18-25, 27 and 29-30 are rejected under 35 U.S.C. 103(a) as being unpatentable over Birnbaum et al 2010/0017489, hereinafter Birnbaum further in view of Rosenberg et al (6,278,439) hereinafter, Rosendberg further in view of Kildal et al (2011/0267181) hereinafter, Kildal.

1. In regards to claim 1, Birnbaum teaches a method of producing a haptic effect comprising (abstract):

receiving a first gesture signal [0032, 0074-0076];
receiving a second gesture signal (fig. 1 (114) "sensors");
generating a dynamic [0069-0070] (fig. 3 (309)s) interaction parameter using the first gesture signal and the second gesture signal ([0032-0033] for example tilt and acceleration) ; and Examiner notes, [0030] of the current specification that defines a "gesture". A simple gesture may be a touch, or "finger on" gesture and lifting the "finger off", could be a second gesture. Therefore, a simple touch and release is two gestures.
applying a drive signal to a haptic actuator according to the dynamic interaction parameter [0036] (fig. 1 (118)).

Birnbaum fails to teach a haptic effect that evolves over time as it responds to one or more input parameters using a mapping schema to map an input parameter onto a changing property of the haptic effect

applying a drive signal to a haptic output device for continuously modifying the haptic effect according to the dynamic interaction parameter.

However, Rosenberg teaches a haptic effect that evolves over time as it responds to one or more input parameters (fig. 5 (204) and (206)) and (208)) using a mapping schema to map an input parameter onto a changing property of the haptic effect (col. 15-16, lines 54-47)

applying a drive signal to a haptic output device for continuously modifying the haptic effect according to the dynamic interaction parameter (col. 3, lines 36-55, col. 12-14, 65 "condition" related sensations, or "effect" related sensations).

It would have been obvious to one of ordinary skill in the art to modify the haptic device of Birnbaum to further include a haptic effect that evolves over time as it responds to one or more input parameters using a mapping schema to map an input parameter onto a changing property of the haptic effect applying a drive signal to a haptic output device for continuously modifying the haptic effect according to the dynamic interaction parameter as taught by Rosenberg in order to provide an impulse-shaped force signal that is used to provide feel sensations to a user manipulating a force feedback device. The force signal includes an impulse of high magnitude and a steady-state force following the impulse, which provides a realistic sensation of constant force without having to continuously output a high magnitude force. That is, the present invention advantageously manipulates only those variables (impulse and steady state) of the force signal that have a significant impact on the perception of the user, reducing the complexity of the required hardware and minimizing the computational burden of representing diverse feel sensations. In addition, the local processor technology reduces the computational burden from the host processor. Furthermore, the overlapping of data in force signal transmissions reduces the computation burden of checking for errors and handshaking with a sending device. These improvements allow a computer system to provide accurate and realistic force feedback using a low-cost force feedback device and is thus ideal for the mass market of home computer systems.

Birnbaum and Rosenberg fail to expressly teach using a method of synthesis of multiple gestures inputs or device sensor inputs to give a greater precision to the dynamic interaction parameter.

However, Kildal teaches a method of synthesis of multiple gestures inputs or device sensor inputs to give a greater precision to a dynamic interaction parameter

[0048] For the illusion to work, the electronic device may be arranged to control the change in force applied and perceiving tactile friction-like impulses to occur simultaneously and minimize latency. However, to an extent, latency can be used as a design parameter too to create some effects. Potentially any of audio synthesis techniques may be applied to feed audio waves at appropriate frequencies in the vibra actuator. For instance, subtractive synthesis, additive synthesis, granular synthesis, wavetable synthesis, frequency modulation synthesis, phase distortion synthesis, physical modeling synthesis, sample-based synthesis or subharmonic synthesis may be applied. In practice, these techniques may be used in a granular form: very short so-called grains of vibration (temporally short burst of vibration with a defined design regarding the properties of the vibration) are produced (only a few milliseconds long), so that the system is very responsive. The properties of these grains can be adapted on the basis of the current force, X, Y position etc. (emphasis added)

It would have been obvious to modify the haptic feedback means of Birnbaum and Rosenberg to further include a method of synthesis of multiple gestures inputs or device sensor inputs to give a greater precision to the dynamic interaction parameter as taught by Kildal in order to help define the haptic response.

2. In regards to claim 12, Birnbaum teaches a haptic effect enabled system comprising (abstract):

a haptic actuator [0032, 0074-0076];

a drive module electronically coupled to the actuator for receiving a first gesture signal (fig. 1 (114) "sensors");

receiving a second gesture signal, and generating a dynamic [0069-0070] (fig. 3 (309)s) interaction parameter using the first gesture signal and the second gesture signal ([0032-0033] for example tilt and acceleration) and

a drive circuit electronically coupled to the drive module and the actuator for applying a drive signal to the actuator according to the dynamic interaction parameter [0036] (fig. 1 (118)).

Birnbaum fails to teach a haptic effect that evolves over time as it responds to one or more input parameters using a mapping schema to map an input parameter onto a changing property of the haptic effect

applying a drive signal to a haptic output device for continuously modifying the haptic effect according to the dynamic interaction parameter.

However, Rosenberg teaches a haptic effect that evolves over time as it responds to one or more input parameters (fig. 5 (204) and (206)) and (208)) using a mapping schema to map an input parameter onto a changing property of the haptic effect (col. 15-16, lines 54-47)

applying a drive signal to a haptic output device for continuously modifying the haptic effect according to the dynamic interaction parameter (col. 3, lines 36-55, col. 12-14, 65 "condition" related sensations, or "effect" related sensations).

It would have been obvious to one of ordinary skill in the art to modify the haptic device of Birnbaum to further include a haptic effect that evolves over time as it responds to one or more input parameters using a mapping schema to map an input parameter onto a changing property of the haptic effect applying a drive signal to a

haptic output device for continuously modifying the haptic effect according to the dynamic interaction parameter as taught by Rosenberg in order to provide an impulse-shaped force signal that is used to provide feel sensations to a user manipulating a force feedback device. The force signal includes an impulse of high magnitude and a steady-state force following the impulse, which provides a realistic sensation of constant force without having to continuously output a high magnitude force. That is, the present invention advantageously manipulates only those variables (impulse and steady state) of the force signal that have a significant impact on the perception of the user, reducing the complexity of the required hardware and minimizing the computational burden of representing diverse feel sensations. In addition, the local processor technology reduces the computational burden from the host processor. Furthermore, the overlapping of data in force signal transmissions reduces the computation burden of checking for errors and handshaking with a sending device. These improvements allow a computer system to provide accurate and realistic force feedback using a low-cost force feedback device and is thus ideal for the mass market of home computer systems.

Birnbaum and Rosenberg fail to expressly teach using a method of synthesis of multiple gestures inputs or device sensor inputs to give a greater precision to the dynamic interaction parameter.

However, Kildal teaches a method of synthesis of multiple gestures inputs or device sensor inputs to give a greater precision to a dynamic interaction parameter [0048].

It would have been obvious to modify the haptic feedback means of Birnbaum and Rosenberg to further include a method of synthesis of multiple gestures inputs or device sensor inputs to give a greater precision to the dynamic interaction parameter as taught by Kildal in order to help define the haptic response.

3. In regards to claim 23, Birnbaum teaches a non-transitory computer readable medium having instructions stored thereon that, when executed by a processor, causes the processor to produce a haptic effect, the instructions comprising (abstract):

- receiving a first gesture signal [0032, 0074-0076];
- receiving a second gesture signal (fig. 1 (114) "sensors");
- generating a dynamic [0069-0070] (fig. 3 (309)s) interaction parameter using the first gesture signal and the second gesture signal ([0031-0033] for example tilt and acceleration) and
- applying a drive signal to a haptic actuator according to the dynamic interaction parameter [0036] (fig. 1 (118)).

Birnbaum fails to teach a haptic effect that evolves over time as it responds to one or more input parameters using a mapping schema to map an input parameter onto a changing property of the haptic effect

- applying a drive signal to a haptic output device for continuously modifying the haptic effect according to the dynamic interaction parameter.

However, Rosenberg teaches a haptic effect that evolves over time as it responds to one or more input parameters (fig. 5 (204) and (206)) and (208)) using a mapping schema to map an input parameter onto a changing property of the haptic effect (col. 15-16, lines 54-47)

applying a drive signal to a haptic output device for continuously modifying the haptic effect according to the dynamic interaction parameter (col. 3, lines 36-55, col. 12-14, 65 "condition" related sensations, or "effect" related sensations).

It would have been obvious to one of ordinary skill in the art to modify the haptic device of Birnbaum to further include a haptic effect that evolves over time as it responds to one or more input parameters using a mapping schema to map an input parameter onto a changing property of the haptic effect applying a drive signal to a haptic output device for continuously modifying the haptic effect according to the dynamic interaction parameter as taught by Rosenberg in order to provide an impulse-shaped force signal that is used to provide feel sensations to a user manipulating a force feedback device. The force signal includes an impulse of high magnitude and a steady-state force following the impulse, which provides a realistic sensation of constant force without having to continuously output a high magnitude force. That is, the present invention advantageously manipulates only those variables (impulse and steady state) of the force signal that have a significant impact on the perception of the user, reducing the complexity of the required hardware and minimizing the computational burden of representing diverse feel sensations. In addition, the local processor technology reduces the computational burden from the host processor. Furthermore, the

overlapping of data in force signal transmissions reduces the computation burden of checking for errors and handshaking with a sending device. These improvements allow a computer system to provide accurate and realistic force feedback using a low-cost force feedback device and is thus ideal for the mass market of home computer systems.

Birnbaum and Rosenberg fail to expressly teach using a method of synthesis of multiple gestures inputs or device sensor inputs to give a greater precision to the dynamic interaction parameter.

However, Kildal teaches a method of synthesis of multiple gestures inputs or device sensor inputs to give a greater precision to a dynamic interaction parameter [0048]

It would have been obvious to modify the haptic feedback means of Birnbaum and Rosenberg to further include a method of synthesis of multiple gestures inputs or device sensor inputs to give a greater precision to the dynamic interaction parameter as taught by Kildal in order to help define the haptic response.

4. In regards to claims 2, 13, and 24 Birnbaum as modified by Rosenberg teaches wherein the first or second gesture signal comprises a vector signal (col. 17-18, lines 65-14 Rosenberg).

5. In regards to claims 3, 14, and 25 Birnbaum as modified by Rosenberg teaches the method of claim 1 wherein the first or second gesture signal comprises an on-screen signal (fig. 5a and 5b (520 and 530) Rosenberg)

6. In regards to claim 5, 16, and 27 Birnbaum as modified by Rosenberg teaches the method of claim 1 wherein generating a dynamic interaction parameter comprises generating a dynamic interaction parameter using the first gesture signal and the second gesture signal and a physical model [0025] Birnbaum.

7. In regards to claims 7, 18 and 29, Birnbaum as modified by Rosenberg teaches the method of claim 1 further comprising (abstract):

receiving a first device sensor signal [0030]; Birnbaum
receiving a second device sensor signal (fig. 3b 302 Birnbaum); and
wherein generating a dynamic interaction parameter comprises generating a dynamic interaction parameter using the first gesture signal and the second gesture signal and the first device sensor signal and the second device sensor signal [0029-0032] Birnbaum.

8. In regards to claims 8, 19, and 30 Birnbaum as modified by Rosenberg teaches the method of claim 1 wherein the first device sensor signal or the second device sensor signal comprises an accelerometer signal [0019].

9. In regards to claim 9, and 20 Birnbaum as modified by Rosenberg teaches the method of claim 1 wherein the first device sensor signal or the second device sensor signal comprises a gyroscope signal.[0019] Birnbaum

10. In regards to claim 10 and 21 Birnbaum as modified by Rosenberg teaches the method of claim 1 wherein the first device sensor signal or the second device sensor signal comprises an ambient signal.[0019] Birnbaum

11. In regards to claim 11 and 22 Birnbaum as modified by Rosenberg teaches the method of claim 1 wherein the first device sensor signal or the second device sensor signal comprises a virtual sensor signal [0019]. Birnbaum

12. Claims 4, 6, 15, 17, 26 and 28 are rejected under 35 U.S.C. 103(a) as being unpatentable over Birnbaum and Rosenberg and Kildal in view of Westerman et al (2002/0015024) hereinafter, Westerman.

13. In regards to claim 4, 15, and 26 Birnbaum fails to teach the method of claim 1 wherein generating a dynamic interaction parameter comprises generating a dynamic interaction parameter from a difference between the first gesture signal and the second gesture signal.

However, Westerman teaches wherein generating a dynamic interaction parameter comprises generating a dynamic interaction parameter from a difference between the first gesture signal and the second gesture signal [00261].

It would have been obvious to one of ordinary skill in the art to modify the sensing means of Birnbaum to further include herein generating a dynamic interaction parameter comprises generating a dynamic interaction parameter from a difference between the first gesture signal and the second gesture signal as taught by Westerman in order to determine roll, tilt, and direction [0261].

14. In regards to claim 6, 17, and 28 Birnbaum fails to teach the method of claim 1 wherein generating a dynamic interaction parameter comprises generating a dynamic interaction parameter using the first gesture signal and the second gesture signal and an animation.

However, Westerman teaches wherein generating a dynamic interaction parameter comprises generating a dynamic interaction parameter using the first gesture signal and the second gesture signal and an animation (fig. 13 (201-208)).

It would have been obvious to one of ordinary skill to modify the interaction parameter of Birnbaum to use wherein generating a dynamic interaction parameter comprises generating a dynamic interaction parameter using the first gesture signal and the second gesture signal and an animation as taught by Westerman in order to provide interaction of hand contacts [00128-00129].

Response to Arguments

Applicant's arguments with respect to claims 1-30 have been considered but are moot because the arguments do not apply to any of the combination of references being used in the current rejection.

Conclusion

2. Applicant's amendment necessitated the new ground(s) of rejection presented in this Office action. Accordingly, **THIS ACTION IS MADE FINAL**. See MPEP § 706.07(a). Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is filed within TWO MONTHS of the mailing date of this final action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the date of this final action.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to GRANT SITTA whose telephone number is (571)270-1542. The examiner can normally be reached on M-F 9-6.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Alexander Beck can be reached on 571-272-7765. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

/GRANT SITTA/
Primary Examiner, Art Unit 2622

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Notice of References Cited	Application/Control No. 13/472,698	Applicant(s)/Patent Under Reexamination BIRNBAUM ET AL.	
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*		Document Number Country Code-Number-Kind Code	Date MM-YYYY	Name	Classification
*	A	US-2011/0267181	11-2011	Kildal, Johan	340/407.2
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	C	US-			
	D	US-			
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	K	US-			
	L	US-			
	M	US-			


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	N					
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NON-PATENT DOCUMENTS

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Dates in MM-YYYY format are publication dates. Classifications may be US or foreign.

Search Notes 	Application/Control No. 13472698	Applicant(s)/Patent Under Reexamination BIRNBAUM ET AL.
	Examiner GRANT SITTA	Art Unit 2629

CPC- SEARCHED		
Symbol	Date	Examiner

CPC COMBINATION SETS - SEARCHED		
Symbol	Date	Examiner

US CLASSIFICATION SEARCHED			
Class	Subclass	Date	Examiner
345	173	7/5/2012	GS
345	173	11/26/2012	GS
345	173	6/12/2013	GS
345	173,156	12/16/2013	GS

SEARCH NOTES		
Search Notes	Date	Examiner
Searched EAST (USPGPUB, USPAT, USOCR, FPRS, EPO, JPO, DERWENT, IBM)	7/5/2012	GS
Searched EAST (USPGPUB, USPAT, USOCR, FPRS, EPO, JPO, DERWENT, IBM)	11/26/2012	GS
Searched EAST (USPGPUB, USPAT, USOCR, FPRS, EPO, JPO, DERWENT, IBM)	6/12/2013	GS
Investor Search	6/12/2013	GS
Searched EAST (USPGPUB, USPAT, USOCR, FPRS, EPO, JPO, DERWENT, IBM)	12/16/2013	GS
Inventor Search	12/16/2013	GS

INTERFERENCE SEARCH			
US Class/ CPC Symbol	US Subclass / CPC Group	Date	Examiner

	/GRANT SITTA/ Primary Examiner.Art Unit 2694
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EAST Search History

EAST Search History (Prior Art)

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S32	22	("20050243069" "20060061542" "20060132458" "20070029172" "20070236959" "20080150767" "20090154138" "20090284397" "20100134431" "20100137033" "20100141587").PN.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2012/07/05 12:34
S33	1	"20100017489"	US-PGPUB; USPAT	OR	OFF	2012/11/26 11:05
S34	1	"13472698"	US-PGPUB; USPAT	OR	OFF	2012/11/26 11:07
S35	48	((DAVID) near2 (BIRNBAUM)).INV.	US-PGPUB; USPAT	OR	OFF	2012/11/26 11:18
S36	69	((JUAN) near2 (CRUZ-HERNANDEZ)).INV.	US-PGPUB; USPAT	OR	OFF	2012/11/26 11:19

EAST Search History

S37	132	((DANNY) near2 (GRANT)).INV.	US-PGPUB; USPAT	OR	OFF	2012/11/26 11:19
S38	12	((CHRIS) near2 (ULLRICH)).INV.	US-PGPUB; USPAT	OR	OFF	2012/11/26 11:19
S39	1048	dynamic same gesture	US-PGPUB; USPAT	OR	OFF	2012/11/26 11:19
S40	432	dynamic same gesture and "345"/\$5.ccls.	US-PGPUB; USPAT	OR	OFF	2012/11/26 11:22
S41	159	("4641349" "4843568" "5148477" "5454043" "5548659" "5570113" "5577179" "5581276" "5594469").PN. OR ("6072494").URPN.	US-PGPUB; USPAT; USOCR	OR	OFF	2012/11/26 11:59
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S44	3046	(dynamic chang\$4) same haptic	US-PGPUB; USPAT; USOCR	OR	OFF	2012/11/26 12:07
S45	958	(dynamic chang\$4) same haptic and "345"/\$5.ccls.	US-PGPUB; USPAT; USOCR	OR	OFF	2012/11/26 12:07
S46	219	(dynamic chang\$4) same haptic and "345"/173.ccls.	US-PGPUB; USPAT; USOCR	OR	OFF	2012/11/26 12:07
S47	123	("20020030663" "20020033795" "20020149561" "20020149570" "20030016211" "20030030628" "20030058265" "20030067449" "20030071795" "20030128191" "20050007342" "20050128186" "20060033703" "20060109254" "20060109256" "4023290" "4101884" "4108164" "4127752" "4242823" "4414537" "4414984" "4550221" "4557275" "4581491" "4584625" "4692756" "4715235" "4757453" "4758165" "4772205" "4791416" "4821030" "4871992" "4885565" "4926879" "5035242" "5121091" "5143505" "5159159" "5165897" "5175459" "5212473" "5223658" "5237327" "5245245" "5262777" "5316017" "5321762" "5334893" "5355148" "5376948" "5389849" "5437607" "5440183" "5521336" "5562707" "5580251" "5638060" "5650704" "5719561" "5729249" "5767457" "5835080" "5887995" "5889236" "5896076"	US-PGPUB; USPAT; USOCR	OR	OFF	2012/11/26 12:07

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USPAT;
USOCR

12:09

EAST Search History

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S52	1	"12458312"	US-PGPUB; USPAT; USOCR	OR	OFF	2012/11/26 12:26
S53	874	lod same leakage near3 current	US-PGPUB; USPAT; USOCR	OR	OFF	2012/11/26 13:10
S54	122	lod same leakage near3 current same (amorphous same silicon)	US-PGPUB; USPAT; USOCR	OR	OFF	2012/11/26 13:10
S55	3	"7768611"	US-PGPUB; USPAT; USOCR	OR	OFF	2012/11/26 13:14
S56	1	"13472698"	US-PGPUB; USPAT	OR	OFF	2012/12/07 12:23
S57	1	"20100017489"	US-PGPUB; USPAT	OR	OFF	2012/12/07 12:32
S58	1	"20020015024"	US-PGPUB; USPAT	OR	OFF	2012/12/07 12:32
S59	0	(continous\$4 same (chang\$4 modify\$4)) same (haptic)	US-PGPUB; USPAT	OR	OFF	2012/12/13 10:10
S60	0	(continous\$4 same (chang\$4 modify\$4)) same (haptic)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2012/12/13 10:11
S61	3301	((chang\$4 modify\$4)) same (haptic)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2012/12/13 10:11
S62	1233	((chang\$4 modify\$4)) same (haptic) same feed\$1back	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2012/12/13 10:11
S63	591	((chang\$4 modify\$4)) same (haptic) same feed\$1back and dynamic	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2012/12/13 10:12
S64	259	((chang\$4 modify\$4)) same (haptic) same feed\$1back and dynamic and "345"/\$5.ccls.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2012/12/13 10:13
S65	135	("20010035854" "20020044132" "20020177471" "20030063128"	US-PGPUB; USPAT;	OR	OFF	2012/12/13 10:24

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EAST Search History

S67	30	("20010009428" "20020085037" "20020101458" "20020175955" "20020201458" "4720703" "4931783" "5276795" "5500936" "5581670" "5627960" "5634064" "5638523" "5666499" "5689667" "5760773" "5798752" "5828360" "6037937" "6097387" "6118427" "6246411" "6262719" "6369837" "6549219" "6865719" "6918091" "6938221" "7058902").PN. OR ("7770135").URPN.	US-PGPUB; USPAT; USOCR	OR	OFF	2012/12/13 10:36
S68	25	((chang\$4 modify\$4) same (haptic) same feed\$1back same dynamic and "345"/\$5.ccls.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2012/12/13 10:36
S69	131	("3832895" | "3919691" | "4414984" | "4550617" | "4604016" | "4706294" | "4731603" | "4795296" | "4823634" | "4868549" | "4885565" | "4933584" | "4983901" | "5103404" | "5107080" | "5107262" | "5136194" | "5146566" | "5184319" | "5186629" | "5203563" | "5296871" | "5334893" | "5354162" | "5388992" | "5399091" | "5405152" | "5440183" | "5489812" | "5565840" | "5580251" | "5583478" | "5587937" | "5589828" | "5619180" | "5631861" | "5643087" | "5656901" | "5661446" | "5669818" | "5684722" | "5691747" | "5696537" | "5709219" | "5714978" | "5721566" | "5734373" | "5736978" | "5739811" | "5742278" | "5754023" | "5755577" | "5767839" | "5781172" | "5784052" | "5790108" | "5805140" | "5821920" | "5857986" | "5889672" | "5894263" | "5897437" | "5903085" | "5914705" | "5945772" | "5956016" | "5973670" | "5979892" | "5984880" | "5986643" | "6001014" | "6002184" | "6004134" | "6044646" | "6078126" | "6088017" | "6088019" | "6100874" | "6104158" | "6104382" | "6154201" | "6184868" | "6198206" | "6211861" | "6256011" | "6275213" | "6317032" | "6424333" | "RE37374").PN. OR ("6693622").URPN.	US-PGPUB; USPAT; USOCR	OR	OFF	2012/12/13 10:38
S70	130	("20020089500" "20030048277" "20030234781" "20040233196" "20050001831" "20050062738" "20050093821" "20050128210" "20050128211" "3531868" "3920972" "3944798" "4521685" "4604016" "4632341" "4638798" "4653011" "4654648" "4655673" "4661032" "4670851" "4680519" "4703443" "4729098" "4769763" "4791934" "4819195" "4839838" "4853874" "4907973" "4942538" "4945305" "4945501" "4961138"	US-PGPUB; USPAT; USOCR	OR	OFF	2012/12/13 10:38

EAST Search History

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		"5186629"	"5186695"	"5203563"				
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		"5296871"	"5299810"	"5309140"				
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S74	25	("20030072441" "20050180592" "2128555" "2280610" "2561355" "3075101" "3360704" "3830099" "4120617" "4318016" "5062140" "5184037" "5246353" "5602432" "6265796" "6268671" "6359371" "6538799" "6873067").PN. OR	US-PGPUB; USPAT; USOCR	OR	OFF	2012/12/13 11:26

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S77	48	((DAVID) near2 (BIRNBAUM)).INV.	US-PGPUB; USPAT	OR	OFF	2012/12/13 11:40
S78	69	((JUAN) near2 (CRUZ- HERNANDEZ)).INV.	US-PGPUB; USPAT	OR	OFF	2012/12/13 11:40
S79	134	((DANNY) near2 (GRANT)).INV.	US-PGPUB; USPAT	OR	OFF	2012/12/13 11:40
S80	12	((CHRIS) near2 (ULLRICH)).INV.	US-PGPUB; USPAT	OR	OFF	2012/12/13 11:40
S81	49	"6278439"	US-PGPUB; USPAT	OR	OFF	2013/06/07 08:52
S82	1	"13472698"	US-PGPUB; USPAT	OR	OFF	2013/06/07 09:38
S83	50	((DAVID) near2 (BIRNBAUM)).INV.	US-PGPUB; USPAT	OR	OFF	2013/06/07 10:09
S84	75	((JUAN) near2 (CRUZ- HERNANDEZ)).INV.	US-PGPUB; USPAT	OR	OFF	2013/06/07 10:09
S85	144	((DANNY) near2 (GRANT)).INV.	US-PGPUB; USPAT	OR	OFF	2013/06/07 10:09
S86	13	((CHRIS) near2 (ULLRICH)).INV.	US-PGPUB; USPAT	OR	OFF	2013/06/07 10:12
S87	13	("20020133093" "20030149803" "20050113167" "20080221925" "20080243581" "20090125380" "20090182620" "4860215" "6262738" "6275213" "6604064" "6621448" "7952483").PN. OR ("8380561").URPN.	US-PGPUB; USPAT; USOCR	OR	OFF	2013/06/07 10:12
S88	112	haptic same chang\$4 same dynamic	US-PGPUB; USPAT; USOCR	OR	OFF	2013/06/07 10:13
S89	11	("20020141378" "20030026268" "20040148520" "20040181599"	US-PGPUB; USPAT;	OR	OFF	2013/06/07 10:14

EAST Search History

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EAST Search History


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EAST Search History (Interference)

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12/ 16/ 2013 1:24:57 PM

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<i>Index of Claims</i> 	Application/Control No. 13472698	Applicant(s)/Patent Under Reexamination BIRNBAUM ET AL.
	Examiner GRANT SITTA	Art Unit 2629

✓	Rejected
=	Allowed

-	Cancelled
÷	Restricted

N	Non-Elected
I	Interference

A	Appeal
O	Objected

Claims renumbered in the same order as presented by applicant
 CPA
 T.D.
 R.1.47

CLAIM		DATE							
Final	Original	07/05/2012	11/26/2012	06/12/2013	12/16/2013				
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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
13/472,698	05/16/2012	David BIRNBAUM	IMM389C1	6404
103772	7590	06/30/2014	EXAMINER	
Immersion Corporation 30 Rio Robles San Jose, CA 95134			SITTA, GRANT	
			ART UNIT	PAPER NUMBER
			2622	
			MAIL DATE	DELIVERY MODE
			06/30/2014	PAPER

Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

Notice of Abandonment	Application No.	Applicant(s)
	13/472,698	BIRNBAUM ET AL.
	Examiner	Art Unit
	GRANT SITTA	2622

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address--

This application is abandoned in view of:

1. Applicant's failure to timely file a proper reply to the Office letter mailed on 24 December 2013.
 - (a) A reply was received on _____ (with a Certificate of Mailing or Transmission dated _____), which is after the expiration of the period for reply (including a total extension of time of _____ month(s)) which expired on _____.
 - (b) A proposed reply was received on _____, but it does not constitute a proper reply under 37 CFR 1.113 to the final rejection. (A proper reply under 37 CFR 1.113 to a final rejection consists only of: (1) a timely filed amendment which places the application in condition for allowance; (2) a timely filed Notice of Appeal (with appeal fee); or (3) a timely filed Request for Continued Examination (RCE) in compliance with 37 CFR 1.114).
 - (c) A reply was received on _____ but it does not constitute a proper reply, or a bona fide attempt at a proper reply, to the non-final rejection. See 37 CFR 1.85(a) and 1.111. (See explanation in box 7 below).
 - (d) No reply has been received.

2. Applicant's failure to timely pay the required issue fee and publication fee, if applicable, within the statutory period of three months from the mailing date of the Notice of Allowance (PTOL-85).
 - (a) The issue fee and publication fee, if applicable, was received on _____ (with a Certificate of Mailing or Transmission dated _____), which is after the expiration of the statutory period for payment of the issue fee (and publication fee) set in the Notice of Allowance (PTOL-85).
 - (b) The submitted fee of \$ _____ is insufficient. A balance of \$ _____ is due.
The issue fee required by 37 CFR 1.18 is \$ _____. The publication fee, if required by 37 CFR 1.18(d), is \$ _____.
 - (c) The issue fee and publication fee, if applicable, has not been received.

3. Applicant's failure to timely file corrected drawings as required by, and within the three-month period set in, the Notice of Allowability (PTO-37).
 - (a) Proposed corrected drawings were received on _____ (with a Certificate of Mailing or Transmission dated _____), which is after the expiration of the period for reply.
 - (b) No corrected drawings have been received.

4. The letter of express abandonment which is signed by the attorney or agent of record or other party authorized under 37 CFR 1.33(b). See 37 CFR 1.138(b).

5. The letter of express abandonment which is signed by an attorney or agent (acting in a representative capacity under 37 CFR 1.34) upon the filing of a continuing application.

6. The decision by the Board of Patent Appeals and Interference rendered on _____ and because the period for seeking court review of the decision has expired and there are no allowed claims.

7. The reason(s) below:

Examiner called on 6/27/14 and confirmed no response has been mailed

	/GRANT SITTA/ Primary Examiner, Art Unit 2622
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Petitions to revive under 37 CFR 1.137, or requests to withdraw the holding of abandonment under 37 CFR 1.181, should be promptly filed to minimize any negative effects on patent term.