

Fig. 6A

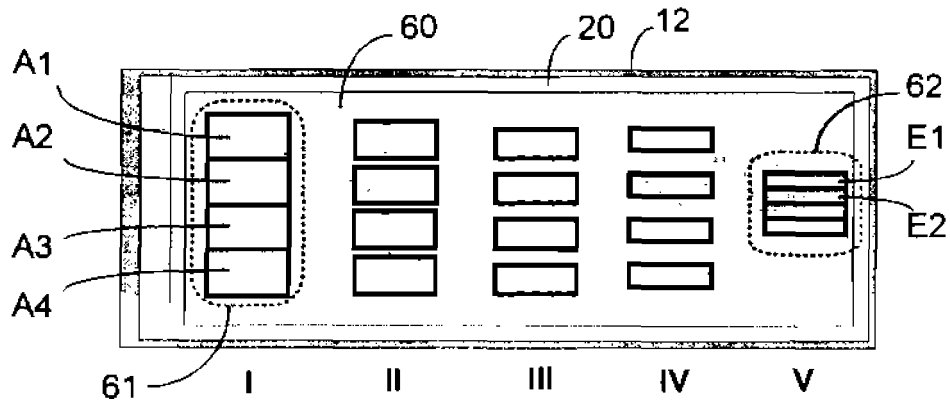


Fig. 6B

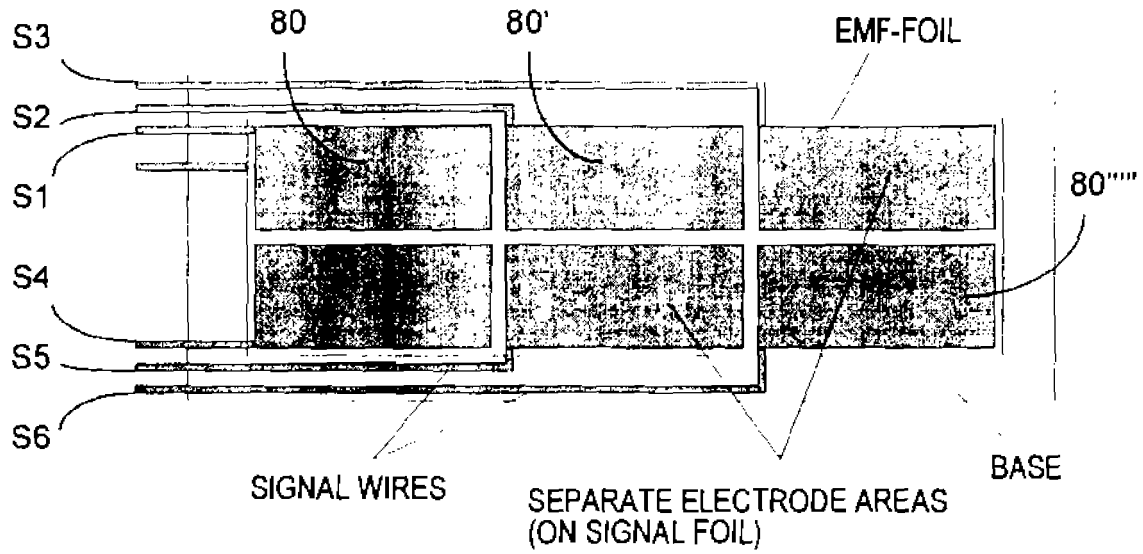


Fig. 8A

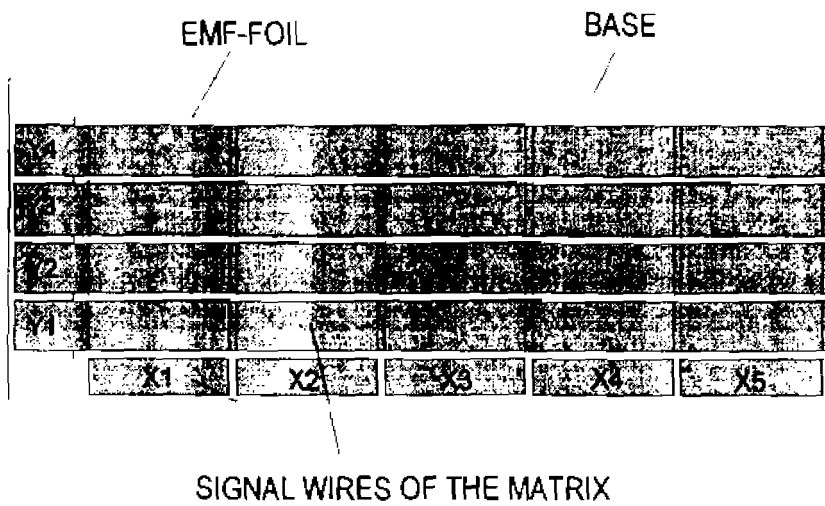


Fig. 8B

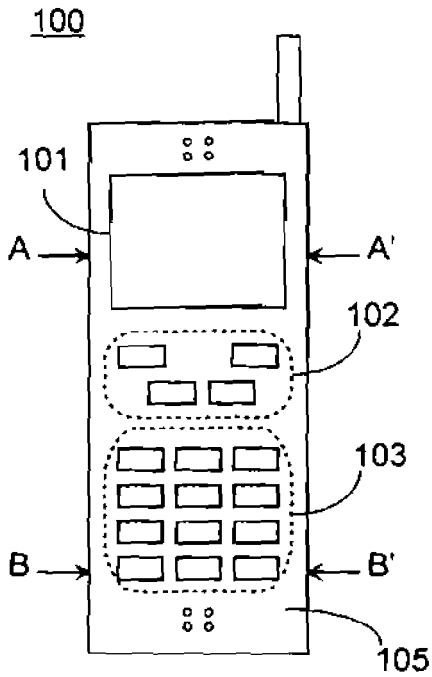


Fig. 10A

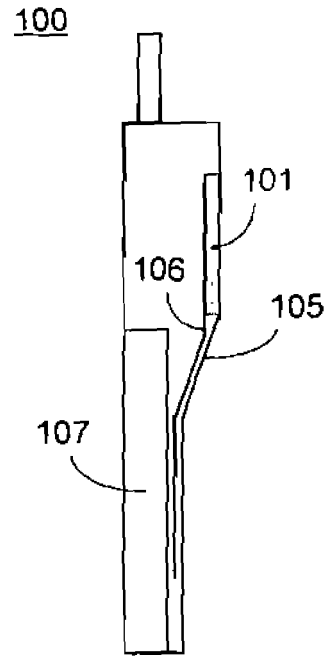


Fig. 10B

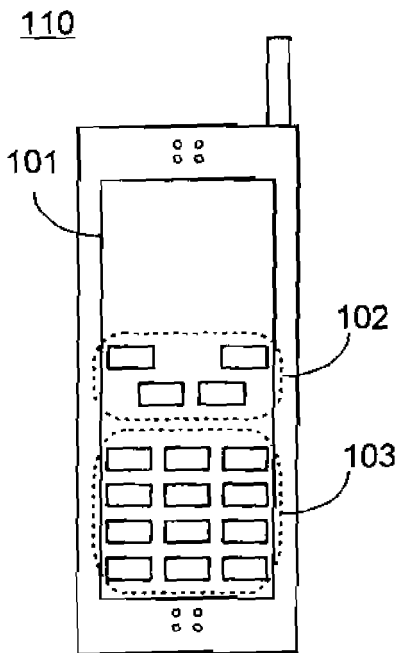


Fig. 10C

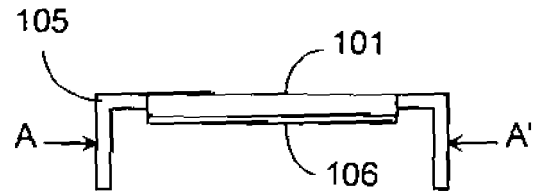


Fig. 10D

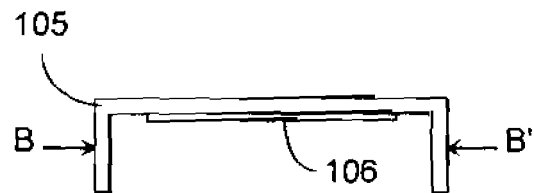


Fig. 10E

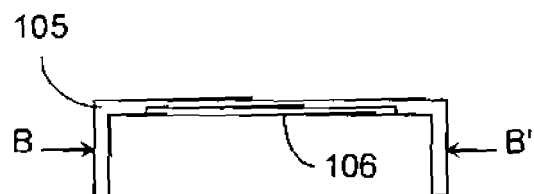


Fig. 10F

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<p>(30) Priority: 28.06.1996 FI 962692</p>	<p>(74) Representative: Johansson, Folke Anders Nokia Corporation P.O. Box 226 00045 Nokia Group (FI)</p>
<p>(71) Applicant: Nokia Corporation 02150 Espoo (FI)</p>	
<p>(72) Inventors: <ul style="list-style-type: none"> • Terho, Mikko 33820 Tampere (FI) </p>	

(54) **Terminal device with touch screen**

(57) The scope of the present invention is touch sensitive display construction (50), in connection of which touch sensitive element (20, 40) is used. In touch sensitive display construction (50) according to the invention touch sensitive element (20, 40) has been placed

in a protected space under display (12, 101). When display (12, 101) is touched, the force is transferred to touch sensitive film (20, 40) through display (12, 101). For the detection of touching preferably e.g. EMF- (Electro Mechanical Film) film (20, 40, 106) is used and as a display e.g. a LCD-display

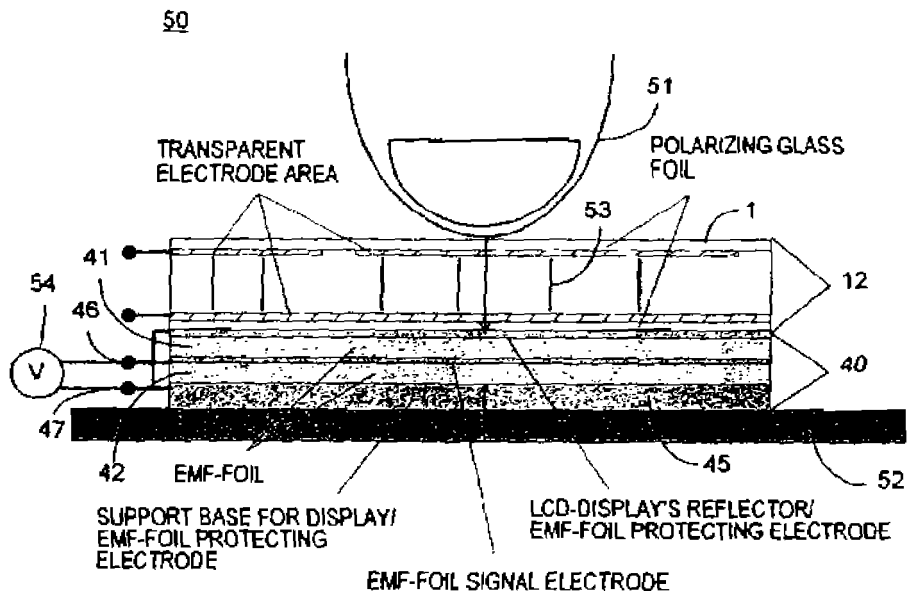


Fig. 5

EP 0 817 110 A3



European Patent
Office

Application Number

EP 97 66 0066

CLAIMS INCURRING FEES

The present European patent application comprised at the time of filing more than ten claims.

- Only part of the claims have been paid within the prescribed time limit. The present European search report has been drawn up for the first ten claims and for those claims for which claims fees have been paid, namely claim(s):
- No claims fees have been paid within the prescribed time limit. The present European search report has been drawn up for the first ten claims.

LACK OF UNITY OF INVENTION

The Search Division considers that the present European patent application does not comply with the requirements of unity of invention and relates to several inventions or groups of inventions, namely:

see sheet 8

- All further search fees have been paid within the fixed time limit. The present European search report has been drawn up for all claims.
- As all searchable claims could be searched without effort justifying an additional fee, the Search Division did not invite payment of any additional fee.
- Only part of the further search fees have been paid within the fixed time limit. The present European search report has been drawn up for those parts of the European patent application which relate to the inventions in respect of which search fees have been paid, namely claims:
- None of the further search fees have been paid within the fixed time limit. The present European search report has been drawn up for those parts of the European patent application which relate to the invention first mentioned in the claims, namely claims:

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

EP 97 66 0066

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 The European Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

02-03-2004

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

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(22) Date of filing 14 Aug 1985

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(51) INT CL⁴
G08C 21/00

(52) Domestic classification (Edition I):
G1N 1A3B 3S10 3S11 3S1A 3S2 3V5 4C 7H2 7S AQA

(56) Documents cited
G6 A 2136567 US 4121049 US 3857475
GB A 2125971

(58) Field of search
G1N
H4T
Selected US specifications from IPC sub-class G08C

(54) Pressure sensitive device

(57) This device is a touch screen or touch keyboard having a surface (1) and using force or pressure sensors (T1-T4) to measure force applied by the finger to the surface. Calculation of the position of the finger at areas not directly overlying any of the sensors is carried out on the basis of the data from the sensors. Three or four such sensors may be used. In addition to those sensors, there is a further sensor (T5) to which a weight (4) is attached to measure the forces applied to the screen or keyboard as a whole to compensate in the calculations for movements (change of orientation) of the screen or keyboard.

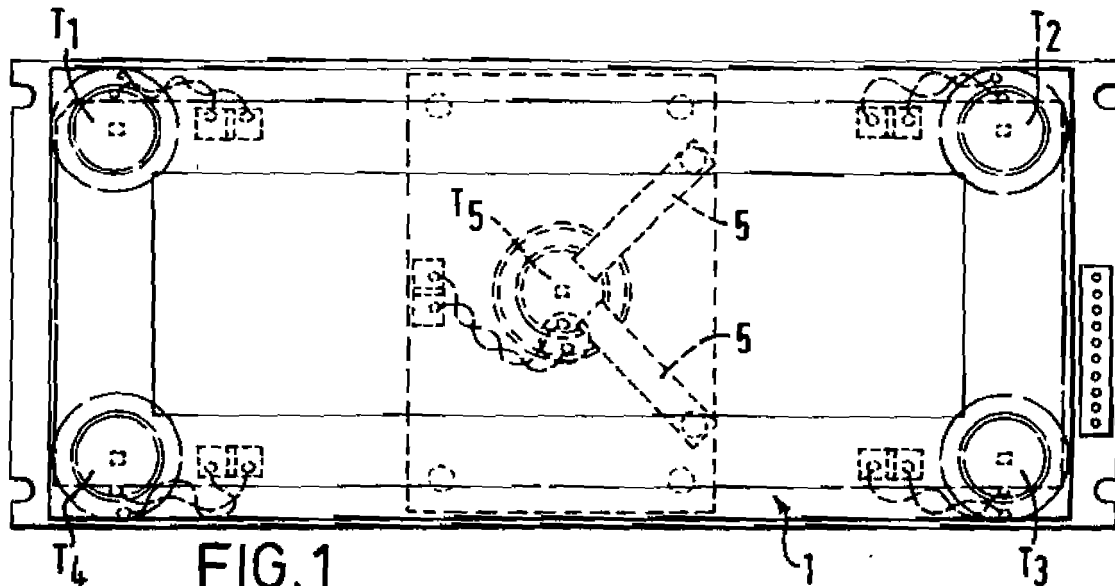


FIG. 1

GB 2 180 342 A

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EXHIBIT 1010 - PAGE 393

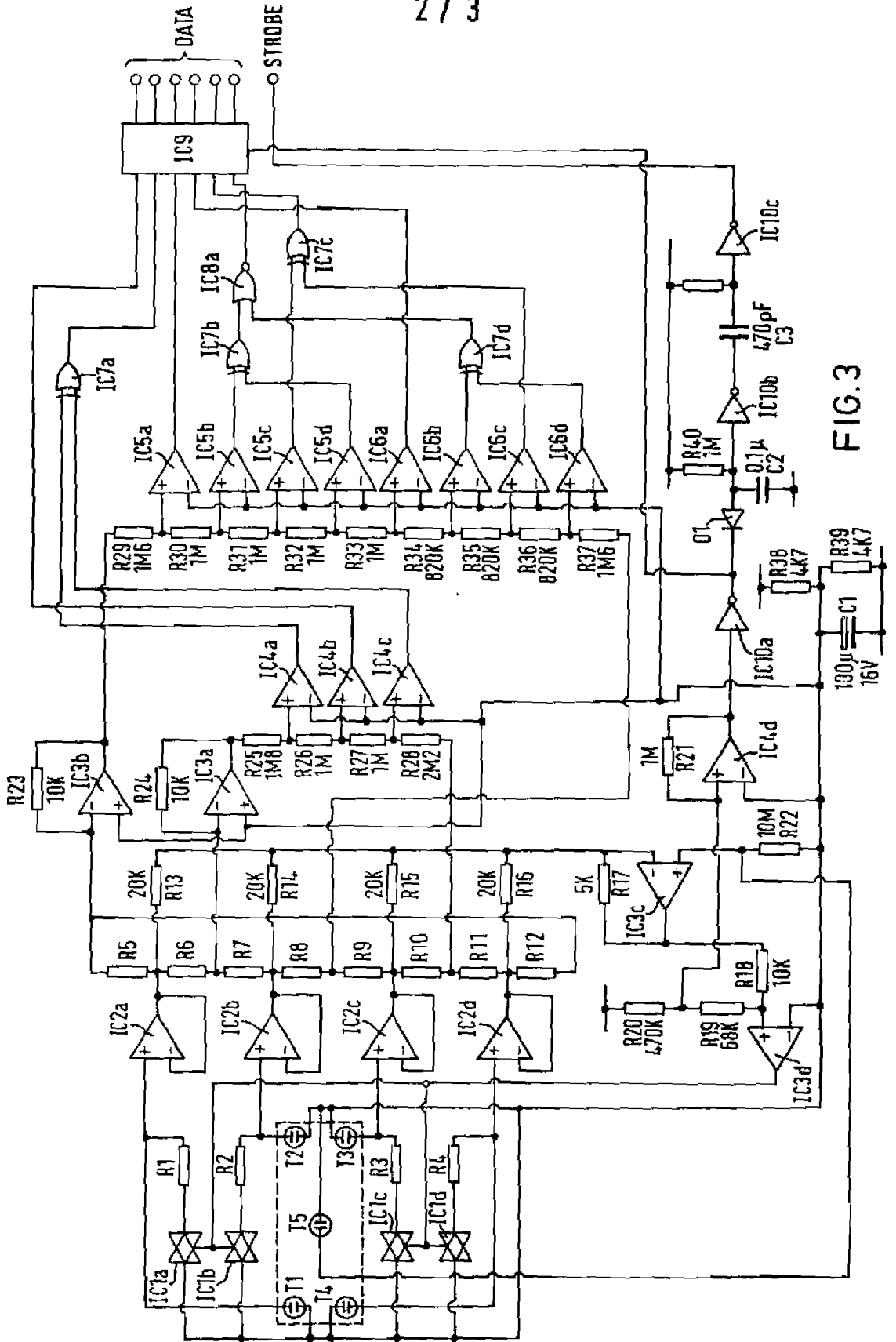


FIG. 3

SPECIFICATION

Pressure sensitive device

5 The present invention relates to a pressure sensitive device and to a location sensing apparatus incorporating the device.

It is sometimes undesirable or impossible to use a conventional keyboard employing mechanical switches as an input device for microprocessor controlled equipment. Other input devices have been devised, including so-called "touch screens". There are currently on the market various microprocessor based systems which have a "touch screen" as a built in feature. There are also kits available for fitting standard systems with touch screens. In most cases the touch screen is located in front of a CRT display.

20 The addition of a touch screen enables a conventional monitor display to be used to input data to a microprocessor. This is done by displaying on the monitor display a plurality of different regions or "keys". The "touch screens" can sense which of those regions is being indicated by a user to impart that information to the microprocessor. The usefulness of these touch screens is that the regions displayed can be positioned, labelled and changed in size automatically by the microprocessor software. Such an arrangement allows a high degree of flexibility in the positioning and labelling of keys used to control a computer program. It is particularly useful when the program contains a number of operating modes which may be entered into. The positioning and labelling of keys can be chosen at will for each mode of operation.

However, heretofore touch screens have employed various techniques each of which leave much to be desired by way of transparency, accuracy, power consumption, durability or the complexity and cost of implementation. Examples of these techniques include the interruption of light beams parallel to the display surface or physical contact between conductive films placed in front of the display.

The approach using light beams suffers from the disadvantages of high cost and complexity, high power consumption, possible interference from extraneous sources of radiation and excessive distance between the sensitive surface and parts of the display surface if the latter is not flat, as in the majority of CRT displays.

The approaches based on conductive films suffer from the disadvantages of poor transparency and unreliability. The transparency is compromised by the presence of two layers of metallisation, four or six reflective boundaries, and, in some cases, a matrix of small irregularities used for spacing purposes. As the front film must be flexible, it must be thin, and is therefore vulnerable to damage from sharp objects such as fingernails. It may also

transmit lateral displacement giving rise to wear of the conductive surfaces which, of necessity, must be extremely thin.

70 Although it would theoretically be possible to use such existing touch screens with LCD displays, this is not practicable in low cost portable equipment, owing to high power consumption, poor transparency, high cost or a combination of these drawbacks.

75 According to one aspect of the present invention, there is provided a pressure sensitive device comprising a member coupled to a plurality of transducers arranged to sense pressure applied to the member and disposed in spaced apart relationship such that when pressure is applied to the member at any one of a plurality of locations on the member and spaced from all the transducers, the pressure sensed by each transducer is dependent on the location at which said pressure is applied to the member, each transducer being capable of outputting a signal in dependence on the pressure sensed thereby.

80 According to another aspect of the present invention there is provided a location sensing apparatus having a device as defined in the preceding paragraph and means for processing said signals to provide signals representing coordinates of the location at which said pressure is applied.

95 For a better understanding of the present invention and to show how the same may be carried into effect, reference will now be made, by way of example, to the accompanying drawings in which:

100 Figure 1 is a plan view of a pressure sensitive device;

Figure 2 is a side view of the device of Figure 1; and

105 Figure 3 is a circuit diagram of one form of processing arrangement.

Figure 4 shows an alternative form of pressure sensitive device;

110 Figure 5 is an enlarged view of the encircled portion of Figure 4 showing one form of stress relief mechanism; and

Figure 6 is a diagram of an alternative stress relief mechanism.

115 The principle of operation of the apparatus involves the measurement of forces by means of transducers which form part of the supporting structure of a surface.

Suitable transducers are the type 7BB-20-6A0 manufactured by Murata Mfg. Co.Ltd. Kyoto, Japan.

120 Although such transducers are often used to convert electrical energy into vibrational energy, they also exhibit the property of converting pressure into electrical energy. More accurately, the transducers sense a force applied thereto, which is provided by the pressure applied over the area of the element (finger or the like) used to apply the pressure.

125 This property can be used to good effect by attaching the peripheries of the transducers to

130 APPLE INC.

corner transducers, T_1 - T_4 , mounted on the surface 1 are buffered by respective voltage followers, IC2a-d. The outputs of the voltage followers are applied to nodes of a resistor network, R5-R16 in such a way as to produce five signals corresponding respectively to the sums of adjacent transducer outputs and to the sum of all four transducer outputs. The signals corresponding to the top pair T_1, T_2 and to the left hand pair T_1, T_4 of transducers are inverted respectively by IC3a and IC3b, and the signal corresponding to all four transducers is inverted by IC3c. The output of IC3c is offset by a potential divider, R18-R20, and proportions thereof are applied to voltage comparators IC3d and IC4d, the latter being provided with hysteresis by R21.

Comparator IC3d provides an output which controls four bilateral switches IC1a-d, to cause the transducer output to be zeroed during the periods between applications of pressure by shunting them with resistors R1-R4. Under quiescent conditions the switch is closed. When the total force applied exceeds a preset level determined by the voltage comparator IC3d the switch is opened. For as long as the output remains above the threshold level, the output error will be solely dependent on parasitic leakages which can be kept extremely low by the use of circuitry employing field effect transistors (f.e.t.'s) in the input stages.

When the output falls below the threshold level, the restoring resistance is switched in and any accumulated error is eliminated. In order for this arrangement to function correctly, it is important that the time constant of the transducers and their restoring resistors is large compared with the risetime of the applied force, but small compared to the time between successive applications of force. A time constant of 100ms is appropriate in the present application.

IC4d provides an output which clocks an output register IC9 at the instant that a predetermined pressure has been reached. The input voltage for the comparator IC4d depends on the sum of the voltages from transducers T_1 to T_4 . The resistor chains R25-R28 and R29-R37 drive voltage comparators IC4a-c and IC5a-d, IC6a-d which produce digital signals consisting of eleven bits of data corresponding to the x,y position of an applied force. These signals are decoded to six bits by IC7 and IC8 in such a way that indecision present in any one comparator will only affect one bit of the decoded output. This is to prevent spurious codes being generated if a force is applied at the boundary between the "virtual" keys on the sensitive surface 1. In such a case, the only possible output codes are those corresponding to the "keys" adjacent to the point of application of the force. The code is clocked into register IC9 under the influence of clock pulse from IC4d.

It will be appreciated that the arrangement described, in addition to being sensitive to externally applied forces, will also be sensitive to the effects of acceleration and gravitational fields by virtue of the mass of the sensitive surface 1. These effects are accommodated in the illustrated processing circuitry.

As regards acceleration, the only significant effect is that of vibration, which will introduce a.c. components into the transducer outputs. The illustrated circuitry includes strobe generating circuitry to render it insensitive to vibration by discriminating against short lived transducer outputs. A strobe pulse is only produced after a sustained output voltage of, say, 100 mS duration. Thus the output of IC4d is processed by IC10a-c to produce a delayed strobe pulse for external data transfer. The purpose of this delay of approximately 100mS is to prevent any vibration induced transducer outputs registering as a "key" depression.

The effect of gravity on the sensitive surface could be significant if its orientation is subject to change. The effect could appear as the equivalent of a permanent applied pressure. This effect can be eliminated by use of the fifth transducer T_5 behind the centre of the display 2 mechanically coupled to the weight 4. The output of the fifth transducer T_5 is applied to the non inverting input of IC3c where it is subtracted from the summed outputs of the other four transducers after appropriate weighting. The result is that the system is insensitive to changes in orientation.

One alternative method of implementing the necessary processing is as follows. The voltages corresponding to two opposite edges are added and applied to a voltage comparator. At the instant that a predetermined voltage is reached, the voltages corresponding to the right hand and top edges are input to an analogue to digital conversion system. The two binary numbers obtained correspond to the x and y coordinates of the applied force. These binary numbers can be encoded into any convenient form by additional digital circuits, or they may be input directly to a microprocessor system.

Other arrangements of the transducers and surface are possible. For example, the sensitive surface may be rigidly attached to the transducers, with these preferably located in a plane containing the points of contact on the surface. This is in order to render the transducer outputs independent of lateral forces applied to the sensitive surface.

If it is impracticable to site the transducers in such a position, or if it is more convenient to place the transducers in a different plane (e.g. on a printed circuit board behind the display) then forces may be transmitted to the transducers via linkage structures, and the sensitive surface may be constrained laterally by a means which is free from frictional forces perpendicular to the surface. Flexible straps in

the member is rectangular, there being transducers positioned respectively at corners of the member.

4. A location sensing apparatus having a device as claimed in claim 1, 2 or 3 and means for processing said signals to provide signals representing coordinates of the location at which said pressure is applied.

5. An apparatus as claimed in claim 4, including a device according to claim 3, in which the processing means comprises:
means for combining the signals output from each set of two adjacent transducers to provide signals associated with respective edges of the member; and
means for comparing weighted representations of signals associated with opposite edges with a reference signal to provide said signals representing coordinates.

6. An apparatus as claimed in claim 5, which comprises:
means for inverting the signal associated with one edge of the member, and for applying the inverted signal to one node of a chain of resistive elements;

means for applying the signal associated with the opposite edge of the member to another node of the chain of resistive elements;
comparators for comparing signals at nodes intermediate the one and other nodes with a reference signal, the outputs of said comparators providing said signals representing coordinates.

7. A pressure sensitive device substantially as hereinbefore described with reference to, and as shown in, Figures 1 and 2 of the accompanying drawings.

8. A location sensing apparatus substantially as hereinbefore described with reference to, and as shown in, the accompanying drawings.

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INPUT DEVICE

Publication number: JP11024834

Publication date: 1999-01-29

Inventor: FUJIYAMA TERUKI

Applicant: FUJIYAMA TERUKI; KUJIRADA MASANOBU

Classification:

- international: **G06F3/041; G06F3/03; G06F3/033; G06F3/045;**
G06F3/041; G06F3/03; G06F3/033; (IPC1-7):
G06F3/033; G06F3/03

- European:

Application number: JP19980009534 19980121

Priority number(s): JP19980009534 19980121; JP19970118548 19970509

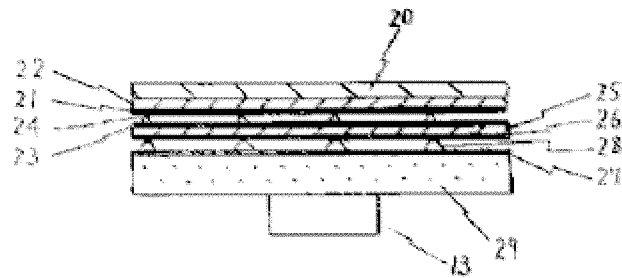
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Abstract of JP11024834

PROBLEM TO BE SOLVED: To provide an input tablet which can be easily operated by a single hand like a mouse and also can generate the switch feeling at an input part to confirm the keying operation of an operator.

SOLUTION: A sheet 22 having a resistor 21 formed on its lower surface is set opposite to a sheet 25 having a resistor 23 and a dot spacer 24 formed on its upper surface under a surface decorative panel 20 to form an X-Y data input part of light operating force. Then the contacts 26 and 27 formed on the lower and upper surfaces of the sheet 25 are placed opposite to a rigid substrate 29 having a dot spacer 28 to form a membrane switch of heavier operating force than the data input part. Thus, an input part of a double structure is obtained.

Meanwhile, a vibration unit 13 is placed under the substrate 29 to form an X-Y tablet input part. A cursor is moved when the X-Y tablet input part is pressed light by a finger and moved, and a switch input operation is attained when the moved cursor position is pushed strong.



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3/03	3 1 0	3/03 3 1 0 L
	3 2 0	3 2 0 F

審査請求 未請求 請求項の数 5 O L (全 8 頁)

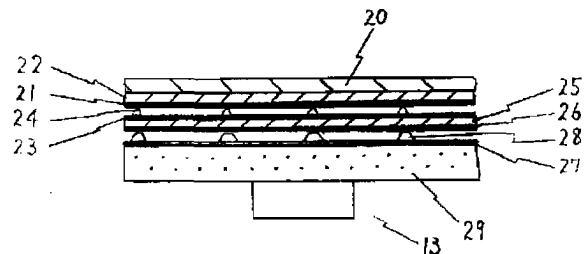
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(32) 優先日	平9(1997)5月9日		
(33) 優先権主張国	日本 (J P)		

(54) 【発明の名称】 入力装置

(57) 【要約】 (修正有)

【課題】 マウスと同様に片手で簡単に操作でき、かつ、入力箇所にスイッチフィーリングを発生させ操作者がキーインしたことが確認できる入力タブレットを提供する。

【解決手段】 表面の化粧パネル20の下に、下面に抵抗体21を形成したシート22と、上面に抵抗体23とドットスペーサー24を形成したシート25を対向して、操作力の軽いX-Yデータ入力部を構成し、シート25の下面に形成した接点26と、上面に接点27とドットスペーサー28を形成した剛体基板29を対向して、前記タブレットよりも操作力の重いメンブレンスイッチを構成し、二層構造の入力部を形成し、剛体基板29の下に振動ユニット13を配置してX-Yタブレット入力部を構成した。X-Yタブレット入力部を指で軽く押さえ移動することによりカーソルを移動し、その箇所を強く押すことによりスイッチ入力する事ができる。



【特許請求の範囲】

【請求項1】操作力の軽いX-Yデータ入力部の下に、前記X-Yデータ入力部よりも操作力の重いメンブレンスイッチを配置した2層構造によりX-Yタブレット入力部を構成し、これらを剛体で保持し、この剛体を介して入力装置の操作部を振動する振動（衝撃）発生ユニットを具備して構成したことを特徴とする入力装置。

【請求項2】二つの抵抗面または複数の接点を対向させたシート間に、押圧力により抵抗が変化する感圧体を挟み込んでX-Yタブレット入力部を形成し、かつ、上記感圧体の抵抗変化を検出する検出部を設けてX-Yタブレットを構成し、シート上の抵抗を検出することにより押下位置を、また、押下力による感圧体の抵抗変化を検出することによってスイッチングを行うことを特徴とする入力装置。

【請求項3】X-Yタブレット入力部の裏面に、剛体を介して入力装置のスイッチングと連動して作動する振動（衝撃）発生ユニットを具備して構成したことを特徴とする請求項2の入力装置。

【請求項4】プッシュスイッチのボタン天面の一部または全部に、プッシュスイッチよりも軽い操作力で作動するX-Yタブレットを配置したことを特徴とする入力装置。

【請求項5】X-Yタブレット入力部の化粧パネルにテンキーと計算マークを表示し、切り替えスイッチによるモードの切り替えにより、タブレットモードは軽いタッチにおいてはX-Yデータを常に送信し続け、加圧によりスイッチングデータを送信する。一方テンキーモードにおいては、軽いタッチにおいてX-Yタブレット入力部からの位置データを検出し、（送信はしない）、加圧によるスイッチングと同時にテンキー表示マークのデータに変換し、表示データを送信する構成としたことを特徴とする入力装置。

【発明の詳細な説明】

【0001】

【発明の属する技術分野】本発明は、パソコンに内蔵または外付けして、位置データおよびスイッチングデータを入力する入力装置に関するものである。

【0002】

【従来の技術】近年、パソコンの操作は、Windows 95（登録商標）に代表されるように、位置データを入力するマウスを移動することにより、カーソルを所定の位置に移動し、人差し指付近に配置されたスイッチをクリックすることによりカーソル位置を決定している。この操作方法により誰にでも簡単に、片手で素早くパソコンの操作をすることができる。しかしながら、マウスは机上を移動して使用するため平坦で広範囲な場所を取り、携帯型のノート型パソコンでは使用しづらい。このため、従来のノート型パソコンではボウルを任意の方向に回転させてカーソルを移動するトラックボウルや位置

データを入力する小型のタブレットが用いられている。

【0003】図12に最新のノート型パソコンに使用されている小型のタブレットの使用例を示す。1はノート型パソコンの画面で、2はタブレット、3は入力スイッチである。画面上の文字や図形を移動させる場合図13に示す通り、タブレット2上を指で軽く押さえ4から5へ移動することにより、画面1上のカーソルを7から画面上の図形8上へ移動し、画面上の図形8を移動させるため別に設けたスイッチ10をクリック（スイッチング）し、スイッチ10を押さえながらタブレット2上を指で軽く押さえ5から6へ移動することにより画面上の図形を9まで移動し、スイッチ10を離すことにより移動を完了するものである。

【0004】

【発明が解決しようとする課題】しかしながら、従来の構成では、カーソル位置を移動するためにタブレット2上を指で軽く押さえながら、かつ、画面上の図形を移動させるために、別のスイッチ10を操作しなければならないため、両手を使わざるを得ず、マウスを使用した場合と比較して操作がわずらわしいし、作業時間もかかるという課題がある。

【0005】本発明はかかる点に鑑み、マウスと同様に片手で、簡単に、確実に、操作できるタブレットを提供するものである。

【0006】

【課題を解決するための手段】この課題を解決するために本発明は、以下の構成としたものである。

【0007】1. 操作力の軽いX-Yデータ入力部の下に、前記X-Yデータ入力部よりも操作力の重いメンブレンスイッチを配置した2層構造によりX-Yタブレット入力部を構成し、これらを剛体で保持し、この剛体を介して入力装置の操作部を振動する振動（衝撃）発生ユニットを配置して、入力装置を構成したものである。

【0008】これにより、X-Yデータ入力部は押下位置を、メンブレンスイッチは押下力を検出することにより、押下位置とスイッチングを同一箇所を検出するとともに、スイッチングと同時に振動発生ユニットを振動することにより、押下場所にて振動による確実な入力確認ができる。

【0009】2. 二つの抵抗面または複数の接点を対向させたシート間に、押圧力により抵抗が変化する感圧体を挟み込んでX-Yタブレット入力部を形成し、かつ、上記感圧体の抵抗変化を検出する検出部を設けてX-Yタブレットを構成し、シート上の抵抗を検出することにより押下位置を、また、押下力による感圧体の抵抗変化を検出することによってスイッチングを行う構成としたものである。

【0010】これにより、一層構造のX-Yタブレット入力部で、押下位置とスイッチング動作を同一箇所で行うことができる。

【0011】3. 上記X-Yタブレットの裏面に、剛体を介して入力装置のスイッチングと連動して作動する振動(衝撃)発生ユニットを具備して構成したものである。

【0012】これにより、スイッチング時は、振動または衝撃によるフィーリングを操作者に与え、スイッチングを操作者に確実に認知させることができる。

【0013】4. プッシュスイッチのボタン天面の一部または全部に、プッシュスイッチよりも軽い操作力で作動するX-Yタブレットを配置し、軽いタッチでX-Yデータを、また、押し圧によりプッシュスイッチのスイ

10 チングを行う構成としたものである。

【0014】これにより、スイッチング時は、プッシュスイッチのタクトフィーリングを操作者に与え、スイッチの入力を確実に操作者に認知させることができる。

【0015】5. X-Yタブレット入力部の化粧パネルにテンキーと計算マークを表示し、切り替えスイッチによるモードの切り替えにより、タブレットモードは、軽いタッチにおいてX-Yデータを常に送信し続け、加圧によりスイッチングデータを送信する。一方テンキーモードは、軽いタッチにおいてX-Yタブレット入力部から

20 位置データを検出し、(送信はしない)、加圧によるスイッチングと同時にテンキー表示マークのデータに変換し、表示データを送信する構成としたものである。

【0016】上記構成により、X-Yタブレットをテンキーとして使用する事が出来る。

【0017】

【発明の実施形態】本発明は上記目的を達成するために以下の構成としたものである。

【0018】本発明の請求項1に記載の発明は、操作力の軽いX-Yデータ入力部の下に、前記X-Yデータ入力部よりも操作力の重いメンブレンスイッチを配置した2層構造によりX-Yタブレット入力部を構成し、これらを剛体で保持し、この剛体を介して入力装置の操作部を振動する振動(衝撃)発生ユニットを配置して、入力装置を構成したものである。

【0019】これにより、X-Yデータ入力部は押下位置を、メンブレンスイッチは押下力を検出することにより、押下位置とスイッチングを同一箇所を検出できるとともに、スイッチングと同時に振動発生ユニットを振動することにより、押下場所にて振動による入力確認が

40 できる。

【0020】この構成により、X-Yタブレット入力部を指で軽く押さえ移動することによりパソコン画面上のカーソルを移動し(位置検出)、その箇所を強く押すことによりスイッチ入力(スイッチング)する事ができ、スイッチ入力と同時に振動発生ユニットを振動することにより、操作者は、押下場所にて振動による入力確認ができる。

【0021】本発明の請求項2に記載の発明は、二つの抵抗面または複数の接点を対向させたシート間に、押圧

力により抵抗が変化する感圧体を挟み込んでX-Yタブレット入力部を形成し、かつ、上記感圧体の抵抗変化を検出する検出部を設けてX-Yタブレットを構成し、シート上の抵抗を検出することにより押下位置を、また、押下力による感圧体の抵抗変化を検出することによってスイッチングを行う構成としたものである。

【0022】この構成により、軽い押下力での位置検出はシート上の二つの抵抗検出で、強い押下力でのスイッチングは感圧体の抵抗変化で検出する事ができ、X-Yタブレットの一層構造のみで、位置検出とスイッチングを同一箇所で行う作用がある。

【0023】本発明の請求項3に記載の発明は、上記X-Yタブレット入力部の裏面に、剛体を介して入力装置のスイッチングと連動して作動する振動(衝撃)発生ユニットを備えて構成したものである。

【0024】この剛体により、振動ユニットの振動をX-Yタブレット入力部の表面に伝達する作用があり、操作者はスイッチング動作の感覚を振動やタクトフィーリングで得られ確実なスイッチ操作が出来る。

【0025】上記構成を組み合わせる事により、タブレットを指で軽く押さえ移動することにより、パソコン画面上のカーソル移動を行い、そのままタブレット上を強く押さえることによりスイッチ入力ができるという作用がある。また、スイッチ入力と同時に振動または衝撃によるフィーリングを操作者に与え、スイッチングを操作者に認知させるという作用がある。

【0026】本発明の請求項4に記載の発明は、プッシュスイッチのボタン天面の一部または全部に、プッシュスイッチよりも軽い操作力で作動するX-Yタブレットを配置した構成としたものである。

【0027】上記構成により、タブレットを指で軽く押さえ移動することにより、パソコン画面上のカーソル移動を行い、そのままタブレット上を強く押さえることによりプッシュスイッチによりスイッチ入力ができるという作用がある。また、タクトフィーリングを有するプッシュスイッチを用いることにより、スイッチ入力と同時にタクトフィーリングを操作者に与え、スイッチングを操作者に認知させるという作用がある。また、ボタン天面の一部のみにX-Yタブレットを配置した構成とすることにより、X-Yタブレットを介さずに直接プッシュスイッチのスイッチングができるため、別のスイッチ入力と共用できる。

【0028】本発明の請求項5に記載の発明は、X-Yタブレット入力部の化粧パネルにテンキーと計算マークを表示し、切り替えスイッチによるモードの切り替えにより、タブレットモードは、軽いタッチにおいてX-Yデータを常に送信し続け、加圧によりスイッチングデータを送信する。一方テンキーモードは、軽いタッチにおいてX-Yタブレット入力部からの位置データを検出し、(送信はしない)、加圧によるスイッチングと同時

にテンキー表示マークのデータに変換し、表示データを送信する構成としたものである。

【0029】上記構成により、X-Yタブレットによりテンキーデータをパソコンに送信できるという作用があり、場所を取るテンキーを別途に必要としない。

【0030】(実施の形態1)以下本発明の第1の実施形態をを図1により説明する。

【0031】図1は、本発明によるX-Yタブレット入力部の保持方法の概略構成図を示す。

【0032】11は剛体基板で、上面にX-Yタブレット入力部12を、下にブランジャーやパイプレーターよりなる振動(衝撃)ユニット13を固定している。剛体基板11は、ダンパー14を介してケース15と上下に可動自在に保持されて、振動(衝撃)ユニット13の振動が、剛体基板11を介して、X-Yタブレット入力部12全体に伝わるよう構成されている。なお、剛体基板11はケース15と一体に形成しても良い。

【0033】この構成により、振動ユニットの衝撃や振動をX-Yタブレット入力部の操作面全体に均一に伝える事が出来る。

【0034】図2は、本発明によるX-Yデータ入力部とメンブレンスイッチの二層構造のX-Yタブレット入力部に振動ユニットを取り付けた場合の断面構成図を示す。

【0035】表面の化粧パネル20の下に、下面に抵抗体21を形成したシート22と、上面に抵抗体23とドットスペーサー24を形成したシート25を対向して、操作力の軽いX-Yデータ入力部を構成し、シート25の下面に形成した接点26と、上面に接点27とドットスペーサー28を形成した剛体基板29を対向して、前記タブレットよりも操作力の重いメンブレンスイッチを構成し、二層構造の入力部を形成し、剛体基板29の下に振動ユニット13を配置してX-Yタブレット入力部を構成したものである。

【0036】図3は、X-Yタブレット入力部の入力位置とスイッチングを検出する方法の一実施例を示した概略説明図を示し、図4は、図3における各端子の入出力を時間を横軸にして表示したものである。

【0037】図3において、X-Yデータ入力部の抵抗と接続した各端子は、対向するシート間でお互い直交し、縦方向をR1横方向をR3とする。また、抵抗R5およびR6は、R1およびR3よりもはるかに大きい値とする。

【0038】未入力の場合は、端子(イ)にV1ボルト、端子(ロ)に0ボルトの電圧を印加しても、端子(ハ)と端子(ニ)の出力は抵抗R6があるため0ボルトとなる。軽くタブレットを押さえた場合は、図3の30が短絡し、端子(ハ)と端子(ニ)の出力はどちらもほぼR1と短絡点までの抵抗R2の分圧となり、 $V(ハ) = V(ニ) = V1 \cdot R2 / R1$

となる。

【0039】次に端子(ハ)にV1ボルト、端子(ニ)に0ボルトの電圧を印加すると端子(イ)と端子(ロ)の出力はどちらもほぼR3と短絡点までの抵抗R4の分圧となり、

$$V(イ) = V(ロ) = V1 \cdot R4 / R3$$

となる。よってこれらの電圧をAD変換等の手段により位置データへ変換することにより押下位置を特定できる。

【0040】次に、同じ箇所を強く押さえることにより、X-Yデータ入力部の真下に構成したメンブレンスイッチの接点26と接点27が接触してスイッチング操作を行う事が出来る。また、スイッチングと同時に剛体基板29の下の振動ユニット13を振動させることにより、操作者に入力フィーリングを与えることが出来る。

【0041】上記構成により、押下位置とスイッチングを同一箇所で行入でき、入力の応答として、同じ箇所で行入、入力フィーリングを発生できる。

【0042】図5は、本発明の構成ブロック図を示す。指先でパネル上を軽く移動した場合、1段目のX-Yデータ入力部31で位置を検出し、マイコン32により位置のデータ処理を行ってパソコン33へ位置データを送信する。パソコン33はこれを受信し、画面34にカーソル等の移動を表示する。また、強く押された場合、2段目のメンブレンスイッチ35でスイッチングの有無をマイコン32により検出し、パソコン33へスイッチングデータを送信すると同時に振動ユニット36を短時間作動、または、ブザー37を短時間鳴らす。パソコン33はスイッチングデータを受信し、画面34にスイッチング表示をしたりワーク後の結果を表示する。パソコン33へ誤入力データが送信された場合は、パソコン33からマイコン32へ誤入力があった事を送信し、マイコン32はこれを受信して振動ユニット36をスイッチング時とは異なったパターンで振動させ、操作者に誤入力を認知させる。以上の構成により、位置データとスイッチングデータの入力を指一本で簡単に行う事が出来るという効果がある。

【0043】(実施の形態2)以下本発明の第2の実施形態をを図6から図8により説明する。

【0044】図6は、本発明による二つの抵抗面を対向させたシート間に、感圧体を挟み込んで構成したX-Yタブレット入力部の断面構成図である。

【0045】下面に抵抗体41を形成したシート42と、上面に抵抗体43を形成したシート44を対向させたシート間に、押圧力により抵抗が変化する感圧体45を挟み込んでX-Yタブレット入力部を形成したものである。46は、振動を伝達する剛体基板で、13は振動(衝撃)ユニットである。

【0046】図7は、図6のX-Yタブレット入力部の感圧体の抵抗変化を検出する方法(押圧変化検出モー

ド)の一実施例を示した概略説明図を示す。(X-Yタブレット入力部の入力位置を検出するモードは、実施形態1と同様なので説明は省略する。)

図8は、これの等価回路と抵抗変化検出の処理ブロック図を示す。

【0047】図7において、端子(イ)にV1ボルト、抵抗R10の一端を0ボルト、トランジスタ47をオンにすると、図8の等価回路となる。

【0048】この回路において、端子(ニ)の出力電圧は、

$$V(ニ) = V1 \cdot R10 / (R7 + R8 + R9 + R10)$$

となる。

【0049】ここで、抵抗R7は圧力を加えると小さくなり圧力を弱めると大きくなる。また、R8とR9は、X-Yタブレット入力部の押下位置の移動によって抵抗値が変化する。

【0050】ここで、X-Yタブレット入力部を指で軽くならざる位置入力の状態においては、端子(ニ)の電圧が頻繁に変化するため、感圧体の抵抗変化を検出する押圧変化検出モードに入らず、実施形態1と同様の方法で入力位置の検出を行う。この入力位置検出モードで、位置移動が停止した場合、押圧変化検出モードに入り、V(ニ)の電圧をA-Dコンバータ48で読み取り、マイコン49で記憶処理する。次に位置検出モードと押圧変化検出モードを交互に行い、再度位置移動があれば位置検出モードに移行し、位置検出モードにおいて位置移動がなく、かつ、押圧変化検出モードにおいてV(ニ)の電圧が規定値以上変化したら(A-Dコンバータの出力が規定量変化したら)マイコン49で前データと比較することによりこれを検知し、押圧の変化があったとみなしてスイッチング動作を実行する。この、スイッチング動作とは、振動ユニット50を振動させたり、パソコン51にスイッチングデータを転送することを指す。

【0051】なお、上記において位置検出モードと押圧変化検出モードの切り替えや実行はマイコン49で行うことにより容易に実施できる。また、振動ユニットの代わりにブザーやパソコンの表示画面の変化で、操作者にスイッチングを認識させても良いことは言うまでもない。

【0052】また、上記実施形態1および2において、抵抗検出方式(アナログ)のX-Yタブレット入力部を用いたが、下面にX方向の複数接点を形成したシートと、上面にY方向の複数接点を形成したシートの接点を対向させて、各交点にスイッチを形成し、押されたスイッチの位置により押下位置を検出する多接点方式のX-Yタブレット入力部(デジタル)を用いても同様の効果が得られる。また、マイコンはパソコン内のCPUと共用しても良い。

【0053】(実施の形態3)図9は、本発明の別実施

例で、プッシュスイッチを用いたX-Yタブレット入力部の概略構成図を、図10は、これの断面図(図9のA-A')を示す。

【0054】プッシュスイッチ55のボタン天面56の一部に、プッシュスイッチ55よりも軽い操作力で作動するX-Yタブレット57を配置し、X-Yタブレット57への軽いタッチでは、位置データを送信し、押し圧(加圧)によるプッシュスイッチ55のスイッチングにより、スイッチング(実行)データを送信する構成としたものである。58は、別の入力ボタンで、プッシュスイッチ59のスイッチングを行うものである。60は、カバー61により一体形成されたガードで、X-Yタブレット57の周囲に指が触れて誤入力するのを防止する。なお、ボタンを平行移動させるためにボタンのツバ62を伸ばしてその先端をボタンの回転支点とするヒンジ構造としても良い。上記において、ボタン56を直接スイッチングすると、スイッチング(実行)データのみ送信される。

【0055】上記構成により、タブレットを指で軽く押さえ移動することにより、パソコン画面上のカーソル移動を行い、そのままタブレット上を強く押さえることによりプッシュスイッチによりスイッチ(実行)入力ができるという作用がある。また、タクトフィーリングを有するプッシュスイッチを用いることにより、スイッチ入力と同時にタクトフィーリングを操作者に与え、スイッチングを操作者に認知させるという作用がある。また、ボタン天面の一部のみにX-Yタブレットを配置した構成とすることにより、X-Yタブレットを介さずに直接プッシュスイッチのスイッチングができるため、別のスイッチ入力を共用できる。

【0056】(実施の形態4)図11は、本発明によりテンキーを構成したものである。

【0057】図11において、X-Yタブレット入力部の化粧パネル20にテンキーと計算マークを表示し、切り替えスイッチ63によるモードの切り替えにより、タブレットモードは、軽いタッチにおいてX-Yタブレット入力部からの位置データを検出し、(送信はしない)、加圧によるスイッチングと同時にテンキー表示マークのデータに変換し、表示データを送信するものである。上記モードの切り換えは、図5における制御用マイコン32の内部ソフトルーチンの切り換えにより容易に実施できる。

【0058】上記により、パソコンの周辺機器であるX-Yタブレットをテンキーとしても使用する事が出来る。

【0059】なお、上記においてX-Yタブレットは静電容量方式でも良いことは言うまでもない。

【0060】

【発明の効果】以上のように、本発明によれば、タブレットを指で軽く押さえ移動することによりパソコン画面

上のカーソルを移動し（位置検出）、タブレットを強く押すことによりスイッチ入力（スイッチング）する事ができ、押下位置検出とスイッチング位置を同一箇所で行うことができるため、指一本で簡単に位置入力とスイッチング入力が可能となるという効果がある。

【0061】また、スイッチ入力と同時に振動または衝撃またはタクトフィーリングによる入力フィーリングを操作者に与えることにより、スイッチングを操作者に認知させることができ、誤入力の防止ができるという効果がある。

【0062】さらに、本発明により単独の周辺機器としてX-Yタブレットを構成しても、マウスのように机を移動して使用しないため、平坦で広範囲な場所を必要とせず置き場所を選ばないという効果がある。

【0063】また、実施形態3においては、ボタン天面の一部のみにX-Yタブレットを配置した構成とすることにより、X-Yタブレットを介さずに直接プッシュスイッチのスイッチングができるため、別のスイッチ入力とプッシュスイッチを共用できるため部品点数が減る。

【0064】また、X-Yタブレットの化粧パネルにテンキーと計算マークを表示し、切り替えスイッチによるモード切り換えにより、X-Yタブレットからの位置データを表示マークのデータに変換し、スイッチングと同時に表示データを送信することにより、X-Yタブレットをテンキーとしても使用する事が出来るという効果がある。

【図面の簡単な説明】

【図1】本発明によるX-Yタブレット入力部の保持方法の概略構成図を示す。

【図2】本発明によるX-Yデータ入力部であるメンブレンスイッチの二層構造の入力部と振動ユニットの断面構成図を示す。

【図3】X-Yタブレット入力部の入力位置とスイッチングを検出する方法の一実施例で、概略説明図を示す。*

*【図4】図3における各端子の入出力を時間を横軸にして示す。

【図5】本発明の構成ブロック図を示す。

【図6】本発明による二つの抵抗面を対向させたシート間に、感圧体を挟み込んで構成したX-Yタブレット入力部の断面構成図を示す。

【図7】図6のX-Yタブレット入力部の感圧体の抵抗変化を検出する方法の一実施例で、概略説明図を示す。

【図8】図7の等価回路と抵抗変化検出の処理ブロック図を示す。

【図9】本発明の別実施例で、プッシュスイッチを用いたX-Yタブレット入力部の概略構成図を示す。

【図10】図9のA-A'断面図を示す。

【図11】本発明によりテンキーを構成したものである。

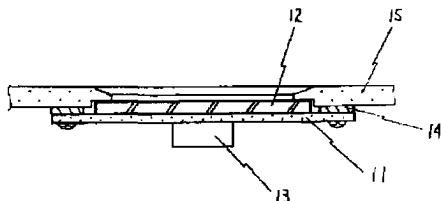
【図12】従来のノートパソコンの構成を示す。

【図13】図10のノートパソコンのX-Yタブレットの使用法を示す。

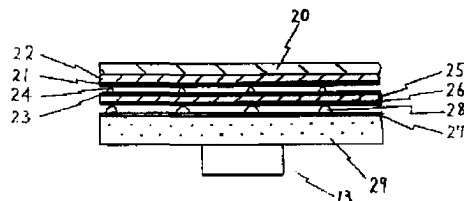
【符号の説明】

- 11 剛体基板, 12 X-Yデータ入力部, 13 振動ユニット, 14 ダンパー, 15 ケース, 20 化粧パネル, 21 抵抗体, 22 シート, 23 抵抗体, 24 ドットスペーサ, 25 シート, 26 接点, 27 接点, 28 ドットスペーサ, 29 剛体基板, 30 X-Yタブレット入力部, 31 マイコン, 32 パソコン, 33 画面, 34 メンブレンスイッチ, 35 振動ユニット, 36 ブザー, 41 抵抗体, 42 シート, 43 抵抗体, 44 シート, 45 感圧体, 46 剛体基板, 47 トランジスタ, 48 A-Dコンバータ, 49 マイコン, 50 振動ユニット, 51 パソコン, 52 プッシュスイッチ, 53 ボタン天面, 54 X-Yタブレット, 55 別の入力ボタン, 56 プッシュスイッチ, 57 ガード, 58 カバー, 59 ツバ, 60 切り換えスイッチ

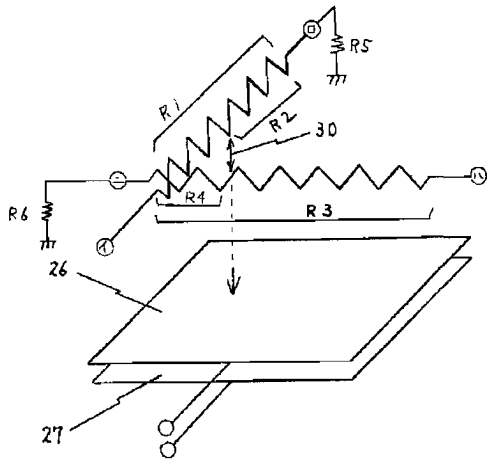
【図1】



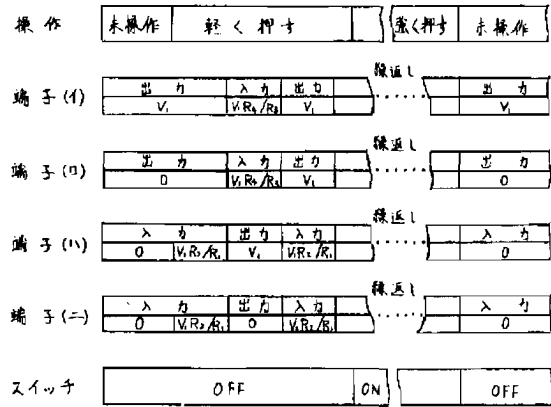
【図2】



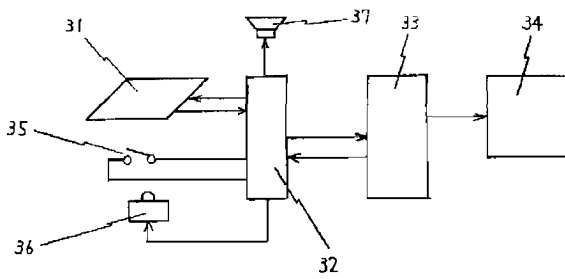
【図3】



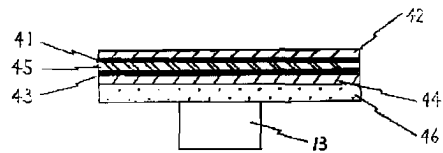
【図4】



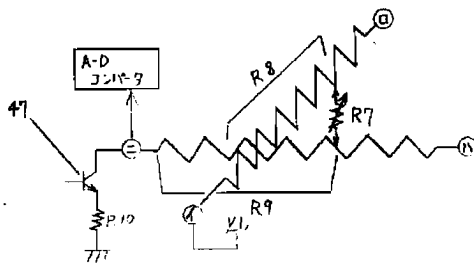
【図5】



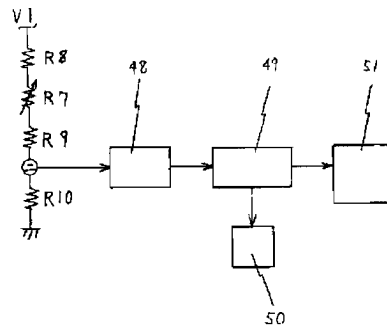
【図6】



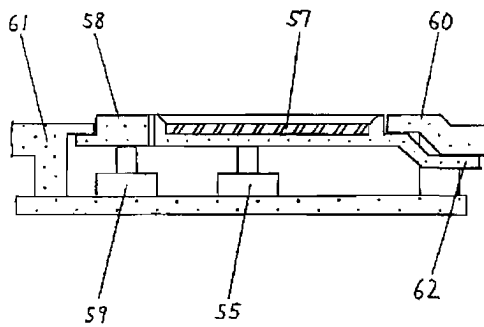
【図7】



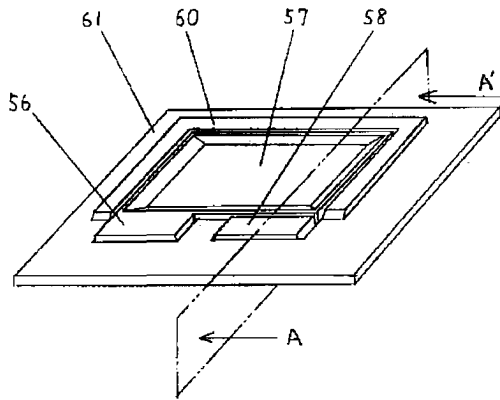
【図8】



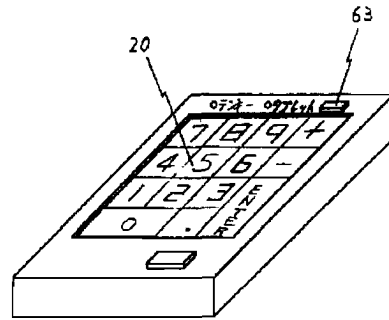
【図10】



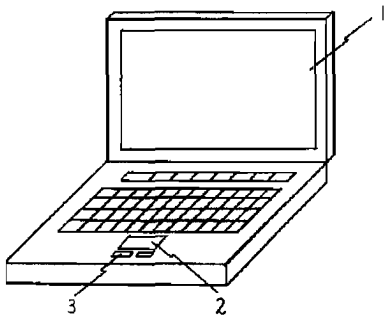
【図 9】



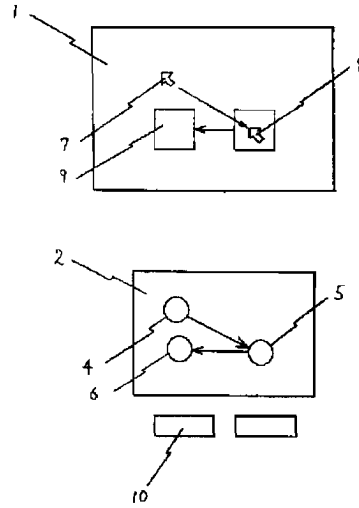
【図 11】



【図 12】



【図 13】



INPUT DEVICE

Publication number: JP8221173

Publication date: 1996-08-30

Inventor: TAIMA SHINOBU

Applicant: HITACHI LTD; HITACHI DEVICE ENG

Classification:

- international: **G06F3/02; G06F3/033; G06F3/041; G06F3/02; G06F3/033; G06F3/041;** (IPC1-7): G06F3/02; G06F3/033

- European:

Application number: JP19950021425 19950209

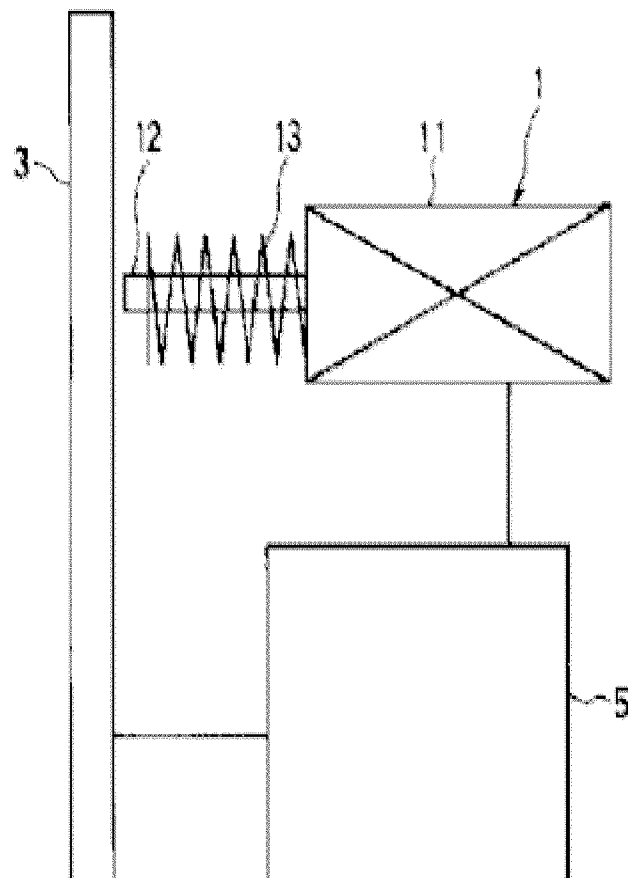
Priority number(s): JP19950021425 19950209

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Abstract of JP8221173

PURPOSE: To improve the operation feeling that operation is securely done by giving a shock or shake to an operator when the operator touches or presses a specific switch.

CONSTITUTION: When the operator presses the specific switch displayed on the screen of a touch panel 3, the touch panel 3 informs a controller 5 that the switch is operated. The controller 5 decides its contents and sends its signal to the object device equipped the touch panel 3. At this time, the controller 5 also sends a signal to an electromagnetic hammer 1 and places the electromagnetic hammer 1 in operation to give a shock to the panel switch 3 from behind, thereby making the operator sense the depression (touch) of the switch on the finger tip (or through a pen held in the hand of the operator). In another way, the electromagnetic hammer 1 is placed in operation after it is confirmed that the object device operates and it may be informed that the object device operates.



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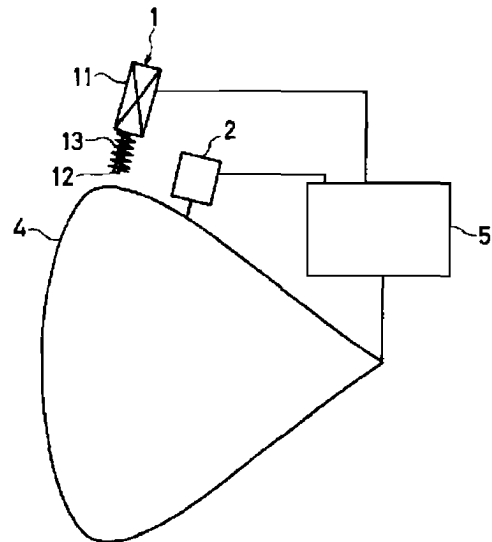
(54)【発明の名称】 入力装置

(57)【要約】

【目的】入力装置において、スイッチを押したことや、スイッチの位置あるいは種類を、触覚に対する刺激により操作者に認識させる。

【構成】タッチパネル4の画面上に表示された所定のスイッチに操作者が触れたとき、操作者にバイブレータ2により所定の振動を与えてスイッチの位置、種類を知らせ、かつ、操作者がスイッチを1秒間に2回以上押したとき、スイッチが押されたことを電磁ハンマ1により衝撃を与えて操作者に知らせる構成。

図 2



1...電磁ハンマー
4...タッチパネル

2...バイブレータ
5...制御装置

1

【特許請求の範囲】

【請求項1】入力装置の所定のスイッチを操作者が触れたか押したとき、前記操作者に衝撃または振動を与え、前記所定のスイッチが触れられたか押されたことを前記操作者に知らせることを特徴とする入力装置。

【請求項2】入力装置の所定のスイッチを操作者が触れたか押したとき、前記操作者に衝撃または振動を与え、前記所定のスイッチの位置を前記操作者に知らせることを特徴とする入力装置。

【請求項3】入力装置の所定のスイッチに操作者が触れたか押したとき、前記操作者に所定の振動を与え、スイッチの位置、種類を案内し、かつ、特定の時間内に2回以上触れたか押したとき、前記操作者に衝撃を与え、前記所定のスイッチが触れられたか押されたことを前記操作者に知らせることを特徴とする入力装置。

【請求項4】前記スイッチがタッチセンサ式のスイッチで、前記入力装置がタッチパネルであることを特徴とする請求項1、2または3記載の入力装置。

【請求項5】前記入力装置がタッチパネルであり、該タッチパネルが画像表示デバイスの表示画面上に設けられていることを特徴とする請求項1、2または3記載の入力装置。

【請求項6】前記スイッチの種類により、前記衝撃の回数、大きさ、間隔の少なくとも一方が異なり、前記操作者に前記スイッチの種類を知らせることを特徴とする請求項1、2または3記載の入力装置。

【請求項7】前記スイッチの種類により、前記振動の周波数、振幅、周波数の時間的变化、振幅の時間的变化の少なくとも1つが異なり、前記操作者に前記スイッチの種類を知らせることを特徴とする請求項1、2または3記載の入力装置。

【請求項8】前記スイッチが触れられているか押されている時間の経過に伴って、前記衝撃の大きさ、間隔の少なくとも一方が変化し、前記操作者に前記スイッチに関する量の程度を知らせることを特徴とする請求項1、2または3記載の入力装置。

【請求項9】前記スイッチが触れられているか押されている時間の経過に伴って、前記振動の周波数、振幅の少なくとも一方が変化し、前記操作者に前記スイッチに関する量の程度を知らせることを特徴とする請求項1、2または3記載の入力装置。

【発明の詳細な説明】

【0001】

【産業上の利用分野】本発明は入力装置に係り、特に、例えば銀行のATM（オートメイトドテラーマシン(Automated Teller Machine)：自動現金引き出し・預け入れ装置)のタッチパネルや、各種機械・機器の操作盤等の各種入力装置に関する。

【0002】

【従来の技術】各種の入力装置のうち、タッチセンサ式

2

のスイッチ(キー)を有する透明なパネルから成るタッチパネルは、画像表示デバイスの表示画面上に取り付けることにより、必要箇所を指で触れるという最も自然な操作で入力できるというデバイスである。タッチパネルは、デザインの自由度が大きく、表示内容が変更可能な画面上で多種多様なキー配列が可能であり、また、省スペース化に有利であるという特長から、銀行のATMや、小型の情報機器である電子手帳等、様々な分野で用いられている。例えば、ATMでは、CRT(カソードレイチューブ(Cathode Ray Tube)：陰極線管)、電子手帳では液晶表示素子(すなわち、液晶表示パネル、LCD：リキッドクリスタルディスプレイ(Liquid Crystal Display))等の画像表示デバイスの前面に、透明で、弾性のある電極を形成した2枚の透明なシートが設けられている。この透明電極は、マトリクス状に形成され、操作者の指先または操作者の持つペン等で触れられた位置が識別できるようになっており、画像表示デバイスの画面の表示内容と組み合わせることにより、操作者が表示された所定のスイッチを触れると、該スイッチに対応する2枚のシートに形成した透明電極間の導通(または抵抗)の変化によって、数字、文字の入力や各種の操作ができるようになっている。この他の検出方式としては、抵抗膜、光センサ、表面波、静電容量等がある。

【0003】

【発明が解決しようとする課題】なお、操作者がタッチパネルのあるスイッチを触れたときに、そのスイッチを触れたことを確認させるために、表示の内容、例えば画面の色を変化させたり、「ピッ」という音を出したりしている。

【0004】しかし、従来のタッチパネルでは、操作者が「スイッチを操作した」という操作感が不足している。これは機械式のスイッチではばね等を用いて、操作者に触覚により操作感が与えられるのに対して、タッチセンサ式のスイッチでは触覚に対する刺激が少ないためである。

【0005】また、機械式のスイッチでは、暗闇でも、あるいは目の不自由な人でも、スイッチに触れて触覚により外形形状を認識することができるので、スイッチの位置、種類が認識しやすく、操作が容易であるが、タッチセンサ式のスイッチでは、スイッチは平らな表示画面上に形成され、スイッチに対応する凹凸を有しないので、画像表示デバイスの画像を目で見ても確認しない限り、スイッチを認識することができず、正しい操作を行うことが難しい。

【0006】本発明の目的は、スイッチを押したときに触覚による操作感を与えて、スイッチを押したことを操作者に認識させることにある。

【0007】本発明の他の目的は、スイッチあるいはその辺り(スイッチが設けられたパネル等)に触れるだけで、スイッチの位置あるいは種類を触覚に対する刺激に

50

より操作者に認識させることにある。

【0008】

【課題を解決するための手段】前記目的を達成するために、本発明の入力装置は、該入力装置の所定のスイッチを操作者が触れたか押したとき、前記操作者に衝撃または振動を与え、前記所定のスイッチが触れられたか押されたことを前記操作者に知らせることを特徴とする。

【0009】また、入力装置の所定のスイッチを操作者が触れたか押したとき、前記操作者に衝撃または振動を与え、前記所定のスイッチの位置を前記操作者に知らせることを特徴とする。

【0010】また、入力装置の所定のスイッチに操作者が触れたか押したとき、前記操作者に所定の振動を与え、スイッチの位置、種類を案内し、かつ、特定の時間内に2回以上触れたか押したとき、前記操作者に衝撃を与え、前記所定のスイッチが触れられたか押されたことを前記操作者に知らせることを特徴とする。

【0011】また、前記スイッチがタッチセンサ式のスイッチで、前記入力装置がタッチパネルであることを特徴とする。

【0012】また、前記入力装置がタッチパネルであり、該タッチパネルが画像表示デバイスの表示画面上に設けられていることを特徴とする。

【0013】また、前記スイッチの種類により、前記衝撃の回数、大きさ、間隔の少なくとも一方が異なり、前記操作者に前記スイッチの種類を知らせることを特徴とする。

【0014】また、前記スイッチの種類により、前記振動の周波数、振幅、周波数の時間的変化、振幅の時間的変化の少なくとも1つが異なり、前記操作者に前記スイッチの種類を知らせることを特徴とする。

【0015】また、前記スイッチが触れられているか押されている時間の経過に伴って、前記衝撃の大きさ、間隔の少なくとも一方が変化し、前記操作者に前記スイッチに関する量の程度を知らせることを特徴とする。

【0016】さらに、前記スイッチが触れられているか押されている時間の経過に伴って、前記振動の周波数、振幅の少なくとも一方が変化し、前記操作者に前記スイッチに関する量の程度を知らせることを特徴とする。

【0017】

【作用】本発明では、入力装置の所定のスイッチを操作者が触れたか押したとき、操作者の指先に直接、あるいは手に持ったペン等を介して衝撃または振動が与えられるので、そのスイッチを押したときの操作感が向上し、操作者はそのスイッチを触れたか押したことをはっきり認識することができる。

【0018】また、入力装置の所定のスイッチに操作者が触れたか押したとき、操作者に衝撃または振動が与えられるので、操作者はそのスイッチの位置あるいは種類を触覚に対する刺激により認識することができる。

【0019】

【実施例】

実施例1

図1は本発明による入力装置の構成を示す図である。

【0020】3は液晶表示素子(LCD)等のフラットディスプレイタイプのタッチパネル、1は電力により衝撃を与えるアクチュエータである電磁ハンマー、5は制御装置(コントローラ)である。電磁ハンマー1は、ソレノイド11、プランジャ12、スプリング13から構成される。なお、ソレノイド11の代わりにモータを用いることができる。

【0021】制御装置5は、タッチパネル3に表示する内容を制御し、タッチパネル3の操作者の操作内容を判定・判断するとともに、電磁ハンマー1を制御する。

【0022】図3、図4はそれぞれタッチパネルの表示画面の例を示す図である。図3の符号6はテンキーを示し、図4は2個のスイッチSW1、SW2のオン、オフキーを示す。

【0023】以下、本実施例の操作について説明する。制御装置5は、あらかじめタッチパネル3の操作・応答について取り決め、設定されたプログラムによって、タッチパネル3を構成する画像表示デバイスの画面に、図3、図4に例示するようなスイッチや指示等を表示する。画像表示デバイスの画面上に設けたタッチパネルは、ソフトウェアによりスイッチ等の表示を容易に変更することができる点が1つの特徴である。したがって、本実施例では、図3、図4を用いて代表的なものについてのみ説明する。

【0024】操作者がタッチパネル3の画面上に表示された特定のスイッチを押すと、タッチパネル3はそのスイッチが操作されたことを制御装置5に知らせる。制御装置5はその内容を判定して、その信号を当該タッチパネル3を備えた対象装置(図示省略。例えば銀行のATMや各種機械・機器)へ知らせる。なお、タッチパネルは広い意味でのスイッチであるから、対象装置へ各種の信号を出力するとともに、タッチパネルは表示装置でもあるから、対象装置からの信号を表示する。

【0025】このとき、制御装置5は対象装置へ知らせるとともに、電磁ハンマー1にも信号を出し、電磁ハンマー1を作動させて、タッチパネル3へ裏側から衝撃を与え、触覚を通して操作者の指先に(あるいは操作者の手に持ったペン等を介して)スイッチが押された(触れられた)ということを知らせる。または、押されたスイッチによりタッチパネル3が出力した信号によって対象装置が応答した情報を元に、対象装置が動作したことを確認してから、電磁ハンマー1を作動させて、対象装置が動作したということを知らせてもよい。

【0026】例えば、図3に示すような画面上のテンキー6の1つを押したときに、電磁ハンマー1により「カチン」という衝撃を与えることにより、所定の数字が入力

できたことを操作者が触覚により認識できる。なおこの場合、操作者がスイッチを押した後、「カチン」という衝撃を最大1秒程度遅らせて与えると、スイッチを押したという操作感が増大する。すなわち、機械式のスイッチでは、操作者が押してからスイッチが機械的に入るまでストロークが存在するため、タイムラグが発生するので、押したという操作感が大きい。したがって、タッチセンサ式のスイッチにおいて、このタイムラグを意図的に生じさせることにより、操作感を向上させることができる。また、電磁ハンマ1を用いて衝撃を与える代わりに、バイブレータを用いて振動を与えてもよい(図2の実施例2参照)。

【0027】また、図4に示すような画面上に表示された「OFF」キーから「ON」キーへスイッチSW1、あるいはSW2を操作する場合、操作者は「ON」と表示されたキーを押す。その信号を受けた制御装置5は、当該タッチパネル3を備えた対象装置へ稼働を開始するように信号を出すとともに、電磁ハンマ1にも信号を出し、電磁ハンマ1を作動させて、タッチパネル3へ衝撃を与え、操作者に触覚を通してスイッチが押されたことを知らせる。または、タッチパネル3の押されたスイッチにより出力した信号によって対象装置が応答した情報を元に、対象装置が稼働したことを確認してから、電磁ハンマ1を作動させて、対象装置の稼働開始を知らせてもよい。

【0028】また、「ON」キーから「OFF」キーへスイッチSW1、あるいはSW2を操作する場合も、前記と同様であるが、つぎのように「ON」と「OFF」とを区別すると、操作者に対する操作感が向上する。すなわち、「ON」キーが押されたときは、「カチン・カチン」と2回の衝撃を与える。「OFF」キーが押されたときは、「カチン」と1回の衝撃を与える。なお、電磁ハンマ1により衝撃を与える代わりに、バイブレータにより(図2の符号2参照)振動を与える場合は、「ON」キーと「OFF」キーとで振動の周波数を変えることが有効である。さらに、キーの種類を操作者に知らせるのに、キーによって衝撃の回数他に、衝撃の大きさ、間隔、またはこれらの組み合わせを異ならせてもよい。また、キーによって振動の周波数他に、振動の振幅、周波数の時間的変化、振幅の時間的変化、あるいはこれらの組み合わせを異ならせてもよい。また、スイッチの種類により衝撃と振動を使い分けてもよい。さらに、衝撃または振動と同時に、ブザー等で音を出したり、画面の色や表示内容を変えると、操作感が一層向上する。

【0029】実施例2

図2は本発明による別の入力装置の構成を示す図である。

【0030】4はCRT(陰極線管)タイプのタッチパネル、1は電磁ハンマ、2はバイブレータ、5は制御装置である。

【0031】図2の入力装置では、タッチパネル4に2種類のアクチュエータ、すなわち、タッチパネル4に衝撃を与える電磁ハンマ1と、振動を与えるバイブレータ2が設けられている。これらのアクチュエータは、制御装置5によりコントロールされる。また、制御装置5は、タッチパネル4に表示する内容と、タッチパネル4の操作者の操作による信号のやりとりを制御する。

【0032】タッチパネル4の操作・応答は、あらかじめプログラムにより取り決められている。操作者がタッチパネルの表面のあるスイッチに触れると、従来のタッチパネルでは操作(入力)されたかと判断するが、本実施例のタッチパネル4に触れたときは、タッチパネル4上の所定のスイッチの種類を示す振動を出すだけである。そのスイッチを操作するには、そのスイッチを例えば1秒間に2回以上触って離すという操作により有効とする。これは、パーソナルコンピュータ等のマウスを用いる場合、ダブルクリックする操作と同様である。もちろん、1秒間に2回以上押すという条件は1つの操作例であり、タッチパネル上のスイッチの位置の案内と操作とが区別がつく方法であればよい。また、スイッチが操作されたとき、電磁ハンマ1が作動して、衝撃を介してそのスイッチの操作が受け付けられたことを操作者に知らせる。

【0033】すなわち、操作者がスイッチが表示されたタッチパネル4の表面に触れると、スイッチの種類によりあらかじめ定められた周波数の振動をバイブレータ2によって与えるようになっている。まず、スイッチのある場所をさがすために、操作者が表示画面に触れると、スイッチのある場所ではそれ独自の周波数の振動が操作者の指先に与えられる。スイッチのない場所を押したときは、振動は与えられない。スイッチ毎に独自の振動の周波数を与えるのがのぞましいが、例えば図3に示すテンキー6のように、基準となる点から同心円上に複数個のスイッチがある場合、中心のスイッチ、図3では「5」のキーと、それ以外のスイッチは相対的な位置により判別できるため、中心のスイッチとそれ以外のスイッチと2種類の周波数を用意すればよい。なお、スイッチを区別するには、振動の周波数だけでなく、振動の振幅の大小、周波数の時間的変化、あるいはこれらの組み合わせを用いることができる。

【0034】また、そのスイッチを入力するときは、あらかじめ定めた所定の短時間間に、例えば1秒間に2度以上触れることにより、その入力が有効となるようになっている。

【0035】操作者がタッチパネル4に触れたとき、タッチパネル4は画面上の特定のスイッチが操作されたことを制御装置5に知らせる。制御装置5はその内容を判定してスイッチのない位置であれば無視し、スイッチのある位置であればあらかじめ定めてあった振動を出すようにバイブレータ2に指示する。これにより、操作者は今触

れている部分がどのキーか触覚を通して知ることができる。操作者は押すべきスイッチを見つけたら、例えば1秒間に2回以上押し、入力を行う。このとき、実施例1と同様に、電磁ハンマ1により所定の衝撃が与えられ、操作者はそのスイッチの操作が行われたことを確認できる。

【0036】実施例3

本実施例では、図5の表示画面に示すような連続的に変化させることができるようなボリュームスイッチに適用する例を示す。なお、連続でなくて、とびとびであっても、例えば音量機器の音量調節のように取り扱えるものに適用可能である。

【0037】図5に示すスライダスイッチSW3、SW4は「UP」キーと「DOWN」キーのスイッチを触れる（押す）ことにより行うが、表示画面上を上下に移動するスライダ7の位置により、図2のタッチパネル4がバイブレータ2により操作者に与える振動の周波数が変化するようにになっている。すなわち、「UP」キーを触り続けると、スライダ7は「0」から「100」の方へ徐々に上昇する。操作者が触り続けている間、タッチパネル4は振動を操作者に与えているが、その振動の周波数が触っている時間の経過とともに、高くなるようになっていく。これにより、操作者に触覚を通して例えば音量の大きさ等の「UP」と「DOWN」の程度（スライダ7の位置）を知らせる。「DOWN」キーを触る場合は、バイブレータ2により与えられる振動の周波数が逆に低くなっていく。なお、周波数を変化させる代わりに、振動の振幅、あるいは電磁ハンマによる衝撃の間隔、大きさ等を変化させることによっても同様の効果が得られる。

【0038】以上本発明を実施例に基づいて具体的に説明したが、本発明は上記実施例に限定されるものではなく、その要旨を逸脱しない範囲において種々変更可能であることは勿論である。本発明は、タッチパネルにより各種機械・機器の起動、停止を行う操作部や、視覚障害

者向けのインタフェースに適用して効果が大きく、上記実施例においては、タッチセンサ式のスイッチを有するタッチパネルを画像表示デバイスの表示画面に設けた入力装置に適用した例について説明したが、これに限定されず、スイッチが印刷表示された表示固定タイプのタッチパネルやタッチスイッチを備えたエレベータ等、あるいは機械式のスイッチを備えた入力装置等、各種の入力装置に適用できる。なお、圧縮空気源を有する生産設備における操作盤等においては上記電磁ハンマの代わりに、圧縮空気を動力源とするハンマを使用可能である。また、電磁ハンマやバイブレータ等のアクチュエータを設ける場所は、パネルの裏側や側面に限定されない。

【0039】

【発明の効果】以上説明したように、本発明によれば、従来の入力装置ではなかった、衝撃または振動という触覚に対する刺激を通して、確実に操作を行ったという、操作感の向上が得られる。また、従来の入力装置では目で見ないと操作できなかったが、衝撃または振動によりスイッチの位置、種類を案内するため、暗闇等、画面を見ることができないときや、目の不自由な人も操作可能となる。

【図面の簡単な説明】

【図1】本発明による入力装置の構成を示す図である。

【図2】本発明による別の入力装置の構成を示す図である。

【図3】タッチパネルの表示画面の例を示す図である。

【図4】タッチパネルの表示画面の別の例を示す図である。

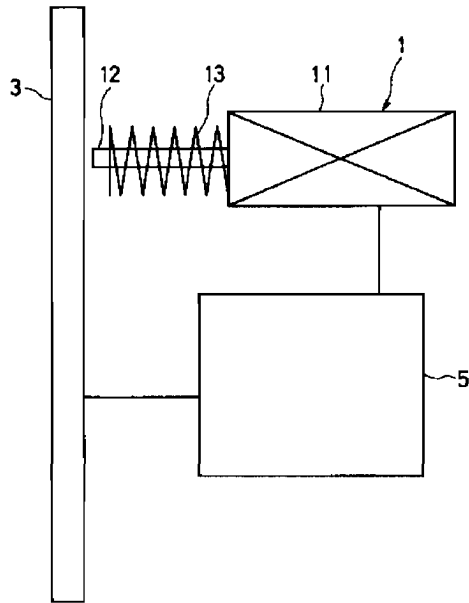
【図5】タッチパネルの表示画面のさらに別の例を示す図である。

【符号の説明】

1…電磁ハンマー、2…バイブレータ、3、4…タッチパネル、5…制御装置、6…テンキー、7…スライダ、11…ソレノイド、12…プランジャ、13…スプリング。

【図1】

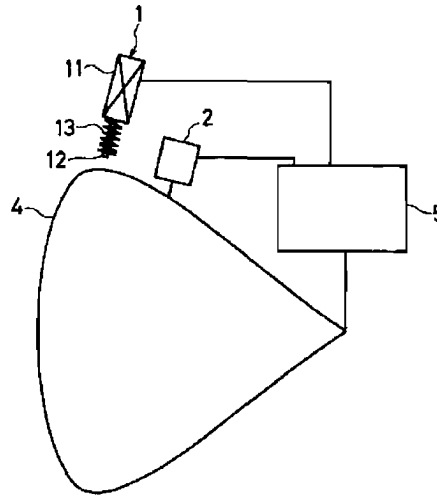
図1



1--電石ハンマー 3--タッチパネル 5--制御装置
 11--ソレノイド 12--プランジャ 13--スプリング

【図2】

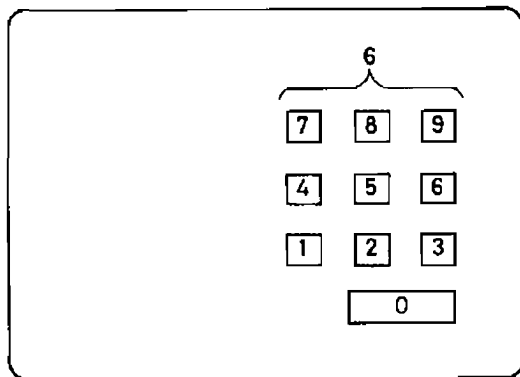
図2



1--電石ハンマー 2--パイブレータ
 4--タッチパネル 5--制御装置

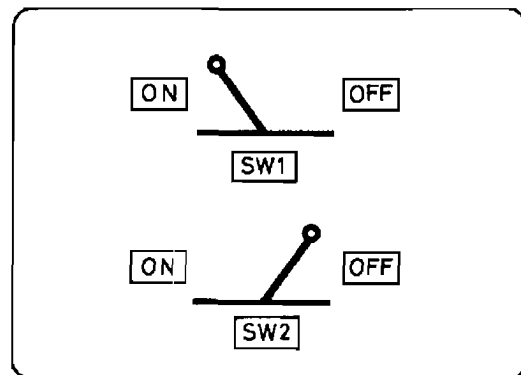
【図3】

図3



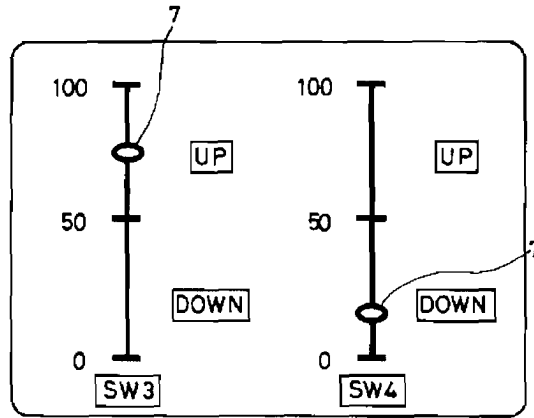
【図4】

図4



【図5】

図5



INPUT DEVICE

Publication number: JP10171586

Publication date: 1998-06-26

Inventor: HOSOKAWA MIKIO

Applicant: SHARP KK

Classification:

- international: **G06F3/041; G06F3/03; G06F3/044; G06F3/045; G06F3/048; G06F3/041; G06F3/03; G06F3/048;** (IPC1-7): G06F3/03; G06F3/03

- European:

Application number: JP19960330109 19961211

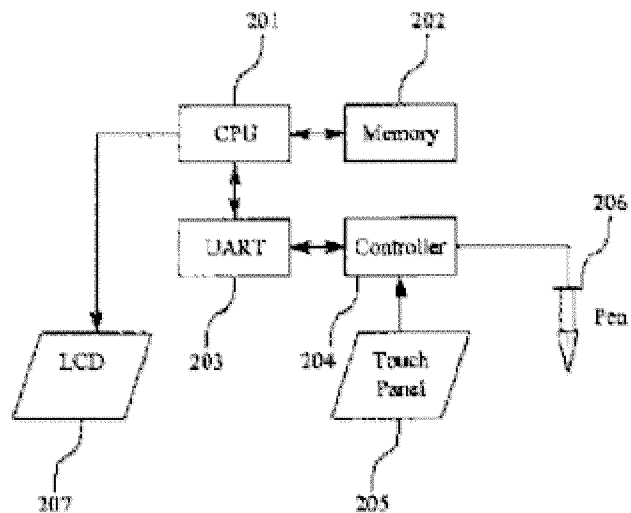
Priority number(s): JP19960330109 19961211

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Abstract of JP10171586

PROBLEM TO BE SOLVED: To provide tool force without providing a pen with a device such as a sensor or the like by calculating the coordinate of pen input from the ratio of current amounts obtained from plural electrodes and calculating the tool force of the pen input from the total sum of the current amounts obtained from the plural electrodes.

SOLUTION: A controller 204 sends coordinate position information and tool force information for which the pen 206 touches a touch panel 205 to a CPU 201 as data based on fine current signal information from the touch panel 205. The CPU 201 stores the data in a memory 202 and displays the information at a corresponding screen position based on the data. At the time of obtaining the coordinate value, a current from the touch panel 205 is supplied from the electrodes at the four corners of the touch panel 205 to the controller 204, a coordinate where the pen 206 touches the touch panel 205 is obtained from the balance of the four current amounts and the tool force is obtained from the overall size of the four current amounts simultaneously.



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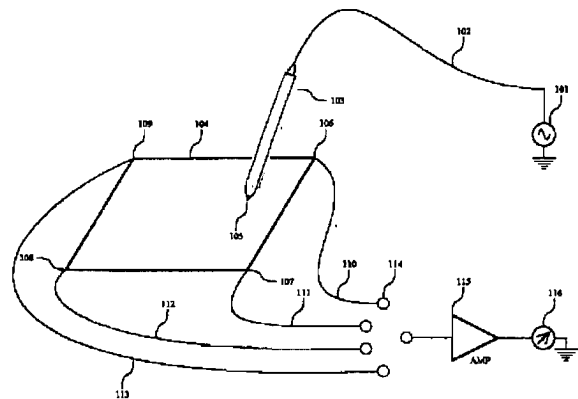
(74)代理人 弁理士 梅田 勝

(54)【発明の名称】 入力装置

(57)【要約】

【課題】 ペン入力装置、特に静電容量を用いて座標情報を検出する場合において、座標情報を得ることは容易であるが、ペンの筆圧情報を得ることは、ペンに圧力センサなどを用いるなどの手段以外では容易に得ることができなかつたため、ペンが大型化するなどの問題があつた。

【解決手段】 ペン103の接触点105において、弾性を備えた導電性素材を用い、タブレット104に接触点105を押し付けることにより、接触面積が増加し、電極106～電極109に流れる電流が増加する。この各電極からの電流値の総和からペンの筆圧情報を算出することにより上記課題を解決する。



【特許請求の範囲】

【請求項1】 ペンがタブレットに触れる際に形成される静電結合により流れる電流を検知することでタブレット上におけるペン入力された座標位置を検出する入力装置において、

弾性を備えた導電性素材により構成されるペンと、ペンがタブレットに触れる際に形成される静電結合により流れる電流を検知する複数の電極と、前記複数の電極から求められる電流量の比率から、ペン入力の座標を算出する座標検知手段と、前記複数の電極から求められる電流量の総和から、ペン入力の筆圧を算出する筆圧検知手段を備えたことを特徴とする入力装置。

【請求項2】 筆圧と電流量の総和の関係が正比例となるように補正する補正值を記憶する筆圧値補正テーブルと、

前記筆圧検知手段により求められた筆圧に対し、前記筆圧値補正テーブルによる補正を行う筆圧値補正手段とを備えたことを特徴とする前記請求項1記載の入力装置。

【請求項3】 ペンとタブレットの接触位置による電流量の総和のばらつきを補正する電流量補正テーブルと、前記筆圧値検出手段による筆圧の検出の際に、入力となる電流量の総和に対し、前記電流量補正テーブルによる電流量の補正を行う電流量補正手段とを備えたことを特徴とする前記請求項1記載の入力装置。

【発明の詳細な説明】

【0001】

【発明の属する技術分野】本発明はペンによる入力を行う装置、例えば携帯型端末装置、パーソナルコンピュータ等に関するものである。

【0002】

【従来の技術】CRTやLCDなどの表示装置に重ね合わされて配置される入力装置が普及している。これは表示装置と入力装置が一体となるものであり、表示されているオブジェクトをペンなどで直接指示することができるために、非常にユーザにわかりやすいインターフェースとなっている。

【0003】これらは、ガラスや他の材質等の加工品で生成されるパネルを表示装置の前面に配置する方法と、LCDの内面または裏面に検出装置を配置する方法に大別される。

【0004】このうち、表示装置前面にパネルを配置して特殊なペンでXYの2次元座標情報を得るタブレットに静電結合を用いた方式がある。この場合、ペン先に一定の交流信号を与え、ペン先がタブレット表面に触れた際、その間に形成される静電容量により、タブレット側に微小電流が流れ込む。この電流を4辺又は4角から計測し、その電流量のバランスから接触点の座標を求めるものである。

【0005】この例では、XYの2次元座標を得るだけ

であるが、ペン先がタブレットを押さえ付ける力、すなわち筆圧をデータとして得たい場合がある。

【0006】特開平8-206351号公報に開示されている技術は、筆圧を求める方法として、弾性先端部を有するペンにて操作した際の接触面積を、2次元座標入力装置から出力される座標値から求め、その面積に対応した押圧力を検出する方法、さらには弾性先端部に歪みセンサを備え、その歪みセンサにより押圧力を求める方法である。

【0007】

【発明が解決しようとする課題】上記したように、ペンなどに特殊なセンサなどを備えて押圧力を求める方法はペンに多くの機構を必要とするために、ペンが大きくなったり重くなったりするという問題が生じる。さらに上記の特開平8-206351号公報の技術は電磁誘導方式によるタブレット入力装置には実現可能であるが、静電結合方式のタブレット入力装置においては実現不可能である。

【0008】よって本願発明は、静電結合方式のタブレット入力装置において、ペンにセンサなどの装置を備えたりすることなしに、筆圧を求めるものである。

【0009】

【課題を解決するための手段】本発明の請求項1によれば、ペンがタブレットに触れる際に形成される静電結合により流れる電流を検知することでタブレット上におけるペン入力された座標位置を検出する入力装置において、弾性を備えた導電性素材により構成されるペンと、ペンがタブレットに触れる際に形成される静電結合により流れる電流を検知する複数の電極と、前記複数の電極から求められる電流量の比率から、ペン入力の座標を算出する座標検知手段と、前記複数の電極から求められる電流量の総和から、ペン入力の筆圧を算出する筆圧検知手段を備えることにより上記課題を解決する。

【0010】本発明の請求項2によれば、筆圧と電流量の総和の関係が正比例となるように補正する補正值を記憶する筆圧値補正テーブルと、前記筆圧検知手段により求められた筆圧に対し、前記筆圧値補正テーブルによる補正を行う筆圧値補正手段とを備えることにより上記課題を解決する。

【0011】本発明の請求項3によれば、ペンとタブレットの接触位置による電流量の総和のばらつきを補正する電流量補正テーブルと、前記筆圧値検出手段による筆圧の検出の際に、入力となる電流量の総和に対し、前記電流量補正テーブルによる電流量の補正を行う電流量補正手段とを備えることにより上記課題を解決する。

【0012】

【発明の実施の形態】以下に、図面を用いて本発明を詳細に説明する。本発明は以下の実施の形態に限定されるものではない。

【0013】図1は静電結合方式の座標入力装置にお

る動作原理を説明する図である。電圧源101から交流信号を発生し、ペンの配線102を經由してペン103の先端にその交流信号を伝える。

【0014】ペン103がタッチパネル104上の接点105に触れた場合、タッチパネル104の各隅に配置されている電極①106、電極②107、電極③108、電極④109にそれぞれ前記交流信号の一部が電流として流れる。

【0015】これらの電流が配線①110、配線②111、配線③112、配線④113を流れ、スイッチ114で順次選択されて増幅器で増幅され、電流計116で計測する。4つの電流量を演算することにより、接点105のタッチパネル104上での相対位置を求めることができる。

【0016】図2は本発明のブロック図である。図2のCPU201は装置における中央演算装置である。メモリ202は、CPU201が処理を実行するための命令及びデータを格納する記憶装置である。内部にはプログラム、各種テーブル、ワークエリアなどを備える。UART203は、シリアル通信を実現するデバイスであり、CPU201とコントローラ204との間のシリアル通信を結んでいる。CPU201がメモリ202に格納されているプログラムに基づき、UART203を經由してコントローラ204にタブレットに関する各種のコマンドを発行する。

【0017】コントローラ204は、ペン206への交流信号を生成したり、Touch Panel 205からの電流を計測し、座標位置や筆圧を算出するタブレット全体のコントローラである。

【0018】ペン206は、コントローラ204からの交流信号を受け、操作者の座標位置や筆圧を求めるための情報をタッチパネル205に与える。タッチパネル205はペン206からの交流信号を受け、コントローラ204が演算に必要とする電流を受け取る。タッチパネル205は電気的配線が施されたガラスや他の透明な材質の板である。

【0019】LCD207は、タッチパネル205の下に配置され、CPU201が生成する画面情報を表示する装置である。

【0020】タブレットの動作を説明する。ペンからの座標を得る場合、コントローラ204はCPU201からのコマンドに基づき、ペン206への交流信号を駆動し、操作者がペン206をタッチパネル205に触れるとき、タッチパネル205から微小電流信号を得る。コントローラ204はこの情報をもとに、ペン206がタッチパネル205に触れた座標位置情報と筆圧情報をCPU201へデータとして送る。CPU201はこのデータをメモリ202へ格納し格納するとともに、そのデータに基づいて対応する画面位置にその情報を表示する。

【0021】本発明においては、この座標値を得る際

すなわちタッチパネル205からの電流が、その4隅の電極からコントローラ204に与えられ、その4つの電流量のバランスから、ペン206がタッチパネル205に触れた座標を求めると同時に、4つの電流量の全体的な大きさから、筆圧を求めるものである。

【0022】ペン206のペン先に一定の弾力を有する導電性素材を用いる。ペン206がタッチパネル205に触れる際にその弾力により先端部が押し潰される。この時のペン先とタッチパネル205との接触面積は、ペン206をタッチパネル205205に押し付ける筆圧に伴い変化する。この接触面積はそのまま、ペン206とタッチパネル205との間に形成される微小コンデンサの静電容量を変化させるため、そこに流れる電流値が変化する。すなわち、筆圧を大きくするに伴い電流値は大きくなる。この電流値の大小を筆圧情報としてコントローラ204はCPU201にUART203を經由して伝達する。

【0023】XY座標を求めるための情報は4つの電流値のバランスであるため、筆圧の大小が電流値に影響してもバランスは変化しないため、XY座標の計算結果には何ら影響をおよぼさない。上述の電流変化は、コントローラ204で4つの電流値の総和で求められる。

【0024】図3は弾力性を有するペン先における形状変化を示す図である。筆圧1の場合のペン先部がパネル表面に接触している面積は接触面積1である。筆圧1より大きな力でパネルに触れる場合、即ち筆圧2の場合の接触する面積は、ペン先部が筆圧により先端が歪むことで増加し接触面積2となる。さらに大きな力、筆圧3で接触した場合、この傾向がさらに進み接触面積3となる。すなわち筆圧が筆圧1、筆圧2、筆圧3と増すにつれ、先端の歪みが大きくなり、接触面積が増加する。

【0025】図4に筆圧と総和電流の関係を示す。図4(A)は筆圧と総和電流の関係を示しており、横軸に総和電流を、縦軸に筆圧値を表している。筆圧値が増加すれば総和電流が増加していくことがわかる。しかしながら、総和電流と筆圧の関係は、ペン先の弾性による応力等の影響により完全な正比例とはならない。そこで、これを正比例とするために実験的に求められる筆圧と総和電流の関係を補正する変換テーブルを設ける。

【0026】図4(B)は補正曲線を表す。横軸は図4(A)と同じく総和電流を、縦軸には補正值を表す。図4(C)は図4(A)の筆圧値に図4(B)補正值を作用させた結果を示している。横軸は総和電流、縦軸は補正された筆圧値である。補正されたことにより、正比例の関係になることがわかる。図5は総和電流と筆圧の変換テーブルである。図4に基づいて補正する曲線を数値の変換テーブルとしたものである。

【0027】ペン206がタッチパネル205に触れる場所によって、総和電流はばらつきが生じる。これはタッチパネル205が全面にわたって一様な抵抗体として

形成されているため、接触点と各隅からの距離により、接触点からコントローラ204までの抵抗値が変化してしまうためである。そこで、この不均一性を均一に補正するために補正テーブルを設ける。

【0028】図6はXY座標による補正範囲と補正値を示した図である。ペン入力装置の入力領域をX軸、Y軸ともに3分割し、全体で9分割したそれぞれの領域毎に補正係数を設ける。ペン206がタッチパネル205に触れた際に求められるXY座標値から、上記分割された9つの領域のいずれに属するかを判断し、該当する補正係数を作用させる。

【0029】例えば、(X0~X1, Y0~Y1)に属する場合は筆圧データを+2%、(X1~X2, Y0~Y1)に属する場合には筆圧データを+1%という補正を行う。

【0030】図7はXY座標及び筆圧データ算出の全体フローチャートである。CPUはプログラムが開始されると、コントローラを初期化し(ステップ701)、メモリ上のワークエリアも初期化する(ステップ702)。その後、ペンへの駆動信号(センス信号)を駆動

【0031】コントローラはパネルに対するペンの操作の有無を検知するために、パネルからの電流があるか否かを検査する(ステップ704)。電流の存在を確認するまで検査を継続し、電流があると判断されたら、4つの電極からの電流を測定し(ステップ705)、XY座標を算出する(ステップ706)。

【0032】次に4つの電流値の総和電流および図5による補正を用いて筆圧を求める(ステップ707)。さらに、XY座標に対する補正(図4による補正)を行う(ステップ708)。そして、XY座標と筆圧データをコントローラからCPUにデータ転送して一連の動作が終了する(ステップ709)。さらに入力を行うかどうかを判定し(ステップ710)、入力が行われない場合には処理を終了する。

【0033】図8はステップ707の処理を詳細に説明したフローチャートである。ステップ801において、4つの電極より流れる電流の電流値を測定し、その合計を総和電流とする。その総和電流の大きさから予め用意された補正データ(図5参照)を選択し(ステップ802)、総和電流より求められた筆圧に補正値を作用させ(ステップ803)、求められた筆圧を総和電流による補正後の筆圧とする(ステップ804)。

【0034】図9はステップ708の処理を詳細に説明したフローチャートである。既に求められた補正されたXY座標データを選択し(ステップ901)、図6のどの領域に属するかを判断し(ステップ902)、該当する補正係数を選択する。総和電流値による補正後の筆圧に対し、この補正係数を作用させることにより(ステップ903)、XY座標に対する補正を施し、最終的な筆

圧データとする。

【0035】以上のような処理により、静電容量を用いる入力装置においても筆圧データを得ることが可能となる。

【0036】

【発明の効果】本発明によれば、2次元の座標情報しか得ることのできなかつたペン入力装置において、ペンなどに複雑な構成を備える必要なく、筆圧情報を得ることができる。筆圧情報を得られることにより、毛筆のような文字への表現力の増加やサインなどの認証などに用いることができる。

【0037】さらに、筆圧と電流の関係を予め得られた補正テーブルにより補正して正比例の関係とするために、ユーザは実際の感覚に近い筆圧データを得ることができる。

【0038】また、タブレットの特性による接触位置における電流のばらつきにおいても、予め得られる補正テーブルにより補正するために、使用者は不均一性を感じることなく入力ができる。

【図面の簡単な説明】

【図1】本発明における入力装置の動作原理を示す図である。

【図2】本発明における入力装置のブロック図である。

【図3】本発明におけるペンの筆圧における形状変化を示す図である。

【図4】本発明における総和電流と筆圧との関係および補正値を示す図である。

【図5】本発明における総和電流→筆圧変換テーブルの例を示す図である。

【図6】本発明におけるXY座標による補正範囲と補正値の例を示す図である。

【図7】本発明における筆圧データ算出処理の流れを示すフローチャートである。

【図8】本発明における筆圧補正処理の流れを示すフローチャートである。

【図9】補正処理における電流補正処理の流れを示すフローチャートである。

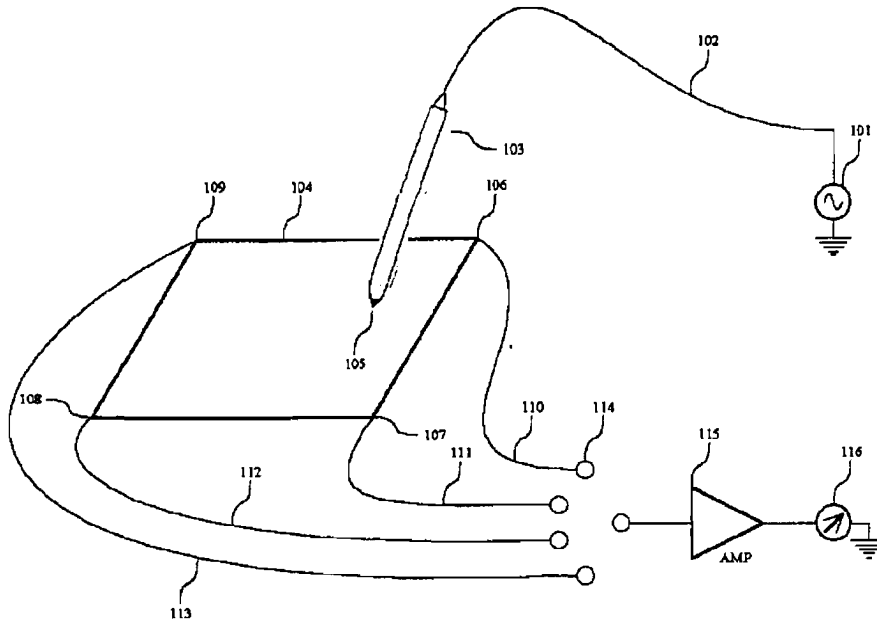
【符号の説明】

- 101 電圧源
- 102 ペン配線
- 103 ペン
- 104 タブレット
- 105 接触点
- 106 電極1
- 107 電極2
- 108 電極3
- 109 電極4
- 110 配線1
- 111 配線2
- 112 配線3

113 配線4
114 スイッチ

* 115 増幅器
* 116 電流計

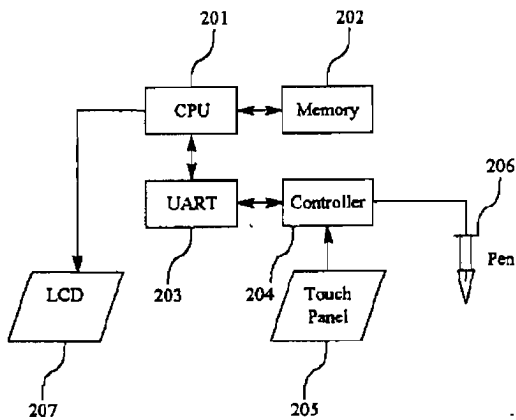
【図1】



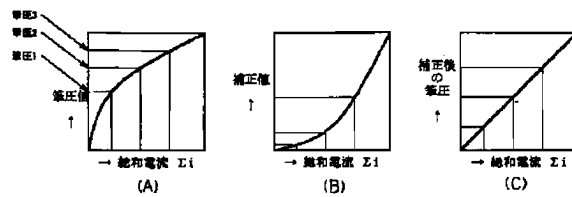
【図5】

ΣI	筆圧データ
0	0
1	1
2	1
3	2
4	2
5	3
6	3
7	3
...	...
...	...
254	62
255	63

【図2】



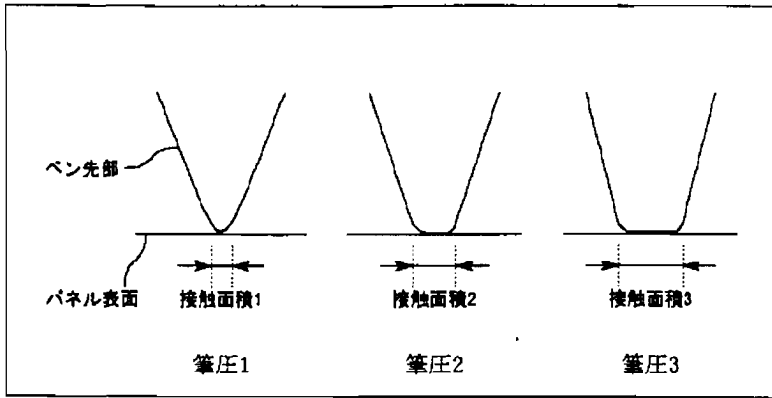
【図4】



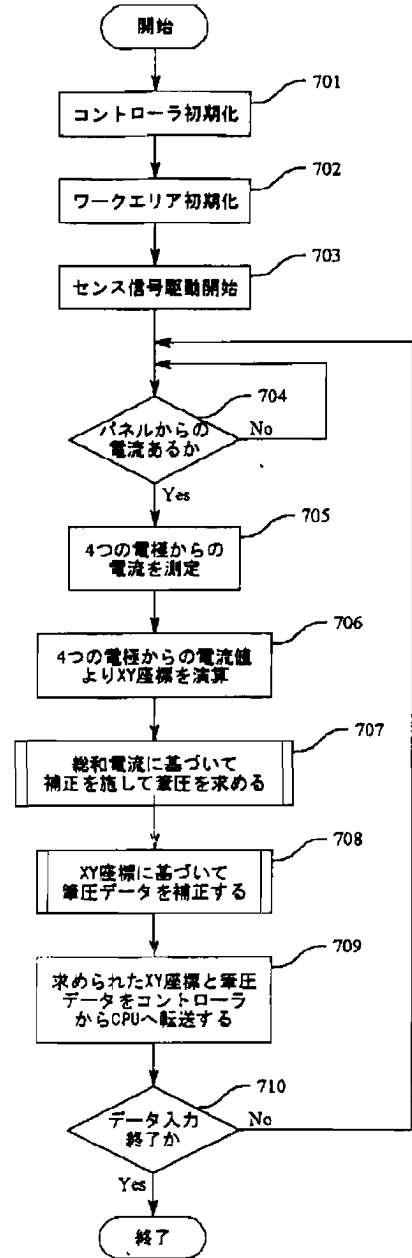
【図6】

y_0	x_1	x_2	x_3
y_1	+2%	+1%	+2%
y_2	+1%	0	+1%
y_3	+2%	+1%	+2%

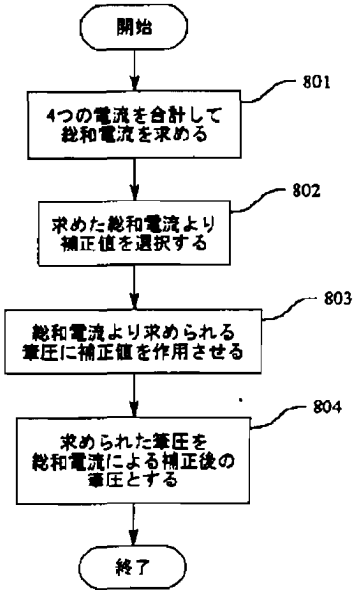
【図3】



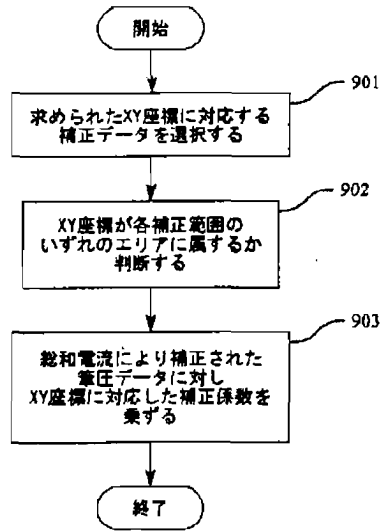
【図7】



【図8】



【図9】



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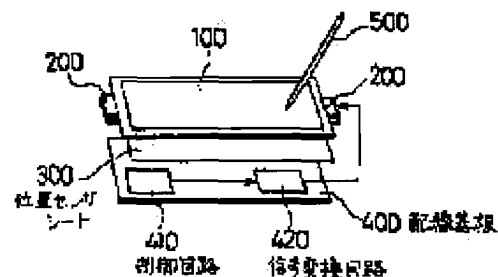
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(54) DISPLAY

(57)Abstract:

PROBLEM TO BE SOLVED: To provide a display with an interface function and with greater reality in addition to the interface function by a simple visual means and aural means.
SOLUTION: A display panel 100 is supported in a state in which a vibration is given by a vibrating element 200. A position sensor sheet 300 is placed on the rear surface of the display panel 100 and a contact position of a pen 500, etc., with the display panel 100 is detected by the position sensor sheet 300. A wiring board 400 is placed and a control circuit 410 and a signal conversion circuit 420 are provided on the rear surface of the position sensor sheet 300. The kind of vibration is determined according to the contact position of the pen 500 and contents of an image which is being displayed, and the kind of vibration is transmitted to the signal conversion circuit 420 by the control circuit 410. A vibrating element 200 is driven based on the instruction of the control circuit 410, the display panel 100 is vibrated and the vibration is transmitted to an operator with the pen 500 by the signal conversion circuit 420.



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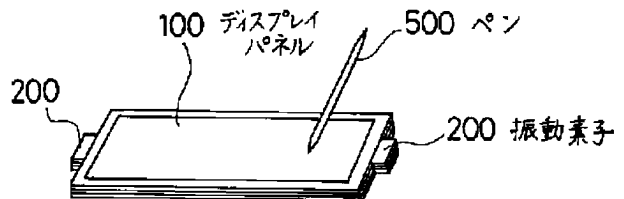
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(54) 【発明の名称】 表示装置

(57) 【要約】

【課題】 単純な視覚的手段や聴覚的手段によるインタフェース機構に加えて、よりリアリティのあるインタフェース機能を有する表示装置を提供する。

【解決手段】 ディスプレイパネル100は、振動素子200によって振動を付与される状態で支持されている。、ディスプレイパネル100の裏面には位置センサーシート300が配置され、ディスプレイパネル100に対するペン500等の接触位置を検出する。位置センサーシート300の裏面には、配線基板400が配置され、制御回路410と信号変換回路420が設けられている。制御回路410はペン500の接触位置と表示中の画像の内容に応じて、振動の種類を決定し、それを信号変換回路420に伝える。信号変換回路420は、制御回路410の指示に基づいて、振動素子200を駆動し、ディスプレイパネル100を振動させ、ペン500を介してオペレータに伝える。



【特許請求の範囲】

【請求項 1】 各種情報を表示する表示画面を有する表示装置において、

前記表示画面に所定の接触手段が接触した場合に、その接触条件を検出する接触条件検出手段と、

前記表示画面に対する接触手段の接触条件に応じて特定の振動を生成し、前記表示画面を介して前記接触手段に伝達する振動生成手段と、

を有することを特徴とする表示装置。

【請求項 2】 前記接触条件検出手段は、前記接触条件として、表示画面に対する接触手段の接触位置を検出する機能を有し、前記振動生成手段は、前記接触手段の接触位置に表示された画像の内容に対応する振動を生成することを特徴とする請求項 1 記載の表示装置。

【請求項 3】 前記画像の内容には、画像のコントラスト、色、意味性、画像属性のいずれか 1 つまたは複数の組み合わせを含むことを特徴とする請求項 2 記載の表示装置。

【請求項 4】 前記画像属性とは、表示画像が文字列画像か、絵乃至図形の画像かを区別するものあることを特徴とする請求項 3 記載の表示装置。

【請求項 5】 前記接触条件検出手段は、前記接触条件として、表示画面に対する接触手段の接触状態を検出する機能を有し、前記振動生成手段は、前記接触手段の接触状態に対応する振動を生成することを特徴とする請求項 1 記載の表示装置。

【請求項 6】 前記接触手段の接触状態には、前記接触手段の接触圧力、移動速度、接触手段の種類の一つまたは複数の組み合わせを含むことを特徴とする請求項 5 記載の表示装置。

【請求項 7】 前記接触条件検出手段は、前記接触条件として、入力途中の画像の属性及び／または意味性を認識する機能を有し、前記振動生成手段は、入力途中の画像の属性及び／または意味性に対応する振動を生成することを特徴とする請求項 1 記載の表示装置。

【請求項 8】 前記接触条件検出手段によって検出される接触条件に応じて特定の音響出力を生成する音響出力生成手段を有することを特徴とする請求項 1 記載の表示装置。

【請求項 9】 前記接触条件検出手段によって検出される接触条件に応じて表示を切り換えるとともに、前記振動生成手段による振動を切り換えることを特徴とする請求項 1 記載の表示装置。

【請求項 10】 前記特定の振動とは、特定の周波数及び／または特定の振幅を有する振動であることを特徴とする請求項 1 記載の表示装置。

【請求項 11】 前記特定の振動とは、前記表示画面に表示された画像の意味性に対応して周波数及び／または振幅が変動する振動であることを特徴とする請求項 1 記載の表示装置。

【請求項 12】 前記表示画面を構成するディスプレイパネルと、前記ディスプレイパネルに振動を付与する振動生成手段としての振動素子と、前記ディスプレイパネルの裏面に配置され、前記ディスプレイパネルに対する接触手段の接触位置を検出する位置センサと、前記位置センサの検出出力に応じて振動の種類を決定する制御回路と、前記制御回路からの制御信号に基づいて前記振動素子へ駆動信号を出力する信号変換回路とを有することを特徴とする請求項 2 記載の表示装置。

【請求項 13】 前記制御回路と前記信号変換回路は、前記位置センサの裏面に配置された配線基板に設けられていることを特徴とする請求項 2 記載の表示装置。

【発明の詳細な説明】

【0001】

【発明の属する技術分野】本発明は、各種情報を表示する表示画面を有する表示装置に関し、特に表示画面に表示した画像を手指やポインティングデバイス等で指定することにより、所定の入力を行う機能を有する表示装置に関する。

【0002】

【従来の技術】従来より、パーソナルコンピュータに設けられる表示装置において、表示画面上に座標検出装置を配置し、表示画面に表示されたアイコン等をタブレット等のペン入力装置によって指定することにより、この指定位置を座標検出装置によって検出し、その指定内容に応じて表示画面を切り換えたり、指定内容に対応したメッセージの音声合成出力を行うようにしたペン入力インタフェース機能を有するものが知られている。

【0003】

【発明が解決しようとする課題】しかしながら、従来のペン入力インタフェース機能を有する表示装置においては、視覚と聴覚とによるフィードバックインタフェースであるため、例えば 3 次元立体表現等のように、リアリティを志向するデジタルコンテンツの情報提供において、質や操作性に限界があるため、一層の直感的リアリティを実現することが望まれる。また、上述した従来の表示装置では、画面とペン先との接触感覚が一樣で滑り易く、硬質であるため、メタファーとする実際の紙とペンの触感覚と比べ、違和感、不確実感があり、ペン入力になじめないユーザが少なくない。

【0004】そこで本発明の目的は、単純な視覚的手段や聴覚的手段によるインタフェース機構に加えて、よりリアリティのあるインタフェース機能を有する表示装置を提供することにある。

【0005】

【課題を解決するための手段】本発明は前記目的を達成するため、各種情報を表示する表示画面を有する表示装置において、前記表示画面に所定の接触手段が接触した場合に、その接触条件を検出する接触条件検出手段と、前記表示画面に対する接触手段の接触条件に応じて特定

の振動を生成し、前記表示画面を介して前記接触手段に伝達する振動生成手段とを有することを特徴とする。

【0006】本発明の表示装置では、例えば手指やペン等の接触手段によって表示画面の特定位置を指定した場合、その接触条件、例えば接触位置、接触圧力、移動速度、接触手段の種類等を接触条件検出手段が検出する。そして、その検出した接触条件に応じて振動生成手段が特定の振動を生成し、これを表示画面を介して接触手段に伝達する。この結果、オペレータの操作内容に応じた振動が接触手段を介してオペレータに伝わる。これにより、従来は無機質であった接触感覚を改善でき、オペレータに感覚的なリアリティを与えることができる。

【0007】

【発明の実施の形態】以下、本発明による表示装置の実施の形態例について説明する。図1は、本発明による表示装置の外観例を示す斜視図であり、図2は、図1に示す表示装置の構成を示す分解斜視図である。本例の表示装置は、ディスプレイパネル100と、振動素子200と、位置センサシート300と、配線基板400とを有し、例えばペン500や手指等によってディスプレイパネル100上の表示領域を指定するものである。ディスプレイパネル100は、LCD表示画面を構成するものであり、各種の画像や文字列を表示するものである。振動素子200は、例えば圧電素子等より構成されたものであり、ディスプレイパネル100をその両側から微動可能に支持するとともに、ディスプレイパネル100に振動を付与するものである。

【0008】位置センサシート300は、ディスプレイパネル100に対するペン500等の接触位置を、電磁誘導方式や静電結合方式等の原理によって検出するものである。配線基板400は、図示しないパーソナルコンピュータからの信号を入力してディスプレイパネル100への表示情報を出したり、位置センサシート300からの検出信号を処理する制御回路410を設けたものである。また、配線基板400には、制御回路410からの制御信号に基づいて振動素子200の駆動信号を出力する信号変換回路420が設けられている。

【0009】以上のような構成の表示装置において、制御回路410は、パーソナルコンピュータからの各種コマンドやデータに基づいて、ディスプレイパネル100への画像表示を行う。この画像表示には、オペレータがペン500により選択すべき選択肢をウィンドウやアイコン等によって表示した画像や、オペレータがペン500により任意の描画を行うための画像が含まれる。そして、このような画像表示制御を行っている状態において、ディスプレイパネル100上に接触しているペン500の位置を位置センサシート300で検出する。そして、位置センサシート300は、この位置検出データを制御回路410に出力する。

【0010】制御回路410は、位置センサシート300

0からの位置検出データに基づいて、例えばオペレータによる選択指示等を認識し、この指示に基づいて、画面の切り換えやデータの取り込み等の各種処理を行う。また、制御回路410は、位置センサシート300からの位置検出データと、ディスプレイパネル100に表示している特定の画像（オブジェクト）の位置データとを照合し、一致している場合には、そのオブジェクトに対応した振動を所定のアルゴリズムに基づいてリアルタイムに決定する。なお、この決定は、予め制御回路410のメモリ内に、オブジェクトの位置データとともに、振動の種類を対応させたテーブルを記憶しておき、このテーブルを参照して振動の種類を決定してもよい。

【0011】そして、制御回路410は、その決定した振動に対応する制御信号を信号変換回路420に出力する。信号変換回路420は、この制御信号に対応して駆動信号を振動素子200に出力する。これにより、振動素子200が作動し、ディスプレイパネル100を振動させる。そして、このディスプレイパネル100を振動させる場合の周波数や振幅等を変えることにより、オブジェクトに対応した振動をペン500等を介してオペレータに伝えることができ、よりリアリティのあるインタフェース機能を得ることができる。

【0012】次に、オブジェクトの種類と振動の種類との対応関係の具体例について説明する。図3は、オブジェクトのコントラストによって振動の強弱、波形を変化させる例を示す説明図である。図3(A)に示すように、ディスプレイパネル100には、輪郭のはっきりしたストライプ画像10Aと、輪郭のはっきりした細いストライプ画像10Bと、輪郭のはっきりしないストライプ画像10Cと、輪郭のはっきりしない太いストライプ画像10Dが表示されている。

【0013】そして、これらのストライプ画像10A～10Dを横断するように、ペン50を進ませた場合、その接触点の変位に同期して、図3(B)に示すように、ストライプ画像10A～10Dの輪郭の強弱と幅に応じた振動12A～12Dを生成し、これをペン500を介してオペレータに伝える。これによりオペレータは、ペン500を各ストライプ画像10A～10D上で操作しているときには、そのストライプ画像10A～10Dに応じた振動を受け、一定の抵抗感を感じることができる。この結果、無機質で均一な接触感によりペン500を操作するのに比較して、よりリアルな操作感を与えることができる。したがって、このようなペン500より受ける振動による操作感の変化と、表示画像の切り換えによる視覚的な効果、さらには音声合成による聴覚的な効果とを連動させることで、よりリアリティのあるインタフェース機能を得ることができる。

【0014】なお、振動を選択する画像の条件として、は、上述した画像のコントラストの他に、APPLE INC. 特許第426号 意味性、画像属性等を用いることができる。ここで画像の

意味性とは、例えば太陽を表した画像と月を表した画像とで振動を変えたり、人を表した画像と犬を表した画像とで振動を変えたりするものである。また、画像属性とは、例えば表示画像が文字列画像か、絵乃至図形の画像かで振動を変えるものである。

【0015】図4、図5は、以上のような各種オブジェクトの触覚変換の例を示す説明図である。図4(B)では、山の高さで振動の強度を示しており、図4(A)に示すような視覚的な表示画像に対し、図4(B)に示すような強度の振動を生成し、その強度に応じて、ペン500を移動した場合の抵抗感を変えることができる。また、図5(B)では、斜線の種類によって振動の種類を示しており、図5(A)に示すような視覚的な表示画像に対し、図5(B)に示すように振動を変化させて、ペン500を移動した場合の抵抗感を変えることができる。このような振動の変化によって各種オブジェクトの触覚変換を行うことができ、立体感をもつオブジェクトとして認識させることができる。

【0016】また、以上の例では、ペン500の接触位置を検出し、この接触位置に応じて振動を生成するようにしたが、上述した位置センサシート300の代わりに、例えばディスプレイパネル100の上面に、透明の圧力センサシートや接触面を検出可能なセンサシートを設け、ペン500の接触圧力や接触面の大きさを検出することにより、この検出結果に基づいて振動を変化させるようにしてもよい。例えば図6は、ペン500の接触圧や接触面の大きさに基づいて、ペン500の種類を識別し、その識別結果に応じて振動の強弱、波形を変化させる例を示す説明図である。

【0017】図6(A)に示すように、フェルトペンによる描画20Aと、チョークによる描画20Bと、クレヨンによる描画20Cとを識別することにより、図6(B)に示すように、各筆記具に応じた22A~22Cを生成し、これをペン500を介してオペレータに伝える。また、筆記具に限らず、他のマテリアル(例えば手指でもよい)を想定し、それに応じて振動を変えることも勿論可能である。また、同様にペン500による接触圧力を検出し、接触圧力に応じて振動を変化させることもできる。

【0018】また、接触位置の検出によって、マテリアルの移動速度を判定し、その結果によって振動を変化させることもできる。さらに、マテリアルの種類、接触圧力、移動速度の組み合わせによって、振動を変化させるようにしてもよい。また、位置検出センサとパターン解析装置とを組み合わせることにより、入力途中の画像の

属性や意味性を認識し、この認識結果に基づいて、振動を変化させるようにしてもよい。例えば、ある選択肢に対し、YESならマル、NOならバツをペン500で入力することにより選択するようなシステムにおいて、ペン500の軌跡がマルかバツかを入力途中でリアルタイムに判断し、この判断に応じて振動の強度を徐々に変化させるような構成とすることも可能である。

【0019】

【発明の効果】以上説明したように本発明の表示装置では、表示画面に所定の接触手段が接触した場合に、その接触条件を検出し、その接触条件に応じて特定の振動を生成し、表示画面を介して接触手段に伝達するようにした。このため、画面上の画像が単に視覚的要素として扱われるのではなく、接触手段を介して伝えられる振動により一定の触覚をもった対象として捉え易くなり、従来は無機質であった接触感覚を改善でき、オペレータに感覚的なリアリティを与えることができる。したがって、グラフィックユーザインタフェースの可能性を広げることができ、触覚を生かしたデジタルコンテンツ(ゲーム、教育等)を構成することも可能となる。また、ペン入力装置と画面との間の接触感をペンと紙との接触感に近づけることができ、シミュレート装置としての表示装置の機能を向上することができる。さらに、軽度視覚障害者に対して、グラフィックユーザインタフェースの補助機能としての利用も可能である。

【図面の簡単な説明】

【図1】本発明による表示装置の外観例を示す斜視図である。

【図2】図1に示す表示装置の構成を示す分解斜視図である。

【図3】図1に示す表示装置において、オブジェクトのコントラストによって振動を変化させる例を示す説明図である。

【図4】図1に示す表示装置において、オブジェクトの触覚変換の例を示す説明図である。

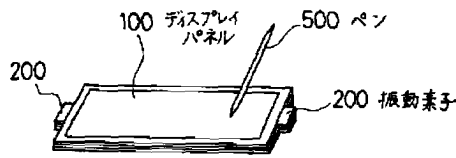
【図5】図1に示す表示装置において、オブジェクトの触覚変換の他の例を示す説明図である。

【図6】図1に示す表示装置において、ペンの接触圧や接触面の大きさに基づいて振動を変化させる例を示す説明図である。

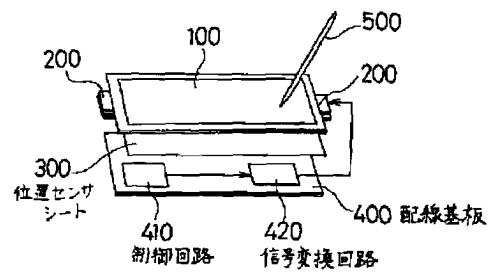
【符号の説明】

100……ディスプレイパネル、200……振動素子、300……位置センサシート、400……配線基板、410……制御回路、420……信号変換回路、500……ペン。

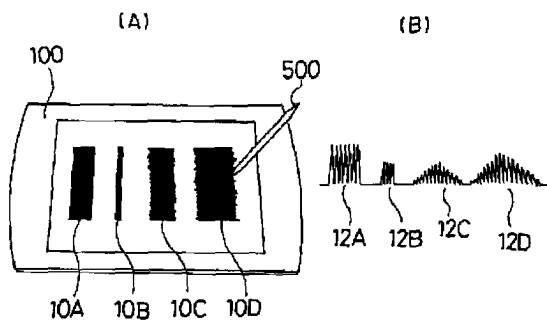
【図1】



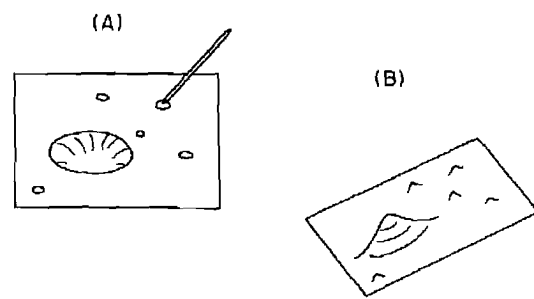
【図2】



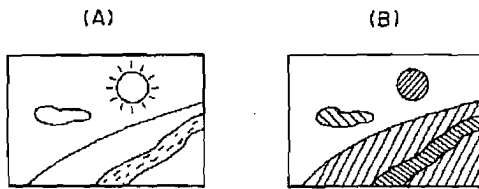
【図3】



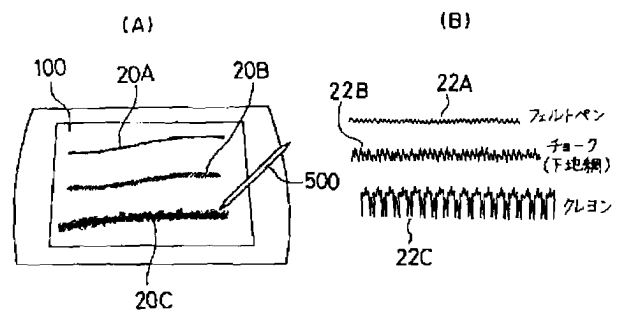
【図4】



【図5】



【図6】



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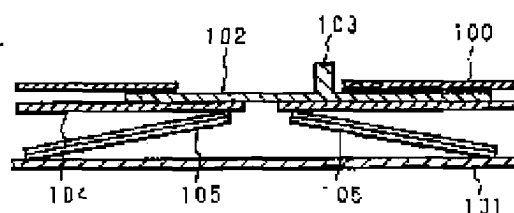
(54) POINTING DEVICE

(57)Abstract:

PROBLEM TO BE SOLVED: To provide a pointing device capable feeding back a tactile action according to moving quantity and moving direction of an operation part.

SOLUTION: This pointing device is provided with an operation board 102 which can be slid and moved in the two-dimensional direction and an operation knob 103 as a cylindrical projection is provided on the surface of the operation board 102. When a user performs a pointing operation by using the operation knob 103, the tactile action is fed back to the user by driving a piezoelectric bimorph element 105 according to slide moving quantity and the moving direction of the operation knob 103.

本発明のポインティングデバイスの実施形態1を示す断面図



110: ケース上部 103: 操作つまみ
131: ケース下部 104: 支持板
102: 操作板 105: 圧電バイモルフ素子

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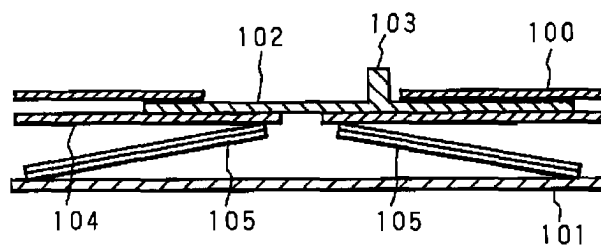
(54) 【発明の名称】 ポインティングデバイス

(57) 【要約】

【課題】 操作部の移動量及び移動方向に応じた触感作用をフィードバックすることができるポインティングデバイスの提供。

【解決手段】 ポインティングデバイスは、2次元方向にスライド移動することができる操作板102を備え、該操作板102の表面には円柱状の突起物である操作つまみ103が設けられている。使用者が操作つまみ103を用いてポインティング操作を行う場合、この操作つまみ103のスライド移動量及び移動方向に応じて圧電バイモルフ素子105を駆動させることによって使用者に対して触感作用をフィードバックする。

本発明のポインティングデバイスの実施の形態1を示す断面図



100:ケース上部 103:操作つまみ
101:ケース下部 104:支持板
102:操作板 105:圧電バイモルフ素子

【特許請求の範囲】

【請求項1】 表示装置に表示されているポインタを移動させるために用いるポインティングデバイスにおいて、

2次元方向に移動可能であり、前記ポインタの移動指示を行うために用いる操作部と、

該操作部の移動量及び移動方向を検出する検出手段と、該検出手段によって検出された前記移動量及び移動方向に応じた触感作用を前記操作部に対して与えさせるべくしてあることを特徴とするポインティングデバイス。

【請求項2】 表示装置に表示されているポインタを移動させるために用いるポインティングデバイスにおいて、

2次元方向に移動可能であり、前記ポインタの移動指示を行うために用いる操作部と、

該操作部に連結されたアクチュエータと、前記操作部の移動量及び移動方向を検出する検出手段と、

該検出手段によって検出された前記移動量及び移動方向に基づいて、前記アクチュエータを駆動する駆動回路とを備えることを特徴とするポインティングデバイス。

【請求項3】 表示装置に表示されているポインタを移動させるために用いるポインティングデバイスにおいて、

2次元方向に移動可能であり、前記ポインタの移動指示を行うために用いる操作部と、

該操作部の第1の方向への移動に対する抵抗力を付与する第1抵抗付与手段と、

前記操作部の第1の方向と直交する第2の方向への移動に対する抵抗力を付与する第2抵抗付与手段と、

前記操作部の第1の方向への移動量及び第2の方向への移動量を検出する検出手段と、

該検出手段によって検出された第1の方向及び第2の方向への移動量に基づいて、第1抵抗付与手段及び第2抵抗付与手段を夫々駆動制御する駆動回路とを備えることを特徴とするポインティングデバイス。

【発明の詳細な説明】

【0001】

【発明の属する技術分野】本発明は、表示装置に表示されているポインタの位置を移動させるポインティングデバイスに関し、特に使用者に対して触感作用をフィードバックすることができるポインティングデバイスに関する。

【0002】

【従来の技術】ディスプレイ等の表示装置に表示されているポインタの位置を移動させるためのポインティングデバイスとして、従来からマウス型ポインティングデバイスが利用されている。マウス型ポインティングデバイスはクリック及びドラッグ等の容易な操作で足り、しかも小型で安価なために広く普及している。しかし従来の

マウス型ポインティングデバイスを用いた場合、ユーザは、ポインタの位置を目視のみによって確認するため、表示装置の画面を注視しなければならない。そのため、細かなポインティング操作を連続して行わなければならない場合等では、使用者の眼に相当な負担がかかることになる。

【0003】このような眼の負担を軽減するために、ポインタの位置情報を触感作用として使用者にフィードバックする触感作用生成器を備えることによって、使用者がポインタの位置を、視覚のみならず触覚によっても確認することができるマウス型ポインティングデバイスが提案されている。

【0004】特許公報第2571793号には、触感作用生成器の作動部がマウスボタン内の一部から突出させて設けてあり、前記作動部の作動によって、マウスボタンに触れている使用者の指に対して触感作用をフィードバックすることができるマウス型ポインティングデバイスが提案されている。

【0005】また特開平6-202801号公報には、圧電式アクチュエータ等の触感作用生成器によってマウスケースの上部が持ち上げられることによって、使用者に対して触感作用を伝えることができるマウス型ポインティングデバイスが提案されている。

【0006】これらの触感作用生成器を備えたマウス型ポインティングデバイスは、ポインタが、アイコン又はウィンドウ等の特定のオブジェクトの位置に達した場合に触感作用を使用者に伝える。したがって、使用者はポインタが特定のオブジェクトの位置に達したことを視覚のみならず触覚によって確認することができる。

【0007】

【発明が解決しようとする課題】しかしながら、従来の触感作用生成器を備えたマウス型ポインティングデバイスは、上述したようにポインタが特定のオブジェクトの位置に達した場合に触感作用を生成するのみであり、そのような特定のオブジェクトの位置に到達するまでの過程におけるポインタの位置情報を触覚によって確認することはできなかった。したがって、ポインティング操作を行っている際に、あとどの程度操作すればポインタを特定のオブジェクトの位置に到達させることができるのかを触覚にて確認することはできないという問題があった。

【0008】ところで、近年、室内のみならず屋外でも使用可能な携帯型の情報処理装置の需要が発生しており、それらの小型・軽量化が要望されるようになってきている。そのような目的を達成するための手段の一つとしてポインティングデバイスにおいても小型・軽量化が図られており、その結果マウス型ポインティングデバイスの代わりにジョイスティック型、トラックボール型及びスライドパッド型等のポインティングデバイスが広く使用されるようになってきている。特にスライドパッド型ポイン

ティングデバイスは、他のポインティングデバイスに比し薄型化が容易であるため、多くの携帯型の情報処理装置が採用している。

【0009】スライドパッド型ポインティングデバイスは、パッド上の検出領域内を筆記具又は指等で押しながら所望の方向に移動させることによって操作するポインティングデバイスである。しかし、このように筆記具又は指等で押しながら細かなポインティング操作を行う場合、その操作の安定性に欠けるという問題があった。

【0010】本発明は斯かる事情に鑑みてなされたものであり、2次元方向に移動可能な操作部の移動量及び移動方向に応じた触感作用を使用者にフィードバックすることによって、ポインタが移動している場合に、あとの程度操作すればポインタを所望の位置に到達させることができるのかを触覚にて確認することができるポインティングデバイスを提供することを目的とする。

【0011】本発明の他の目的は、2次元方向に移動可能な操作部を備え、使用者はこの操作部を用いてポインティング操作を行うことによって、細かなポインティング操作を行う場合であっても操作の安定性を確保することができるポインティングデバイスを提供することにある。

【0012】

【課題を解決するための手段】ポインタが特定のオブジェクトの位置に到達するまでの過程におけるポインタの位置情報を、視覚のみならず触覚によって確認することができる場合、使用者は、ポインティングデバイスを用いて、あとの程度操作すればポインタの位置を所望のオブジェクトの位置に到達させることができるのかを容易に把握することが可能となり、その結果ポインティングデバイスの操作性を向上させることが可能であることを本発明者等は知見した。このような知見に基づいて、以下に示すポインティングデバイスを発明した。

【0013】第1発明に係るポインティングデバイスは、表示装置に表示されているポインタを移動させるために用いるポインティングデバイスにおいて、2次元方向に移動可能であり、前記ポインタの移動指示を行うために用いる操作部と、該操作部の移動量及び移動方向を検出する検出手段と、該検出手段によって検出された前記移動量及び移動方向に応じた触感作用を前記操作部に対して与えさせるべくしてあることを特徴とする。

【0014】第1発明による場合、2次元方向に移動することが可能な操作部と、使用者がこの操作部を用いて操作を行うことによって操作部が移動した場合に、この操作部の移動量及び移動方向を検出する検出手段とを備えている。そして、この検出手段によって検出された操作部の移動量及び移動方向に応じた触感作用を、操作部に対して与えさせるようになしてある。

【0015】これにより操作部を介して、操作部の移動量及び移動方向に応じた触感作用を使用者に対してフィ

ードバックすることができる。したがって、使用者は、あとの程度操作すればポインタを所望の位置に到達させることができるのかを、視覚のみならず触覚によっても確認することができる。

【0016】また、操作部を用いてポインティング操作を行うことによって、細かなポインティング操作を行う場合であっても操作の安定性を確保することができる。

【0017】第2発明に係るポインティングデバイスは、表示装置に表示されているポインタを移動させるために用いるポインティングデバイスにおいて、2次元方向に移動可能であり、前記ポインタの移動指示を行うために用いる操作部と、該操作部に連結されたアクチュエータと、前記操作部の移動量及び移動方向を検出する検出手段と、該検出手段によって検出された前記移動量及び移動方向に基づいて、前記アクチュエータを駆動する駆動回路とを備えることを特徴とする。

【0018】第2発明による場合、2次元方向に移動することが可能な操作部と、この操作部に連結されているアクチュエータと、使用者がこの操作部を用いて操作を行うことによって操作部が移動した場合に、この操作部の移動量及び移動方向を検出する検出手段とを備えている。そして、この検出手段によって検出された操作部の移動量及び移動方向に基づいて、駆動回路がアクチュエータを駆動する。

【0019】このように、使用者が操作部を移動させた場合、ポインティングデバイスによって検出された操作部の移動量及び移動方向に基づいて、駆動回路がアクチュエータを駆動する。その結果このアクチュエータと連結している操作部に対して触感作用が伝達される。すなわち操作部を介して、操作部の移動量及び移動方向に応じた触感作用を使用者に対してフィードバックすることができる。したがって使用者は、ポインティング操作をしている際、あとの程度操作すればポインタを所望の位置に到達させることができるのかを、視覚のみならず触覚によっても確認することができる。

【0020】第3発明に係るポインティングデバイスは、表示装置に表示されているポインタを移動させるために用いるポインティングデバイスにおいて、2次元方向に移動可能であり、前記ポインタの移動指示を行うために用いる操作部と、該操作部の第1の方向への移動に対する抵抗力を付与する第1抵抗付与手段と、前記操作部の第1の方向と直交する第2の方向への移動に対する抵抗力を付与する第2抵抗付与手段と、前記操作部の第1の方向への移動量及び第2の方向への移動量を検出する検出手段と、該検出手段によって検出された第1の方向及び第2の方向への移動量に基づいて、第1抵抗付与手段及び第2抵抗付与手段を夫々駆動制御する駆動回路とを備えることを特徴とする。

【0021】第3発明による場合、2次元方向に移動することが可能な操作部を備え、更に、この操作部を第1

の方向及び第 1 の方向と直交する第 2 の方向への移動に対する抵抗力を夫々付与する第 1 及び第 2 抵抗付手段を夫々備えている。また、使用者がこの操作部を用いて操作を行うことによって操作部が移動した場合に、この操作部の第 1 の方向への移動量及び第 2 の方向への移動量を検出する検出手段を更に備えている。そして、この検出手段によって検出された操作部の第 1 の方向への移動量及び第 2 の方向への移動量に基づいて、駆動回路が、第 1 及び第 2 抵抗付手段夫々を駆動制御する。

【0022】このように、使用者が操作部を移動させた場合、ポインティングデバイスによって検出された操作部の第 1 の方向及び第 2 の方向への移動量に基づいて、駆動回路が第 1 及び第 2 抵抗付手段夫々を駆動制御され、その結果操作部の移動に抵抗力を付与することができる。これにより操作部を介して、操作部の移動量及び移動方向に応じた触感作用を使用者に対してフィードバックすることができる。したがって使用者は、ポインティング操作をしている際、あとの程度操作すればポインタを所望の位置に到達させることができるのかを、視覚のみならず触感によっても確認することができる。

【0023】

【発明の実施の形態】以下、本発明をその実施の形態を示す図面に基いて詳述する。

(実施の形態 1) 図 1 は本発明のポインティングデバイスの実施の形態 1 を備えた情報処理装置を示す外観図である。図 1 に示すとおり、ノート型パーソナルコンピュータである情報処理装置 10 は、画像を表示する液晶表示装置 (LCD) 等の画像表示装置 20 と、該画像表示装置 20 に表示されているポインタ 40 を移動させるために用いるポインティングデバイス 30 とを備えている。

【0024】図 2 は、情報処理装置 1 の要部構成を示す機能ブロック図である。図 2 において、11 は CPU で構成されている制御部を示しており、バス 16 を介して以下のハードウェア各部と接続されていて、それらを制御すると共に、ハードディスク 12 に格納された種々のコンピュータプログラムを実行する。

【0025】ハードディスク 12 は、情報処理装置 10 の動作に必要な種々のソフトウェアのプログラムを格納している。

【0026】RAM 13 は、例えば SRAM またはフラッシュメモリ等で構成され、ソフトウェアの実行時に発生する一時的なデータを記憶する。

【0027】画像表示装置インタフェース部 14 は、画像表示装置 20 が備えるインタフェース部 21 に対して表示する画像データを送信するためのインタフェースである。また、ポインティングデバイスインタフェース部 (以下、PD インタフェース部という) 15 は、ポインティングデバイス 30 が備えるインタフェース部 31 との間で、ポインタ 40 の位置情報を送受信するためのイ

ンタフェースである。

【0028】また 22 は、画像表示装置 20 が備える表示部を示しており、該表示部 22 はインタフェース部 21 を介して情報処理装置 10 から受信する画像データを表示する。

【0029】また 32 は、ポインティングデバイス 30 が備える検出器を示しており、該検出器 32 は操作部 33 のスライド移動量及び移動方向を検出し、検出したスライド移動量及び移動方向を、インタフェース部 31 を介して制御部 11 に対して出力するとともに、駆動回路 35 に対しても同じく出力する。駆動回路 35 は、検出器 32 が検出したスライド移動量及び移動方向に基づき、触感作用生成器 34 を駆動制御する。

【0030】図 3 は本発明のポインティングデバイス 30 の実施の形態 1 を示す断面図である。図 3 において、100 はケース上部を、101 はケース下部を夫々示している。またケース上部 100 には略正方形の開口部が設けられている。

【0031】102 は使用者がポインティング操作に用いるための操作板を示しており、該操作板 102 の表面中央付近には円柱状の突起物である操作つまみ 103 が設けられている。使用者は、操作つまみ 103 を用いて操作板 102 をスライド移動させることによってポインティング操作を行う。また操作板 102 の裏面には特定のパターンが形成されており、後述するように、操作板 102 の下方に設けられている光学式 2 次元エンコーダ (図示せず) がこのパターンを読み取ることによって操作つまみ 103 のスライド移動量及び移動方向を検出する。

【0032】なお、操作つまみ 103 の上部に凹部を設け、筆記具などをこの凹部に嵌合させることにより、その筆記具などを用いて操作つまみ 103 をスライド移動させることができるようにしてもよい。また、操作つまみ 103 を上下移動可能にし、この上下移動を検出する検出器を更に設け、この検出器によって操作つまみ 103 が押し下げられたことが検出された場合に、これをポインティングの確定操作と判断するようにしてもよい。

【0033】104 は操作板 102 をスライド移動可能にすべく支持するための支持板を示しており、該支持板 104 の表面と操作板 102 の裏面とが摺接している。また支持板 104 の中央付近には開口部が設けられている。

【0034】105, 105 は長方形の板状をなす 2 個の圧電バイモルフ素子を示しており、これらの圧電バイモルフ素子 105, 105 は、支持板 104 に設けられている開口部を挟んで、短辺が平行するように配置されている。そしてそれらの一端はケース下部 101 に夫々固定されており、他端は支持板 104 の裏面に夫々連結されている。さらに圧電バイモルフ素子 105, 105 は駆動回路 (図示せず) と夫々接続されており、該駆動

回路から所定の電圧が供給されることによって振動する。この振動に連動して操作板102が振動することにより、操作つまみ103を介して使用者に対して触感作用がフィードバックされる。

【0035】また上述したように、操作板102の下方には、発光手段及び受光手段を有する光学式2次元エンコーダ（図示せず）が備えられている。この光学式2次元エンコーダが発光手段及び受光手段を用い、操作板102の裏面に形成されているパターンを支持板104の開口部を通して読み取ることによって、操作つまみ103の

【0036】次に、本発明のポインティングデバイス30の動作について説明する。図4は、本発明のポインティングデバイス30の動作の流れを示すフローチャートである。ポインティングデバイス30は、使用者が操作つまみ103をスライド移動させた場合、その操作つまみ103のX軸及びY軸方向夫々に対するスライド移動量を検出する（S101）。

【0037】次にポインティングデバイス30は、ステップS101にて検出した操作つまみ103のX軸方向の

【0038】

【数1】

$$X_n \text{ mod SCALE} \dots(1)$$

$$Y_n \text{ mod SCALE} \dots(2)$$

【0039】そして触感作用出力値X_n又はY_nが0になったかどうかを判定し（S103）、両方とも値が0でない場合（S103でNO）、ステップS101へ戻る。一方、どちらかの値が0になった場合（S103でYES）、圧電バイモルフ素子105に対して駆動回路から所定の電圧が供給され、その結果圧電バイモルフ素子105が振動することにより触感作用を生成する（S104）。

【0040】このようにして、使用者に対して操作つまみ103の

【0041】なお、操作つまみ103のスライド移動が一旦停止した後再度スライド移動が開始された場合、この停止したことを検知し、その検知した時点からのスライド移動量及び移動方向に応じた触感作用を生成するようにしてもよい。

【0042】（実施の形態2）次に、本発明のポインティングデバイス30の実施の形態2について図5を用いて説明する。なお、実施の形態2は、実施の形態1の場合と同様に、ノート型パーソナルコンピュータに備えら

れたポインティングデバイスである。

【0043】図5（a）は本発明のポインティングデバイス30の実施の形態2を示す平面図であり、（b）は同じく実施の形態2を示す断面図である。図5（a）及び（b）において、120は使用者がポインティング操作に用いるための操作板を示しており、該操作板120の表面中央付近に円柱状の突起物である操作つまみ121を、その裏面に操作つまみ121と対向する位置に半球体状の突起物122を夫々有している。

【0044】また114、114、114、114は、4個の円柱物を夫々示しており、該4個の円柱物114、114、114、114は、支持板115の4辺と対向する夫々の位置に、これらの4辺と全長とが平行するように夫々配置されている。また、対向する1対の円柱物114、114に対して支持板115を囲むように1本のワイヤ116が夫々巻きめぐらされており、これら2本のワイヤ116、116の直交点と上述した突起物122とが固定されている。

【0045】また各円柱物114にはポテンシオメータ又はエンコーダ等を用いた回転量検出器（図示せず）が夫々接続されており、これらの回転量検出器によって各円柱物114の回転量が検出され、検出した回転量に基づいて、操作つまみ121のスライド移動量及び移動方向を検出する。さらに各円柱物114は小型モータ（図示せず）を内蔵しており、この小型モータを駆動することによって各円柱物114の回転が制御される。

【0046】上述した回転量検出器が検出した操作つまみ121のスライド移動量及び移動方向に基づいて、上述した小型モータが各円柱物114の回転を制御することによって、操作つまみ121の移動に対して抵抗力を付与する。これにより、使用者に対して触感作用をフィードバックすることができる。なお、各円柱物114の回転を利用して、操作つまみ121を所定の位置、例えばいわゆるホームポジションに移動させることも可能である。

【0047】なお、その他の構成は実施の形態1と同様であるので、同一符号を付して説明を省略する。

【0048】（実施の形態3）次に、本発明のポインティングデバイス30の実施の形態3について図6を用いて説明する。なお、実施の形態3は、実施の形態1の場合と同様に、ノート型パーソナルコンピュータに備えられたポインティングデバイスである。

【0049】図6（a）は本発明のポインティングデバイス30の実施の形態3を示す平面図であり、（b）は同じく実施の形態3を示す断面図である。図6（a）及び（b）において、操作板120の下方には後述する圧力センサを備えた支持板123が備えられている。支持板123は、上挟板124a及び下挟板124b、並びにこれらの上挟板124a及び下挟板124b間の4隅に備えられる圧力センサ125a、125bを有している。

c, 125dから構成される。また上挟板124aは、押圧された場合に下方へ弾性変形する弾性体から構成されている。さらに上挟板124aの表面には、操作板120の裏面に設けられた突起物122と嵌合するための凹部がマトリクス状に設けられている。

【0050】操作板120の裏面に設けられた突起物122は、上挟板124aの表面と接しており、使用者が操作つまみ121を用いて操作板120をスライド移動させた場合に、突起物122は上挟板124aの表面を押圧しながら摺動する。そしてその際の上挟板124aにおける押圧点を4個の圧力センサ125a, 125b, 125c, 125dを用いて後述する方法にしたがって算出する。

【0051】以下に、4個の圧力センサ125a, 125b, 125c, 125dを用いて上挟板124aにおける押圧点を算出する方法を説明する。ここで、圧力センサ125a, 125b, 125c, 125dが検出する押圧力を夫々P1, P2, P3, P4とし、また上挟板における押圧点の座標をG_x, G_yとする。

【0052】上挟板124aに加わる押圧力は4個の圧力センサ125a, 125b, 125c, 125dに分散され、その総和はP1+P2+P3+P4で表される。そのため、上挟板124aにおける押圧点の座標(G_x, G_y)は、以下の式(3)及び式(4)により算出される。

【0053】

【数2】

$$G_x = \frac{P_1 + P_2}{P_1 + P_2 + P_3 + P_4} \quad \dots(3)$$

$$G_y = \frac{P_1 + P_4}{P_1 + P_2 + P_3 + P_4} \quad \dots(4)$$

【0054】ポインティングデバイス30は、このようにして算出した押圧点のスライド移動量及び移動方向を、インタフェース部31及びPDインタフェース部15を介して制御部11へ出力する。そして制御部11はこの押圧点のスライド移動量及び移動方向に基づいて、ポインタ40の位置情報を算出し、算出した位置情報を画像表示装置20へ出力する。その結果、画像表示装置20上に表示されているポインタ40の位置が移動する。

【0055】一方、使用者が操作つまみ121を用いてポインティング操作をしている場合、操作板120の裏面に設けられた突起物122が、表面に複数の凹部を設けた上挟板124a上を摺動することによって、操作板120が振動する。そしてこの振動が、操作つまみ121を介して使用者に伝達される。このようにして使用者に対して触感作用をフィードバックすることができる。

【0056】また、押圧点の移動がない場合であって、

押圧力が大きくなったときは、これをポインティングの確定操作と判断する。これにより4個の圧力センサ125a, 125b, 125c, 125dを用いて確定操作の判定をすることが可能になる。

【0057】なお、その他の構成は実施の形態1と同様であるので、同一符号を付して説明を省略する。

【0058】(実施の形態4)次に、本発明のポインティングデバイス30の実施の形態4について図7を用いて説明する。なお、実施の形態4は、実施の形態3における操作板120が3枚の異なる板状の部材を備えたポインティングデバイスである。

【0059】図7は本発明のポインティングデバイス30の実施の形態4を示す断面図である。図7において、126, 127及び128は、使用者がポインティング操作に用いるための操作板を構成する第1, 第2及び第3操作板を夫々示している。

【0060】第1操作板126の表面と第2操作板127の裏面とが、第2操作板127の表面と第3操作板128の裏面とが、第3操作板128の表面とケース上部100の裏面とが夫々摺接されており、第1操作板126, 第2操作板127及び第3操作板128は夫々摺動可能に支持されている。また、第2操作板127, 第3操作板128及びケース上部100の裏面の所定位置には、ストッパ129, 129, 129が夫々設けられており、各ストッパ129によって第1操作板126, 第2操作板127及び第3操作板128は摺動する距離が制限される。

【0061】また第1操作板126の表面中央付近に円柱状の突起物である操作つまみ121を、その裏面に操作つまみ121と対向する位置に半球体状の突起物122を夫々有している。

【0062】使用者が操作つまみ121を用いてポインティング操作をしている場合、第1操作板126の裏面に設けられた突起物122が、表面に複数の凹部を設けた上挟板124a上を摺動することによって、操作板120が振動する。そしてこの振動が、操作つまみ121を介して使用者に伝達される。このようにして使用者に対して触感作用をフィードバックすることができる。

【0063】なお、その他の構成は実施の形態3と同様であるので、同一符号を付して説明を省略する。

【0064】上述のように構成したことにより、操作板を小型化することが可能になるので、その結果ポインティングデバイス30の小型化を実現することが可能になる。

【0065】(実施の形態5)次に、本発明のポインティングデバイス30の実施の形態5について図8を用いて説明する。なお、実施の形態5は、実施の形態1の場合と同様に、ノート型パーソナルコンピュータに備えられたポインティングデバイスである。

【0066】図8(a)は本発明のポインティングデバイス30の

イス30の実施の形態5を示す平面図であり、(b)は同じく実施の形態3を示す断面図である。図8(a)及び(b)において、130は操作板120を支持するための支持板を示しており、該支持板130は、上挟板131a及び下挟板131b、並びにこれらの上挟板131a及び下挟板131b間の4隅に備えられる圧力センサ125a、125b、125c、125dから構成される。なお、上挟板131aは、実施の形態3における上挟板124aと異なり、表面に複数の凹部を設けていない。

【0067】また132、132、132、132は形状記憶合金からなるアクチュエータである形状記憶パネを夫々示しており、各形状記憶パネ132の一端は操作板120の4つの側面の所定の位置に夫々連結され、他端はポインティングデバイス30の内部に固定されている。

【0068】なお、その他の構成は実施の形態3と同様であるので、同一符号を付して説明を省略する。

【0069】ポインティングデバイス30は、圧力センサ125a、125b、125c、125dを用いて算出された押圧点のスライド移動量及び移動方向を、インタフェース部31及びPDインタフェース部15を介して制御部11へ出力する。そして制御部11はこの押圧点のスライド移動量及び移動方向に基づいて、ポインタ40の位置情報を算出し、算出した位置情報を画像表示装置20へ出力する。その結果画像表示装置20上に表示されているポインタ40の位置が移動する。

【0070】また前記算出された押圧点のスライド移動量及び移動方向に基づいて、駆動回路(図示せず)によって各形状記憶パネ132に対して所定の電圧が印加される。その結果、これらの形状記憶パネ132は予め記憶された形状に伸び又は縮む。これにより操作つまみ121の移動に対して抵抗力を付与する。これにより、使用者に対して触感作用をフィードバックすることができる。

【0071】(実施の形態6)次に、本発明のポインティングデバイス30の実施の形態6について図9を用いて説明する。なお、実施の形態5は、実施の形態1の場合と同様に、ノート型パーソナルコンピュータに備えられたポインティングデバイスである。

【0072】図9は本発明のポインティングデバイス30の実施の形態6を示す断面図である。図9において、222は使用者がポインティング操作に用いるための操作板を示しており、該操作板222の表面中央付近には円柱状の突起物である操作つまみ223が設けられている。使用者は、操作つまみ223を用いて操作板222をスライド移動させることによってポインティング操作を行う。

【0073】また224a、224bは夫々電極板を示している。そしてこの電極板224aの表面と操作板2

22の裏面とが貼着されており、電極板224bの裏面とケース下部101の表面とが貼着されている。さらに、電極板224a、224b間には、電気粘性流体225が備えられている。なお、電気粘性流体225は、外部から電界を印加することによって粘度が連続的に変化する。

【0074】なお、その他の構成は実施の形態3と同様であるので、同一符号を付して説明を省略する。また図示していないが、上述した他の実施の形態と同様にして、複数の圧力センサ又は光学式2次元エンコーダ等の検出器を用いて操作つまみ223のスライド移動量及び移動方向を検出する。

【0075】ポインティングデバイス30は、検出器(図示せず)によって検出された操作つまみ223のスライド移動量及び移動方向に基づいて、駆動回路(図示せず)によって電極板224a、224bに対して所定の電圧が印加される場合、電気粘性流体225の粘度が変化する。これにより操作つまみ223の移動に対して抵抗力を付与する。これにより、使用者に対して触感作用をフィードバックすることができる。

【0076】(実施の形態7)次に、本発明のポインティングデバイス30の実施の形態7について図10を用いて説明する。なお、実施の形態7は、実施の形態6における電極板224a、224bの代わりにアレイ状の電極パターンを有する電極板を備えた構成のポインティングデバイスである。

【0077】図10は本発明のポインティングデバイス30の実施の形態7を示す断面図である。図10において、226はアレイ状に配された複数の電極を有する電極板を示している。

【0078】なお、その他の構成は実施の形態3と同様であるので、同一符号を付して説明を省略する。また実施の形態6と同様に、図示していないが、上述した他の実施の形態と同様にして、複数の圧力センサ又は光学式2次元エンコーダ等の検出器を用いて操作つまみ223のスライド移動量及び移動方向を検出する。

【0079】ポインティングデバイス30は、検出器(図示せず)によって検出された操作つまみ223のスライド移動量及び移動方向に基づいて、駆動回路(図示せず)によって電極板226を構成している複数の電極に対して所定の電圧が印加される場合、電気粘性流体225の粘度が変化する。これにより操作つまみ223の移動に対して抵抗力を付与する。これにより、使用者に対して触感作用をフィードバックすることができる。

【0080】(実施の形態8)次に、本発明のポインティングデバイス30の実施の形態8について図11を用いて説明する。なお、実施の形態8は、実施の形態1の場合と同様に、ノート型パーソナルコンピュータに備えられたポインティングデバイスである。

【0081】図11は本発明のポインティングデバイス

30の実施の形態8を示す断面図である。図11において、230は使用者がポインティング操作に用いるための操作板222をスライド移動可能にするための支持板であり、該支持板230の裏面の略中央付近には超音波振動子231が備えられている。なお、超音波振動子231が駆動することによって支持板230の表面に定在波が発生する。

【0082】なお、その他の構成は実施の形態3と同様であるので、同一符号を付して説明を省略する。また実施の形態6と同様に、図示していないが、上述した他の実施の形態と同様にして、複数の圧力センサ又は光学式2次元エンコーダ等の検出器を用いて操作つまみ223のスライド移動量及び移動方向を検出する。

【0083】ポインティングデバイス30は、検出器（図示せず）によって検出された操作つまみ223のスライド移動量及び移動方向に基づいて、駆動回路（図示せず）によって超音波振動子231が駆動制御される。これにより支持板230の表面に定在波が発生又は消失する。これにより操作つまみ223の移動に対して抵抗力を付与する。これにより、使用者に対して触感作用をフィードバックすることができる。

【0084】（実施の形態9）次に、本発明のポインティングデバイス30の実施の形態9について図12を用いて説明する。なお、実施の形態7は、実施の形態1の場合と同様に、ノート型パーソナルコンピュータに備えられたポインティングデバイスである。

【0085】図12は本発明のポインティングデバイス30の実施の形態9を示す断面図である。図12において、232は使用者がポインティング操作に用いるための操作板222をスライド移動可能にするための支持板であり、該支持板232は圧電体からなっている。そしてこの支持板232の裏面とアレイ状に複数の電極が配された電極板233の表面とが貼着されている。この電極板233を構成している複数の電極に対して所定の電圧が印加することによって、操作板222の摺動し易い方向を制御する。

【0086】なお、その他の構成は実施の形態3と同様であるので、同一符号を付して説明を省略する。また実施の形態6と同様に、図示していないが、上述した他の実施の形態と同様にして、複数の圧力センサ又は光学式2次元エンコーダ等の検出器を用いて操作つまみ223のスライド移動量及び移動方向を検出する。

【0087】ポインティングデバイス30は、検出器（図示せず）によって検出された操作つまみ223のスライド移動量及び移動方向に基づいて、駆動回路（図示せず）によって電極板233を構成している複数の電極に対して所定の電圧を印加し、操作板222の摺動し易い方向を制御する。これにより操作つまみ223の移動に対して抵抗力を付与する。これにより、使用者に対して触感作用をフィードバックすることができる。

【0088】（実施の形態10）次に、本発明のポインティングデバイスの実施の形態10について図13を用いて説明する。なお、実施の形態10は、実施の形態1の場合のようにノート型パーソナルコンピュータに備えられたポインティングデバイスではなく、携帯電話に備えられたポインティングデバイスである。

【0089】図13は、本発明のポインティングデバイスの実施の形態10を備えた携帯電話を示す平面図である。図13において、携帯電話50は、画像を表示する液晶表示装置（LCD）等の画像表示装置51と、該画像表示装置51に表示されているポインタ54を移動させるために用いるポインティングデバイス52とを備えている。また画像表示装置51には、仮想テンキー55が表示されており、使用者はポインティングデバイス52に備えられた操作つまみ53を用いてポインティング操作を行うことによって、ポインタ54を特定の仮想テンキー55の位置へ移動させ、そこで確定操作を行うことによって仮想テンキー55の押操作を行う。

【0090】なお、図示していないが、上述した他の実施の形態と同様にして、複数の圧力センサ又は光学式2次元エンコーダ等の検出器を用いて操作つまみ53のスライド移動量及び移動方向を検出する。そしてこのスライド移動量及び移動方向に基づいて、使用者に対して触感作用をフィードバックする。

【0091】（実施の形態11）次に、本発明のポインティングデバイスの実施の形態11について図14を用いて説明する。なお、実施の形態11は、テレビジョン等のリモートコントローラ（以下、リモコンという）に備えられたポインティングデバイスである。

【0092】図14（a）は本発明のポインティングデバイス30の実施の形態11を示す平面図であり、（b）は同じく実施の形態11を示す断面図である。図14（a）及び（b）において、リモコン60は、チャンネル番号を示す数字が表示されている表示部61と、該表示部61の特定の部分を光源（図示せず）によって照らすためのポインティングデバイス62とを備えている。

【0093】また、64は使用者がポインティング操作に用いるための操作板を示しており、該操作板64の表面中央付近には円柱状の突起物である操作つまみ63が設けられている。さらに操作板64の所定の位置にはレンズ65が備えられており、操作板64の下方に備えられた光源（図示せず）から発せられた光がレンズ65を通して表示部61の特定の部分を照らすようにしてある。

【0094】使用者は、操作つまみ63を用いて操作板64をスライド移動させることによって所望のチャンネル番号を示す数字が印刷された部分に光を照らす。

【0095】なお、図示していないが、上述した他の実施の形態と同様にして、複数の圧力センサ又は光学式2次元エンコーダ等の検出器を用いて操作つまみ63のスライド移動量及び移動方向を検出する。そしてこのスライド移動量及び移動方向に基づいて、使用者に対して触感作用をフィードバックすることができる。

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次元エンコーダ等の検出器を用いて操作つまみ63のスライド移動量及び移動方向を検出する。そしてこのスライド移動量及び移動方向に基づいて、使用者に対して触感作用をフィードバックする。

【0096】

【発明の効果】以上詳述した如く、本発明のポインティングデバイスによれば、操作部の移動量及び移動方向に応じた触感作用を使用者にフィードバックすることによって、ポインタが移動している場合に、あとどの程度操作すればポインタを所望の位置に到達させることができるのかを触覚にて確認することができる

【0097】また、2次元方向に移動可能な操作部を備え、使用者はこの操作部を用いてポインティング操作を行うことによって、細かなポインティング操作を行う場合であっても操作の安定性を確保することができる等、本発明は優れた効果を奏する。

【0098】(付記)なお、以上の説明に対してさらに以下の項を開示する。

(1) ポインティング操作を確定する確定手段を更に備えることを特徴とする請求項1乃至請求項3の何れかに記載のポインティングデバイス。

(2) 前記操作部は互いに摺動可能な複数の板及びストッパ部を有することを特徴とする請求項1乃至請求項3の何れかに記載のポインティングデバイス。

(3) 前記検出手段は一又は複数の圧力センサを有することを特徴とする請求項1乃至請求項3の何れかに記載のポインティングデバイス。

(4) 前記確定手段は反力を呈示する反力呈示手段を有し、該反力呈示手段は前記検出手段によって検出された操作部の移動量及び移動方向に応じて駆動すべくしてあることを特徴とする第(1)項に記載のポインティングデバイス。

(5) 前記操作部の位置を視覚的に呈示する視覚情報呈示手段を更に備えることを特徴とする請求項1乃至請求項3に記載のポインティングデバイス。

(6) 前記操作部は一又は複数の突起物及びマトリクス状に配された複数の凹部を有することを特徴とする請求項1乃至請求項3の何れかに記載のポインティングデバイス。

(7) 前記アクチュエータは電気粘性流体であることを特徴とする請求項2に記載のポインティングデバイス。

(8) 前記アクチュエータは超音波振動子であることを特徴とする請求項2に記載のポインティングデバイス。

(9) 前記アクチュエータは形状記憶合金であることを特徴とする請求項2に記載のポインティングデバイス。

(10) 前記第1抵抗付手段及び第2抵抗付手段は前記操作部を所定の位置に移動させる操作部移動手段を夫々有することを特徴とする請求項2に記載のポインティングデバイス。

【図面の簡単な説明】

【図1】本発明のポインティングデバイスの実施の形態1を備えた情報処理装置を示す外観図である。

【図2】情報処理装置の要部構成を示す機能ブロック図である。

【図3】本発明のポインティングデバイスの実施の形態1を示す断面図である。

【図4】本発明のポインティングデバイスの動作の流れを示すフローチャートである。

【図5】本発明のポインティングデバイスの実施の形態2を示す平面図及び断面図である。

【図6】本発明のポインティングデバイスの実施の形態3を示す平面図及び断面図である。

【図7】本発明のポインティングデバイスの実施の形態4を示す断面図である。

【図8】本発明のポインティングデバイスの実施の形態5を示す平面図及び断面図である。

【図9】本発明のポインティングデバイスの実施の形態6を示す断面図である。

【図10】本発明のポインティングデバイスの実施の形態7を示す断面図である。

【図11】本発明のポインティングデバイスの実施の形態8を示す断面図である。

【図12】本発明のポインティングデバイスの実施の形態9を示す断面図である。

【図13】本発明のポインティングデバイスの実施の形態10を示す平面図である。

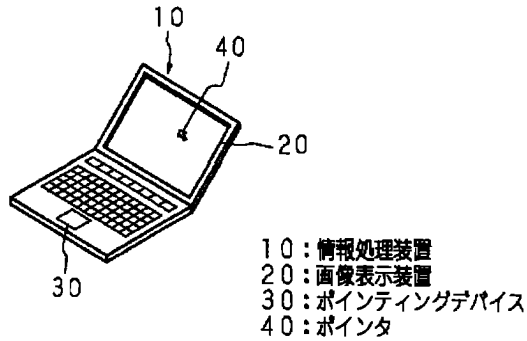
【図14】本発明のポインティングデバイスの実施の形態11を示す平面図及び断面図である。

【符号の説明】

- 100 ケース上部
- 101 ケース下部
- 102 操作板
- 103 操作つまみ
- 104 支持板
- 105 圧電バイモルフ素子

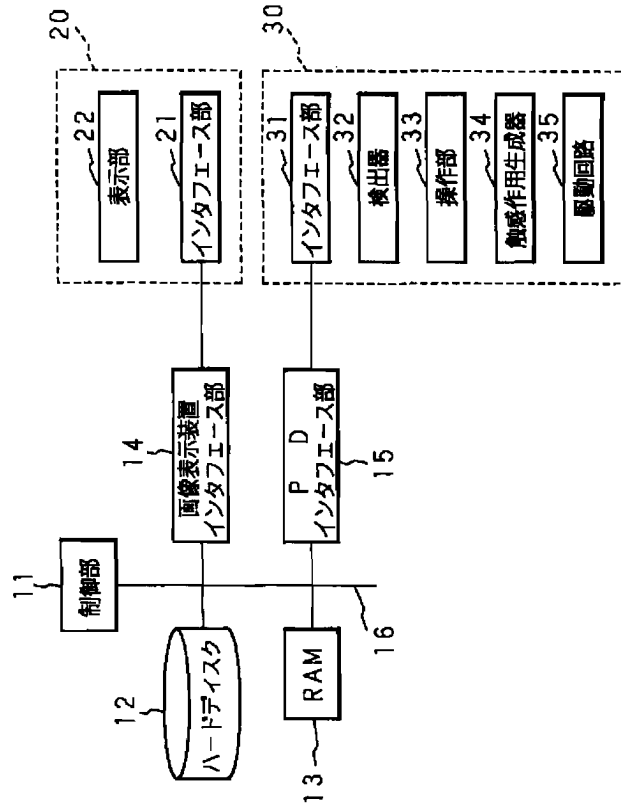
【図1】

本発明のポインティングデバイスの実施の形態1を備えた情報処理装置を示す外観図



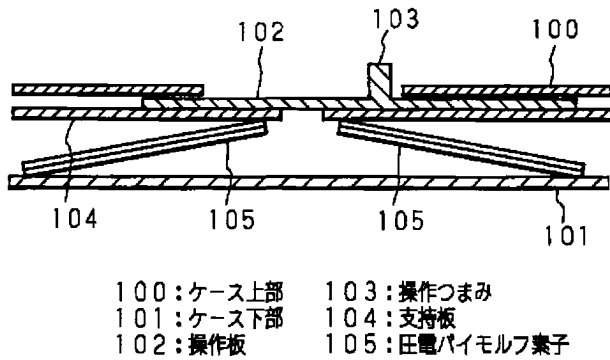
【図2】

情報処理装置の要部構成を示す機能ブロック図



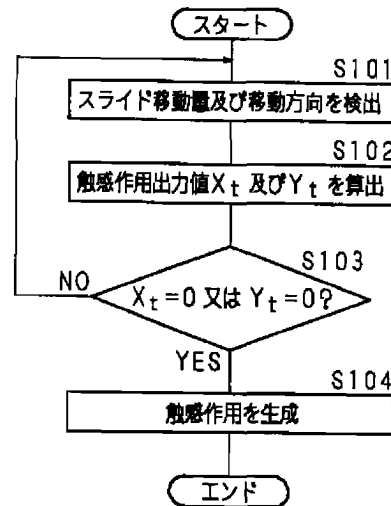
【図3】

本発明のポインティングデバイスの実施の形態1を示す断面図



【図4】

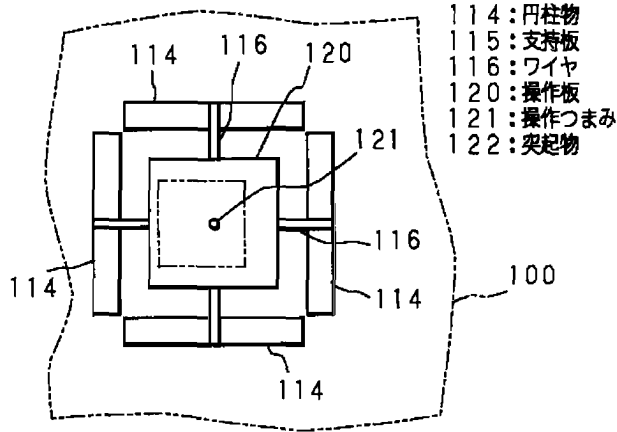
本発明のポインティングデバイスの動作の流れを示すフローチャート



【図5】

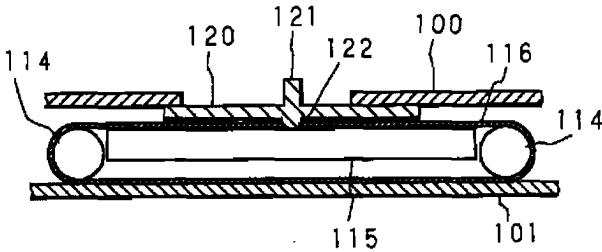
本発明のポインティングデバイスの実施の形態2を示す
平面図及び断面図

(a)



- 114: 円柱物
- 115: 支持板
- 116: フイヤ
- 120: 操作板
- 121: 操作つまみ
- 122: 突起物

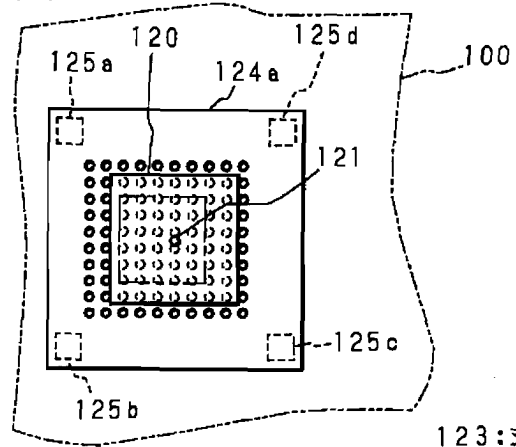
(b)



【図6】

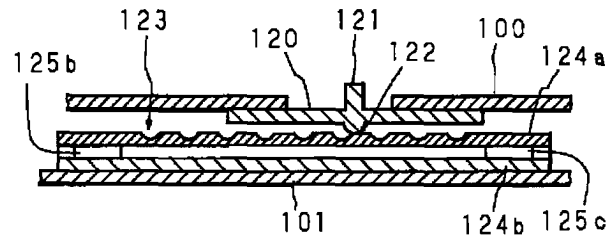
本発明のポインティングデバイスの実施の形態3を示す
平面図及び断面図

(a)



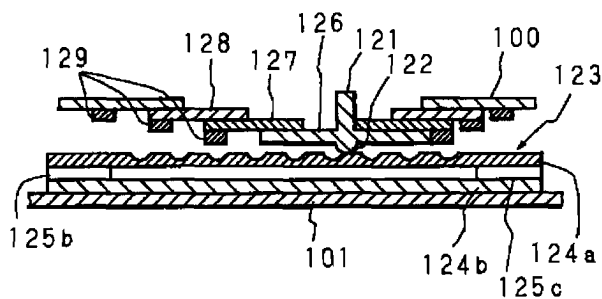
- 123: 支持板
- 124 a: 上挟板
- 124 b: 下挟板
- 125 a, 125 b, 125 c, 125 d: 圧力センサ

(b)



【図7】

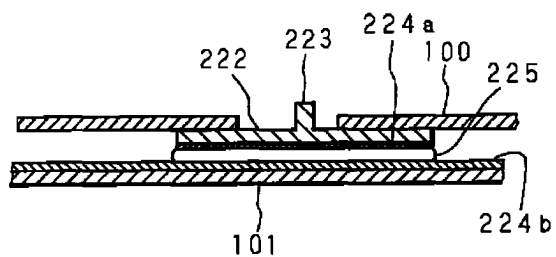
本発明のポインティングデバイスの実施の形態4を示す断面図



- 126: 第1操作板
- 127: 第2操作板
- 128: 第3操作板
- 129: ストッパ

【図9】

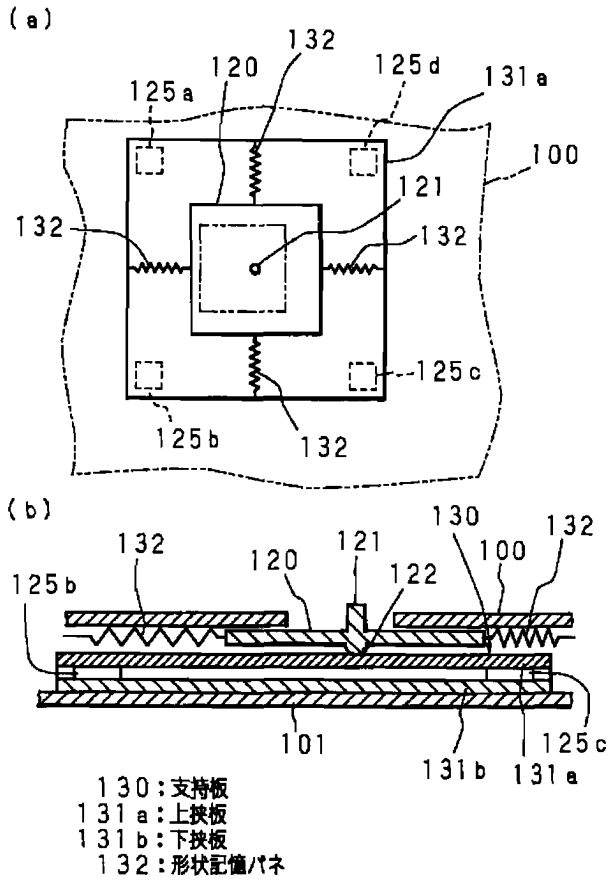
本発明のポインティングデバイスの実施の形態6を示す断面図



- 222: 操作板
- 223: 操作つまみ
- 224 a, 224 b: 電極板
- 225: 電気粘性流体

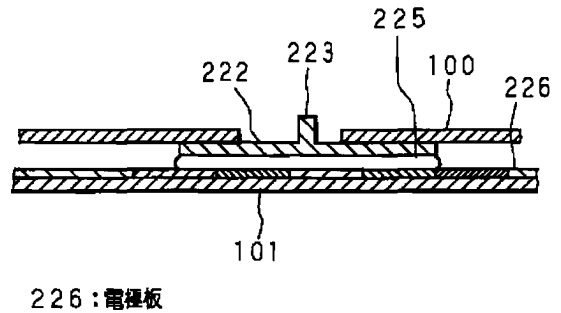
【図 8】

本発明のポインティングデバイスの実施の形態5を示す
平面図及び断面図



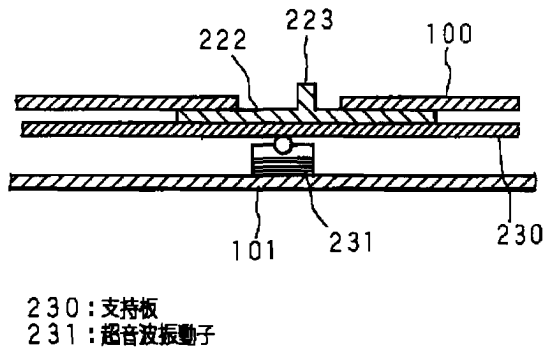
【図 10】

本発明のポインティングデバイスの実施の形態7を示す断面図



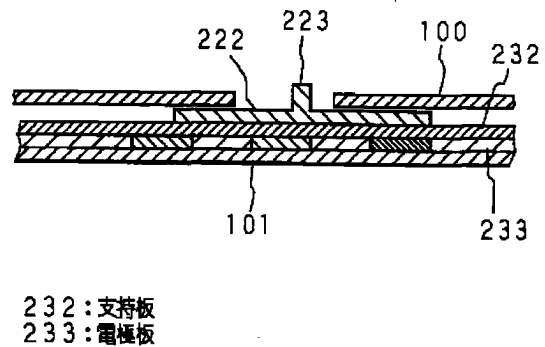
【図 11】

本発明のポインティングデバイスの実施の形態8を示す断面図



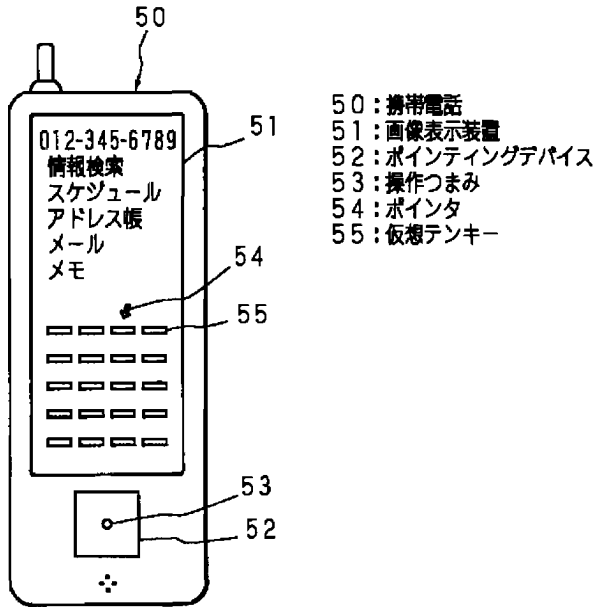
【図 12】

本発明のポインティングデバイスの実施の形態9を示す断面図



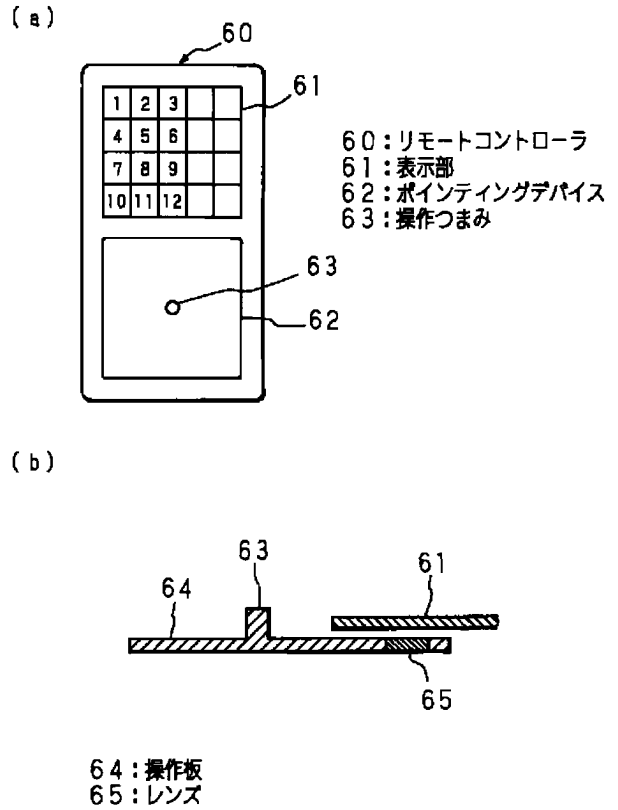
【図13】

本発明のポインティングデバイスの実施の形態10を備えた携帯電話を示す平面図



【図14】

本発明のポインティングデバイスの実施の形態11を示す平面図及び断面図



フロントページの続き

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 BC13 BC31 BC34 DD06 DE07
 5E501 AA02 AA04 AA11 AB03 AC37
 BA05 CA04 CB07 FA02

KEY SWITCH STRUCTURE AND PORTABLE EQUIPMENT USING THE SAME

Publication number: JP2001265485

Publication date: 2001-09-28

Inventor: SUGANUMA TOSHIO

Applicant: SHARP KK

Classification:

- international: **G06F3/02; G06F3/023; H01H13/64; H03M11/08;**
G06F3/02; G06F3/023; H01H13/50; H03M11/06; (IPC1-7): G06F3/02; G06F3/023; H01H13/64; H03M11/08

- European:

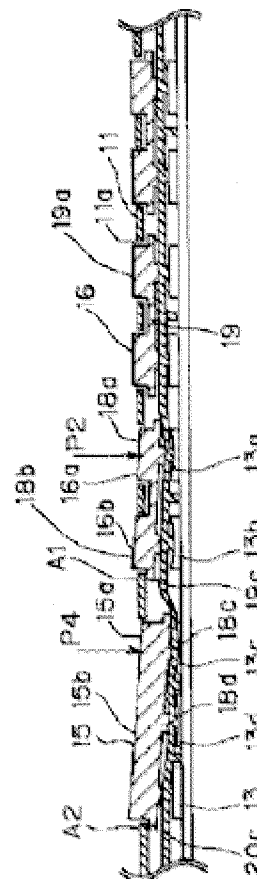
Application number: JP20000081816 20000317

Priority number(s): JP20000081816 20000317

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Abstract of JP2001265485

PROBLEM TO BE SOLVED: To provide an inexpensive and compact key switch structure capable of performing plural functions by the operation of one key switch in a simple structure and portable equipment. **SOLUTION:** This key structure is provided with adjacently arranged key switches 16a and 16b which are respectively provided with press button switches 13a and 13b arranged so as to be adjacent to each other and key tops 18a and 18b arranged at the upper parts of the button switches so as to be integrally formed and a flexible member 12 arranged between the press button switches 13a and 13b and the key tops 18a and 18b. In this case, the key switch 16a is depressed with a stronger pressurizing power P2 than an pressurizing power P1 with which the key switch 16a can be inputted so that the key switch 16b can be simultaneously inputted.



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(21) 出願番号 特願2000-81816 (P2000-81816)
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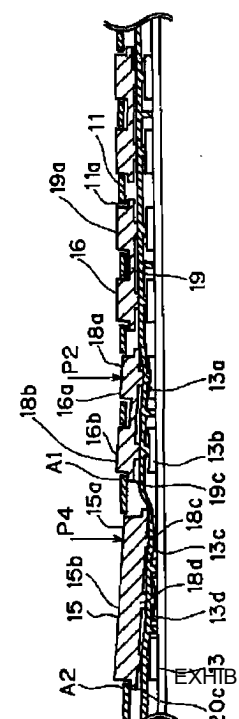
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Fターム (参考) 5B020 CC12 DD02 FF15 GG14 HH21
5G006 AZ09 CB04 CB05

(54) 【発明の名称】 キースイッチ構造及びそれを用いた携帯用機器

(57) 【要約】

【課題】 簡単な構造によって、一つのキースイッチの操作により複数の機能を実行することができ、低価格で小型化を図ることのできるキースイッチ構造及び携帯用機器を提供する。

【解決手段】 隣接して配される押ボタンスイッチ13 a、13 bと、ボタンスイッチのそれぞれ上方に配されて一体に形成されるキートップ18 a、18 bと、押ボタンスイッチ13 a、13 bとキートップ18 a、18 bとの間に設けられる可撓性の可撓性部材12とを有して、隣接して配されるキースイッチ16 a、16 bを備え、キースイッチ16 aを入力可能な押圧力P1よりも強い押圧力P2で押下することにより、キースイッチ16 bを同時に入力できるようにした。



【特許請求の範囲】

【請求項 1】 第 1 の押圧力で押下することにより入力できる第 1 キースイッチと、第 1 キースイッチと隣接して配される第 2 キースイッチとを備え、第 1 キースイッチを第 1 の押圧力よりも強い第 2 の押圧力で押下することにより、第 2 キースイッチを同時に入力できるようにしたことを特徴とするキースイッチ構造。

【請求項 2】 第 1 キースイッチは、第 1 押ボタンスイッチと、第 1 押ボタンスイッチの上方に配されて手指により押下できる第 1 キートップとを有し、第 2 キースイッチは、第 1 押ボタンスイッチと隣接して配される第 2 押ボタンスイッチと、第 2 押ボタンスイッチの上方に配される第 2 キートップとを有し、第 1 キートップと第 2 キートップとを一体に形成するとともに、第 1、第 2 押ボタンスイッチと第 1、第 2 キートップとの間に可撓性の可撓性部材を設けたことを特徴とする請求項 1 に記載のキースイッチ構造。

【請求項 3】 請求項 1 または請求項 2 に記載のキースイッチ構造を備え、第 1 キースイッチを単独で入力したときと、第 1、第 2 キースイッチを同時に入力したときとで、異なる機能を実行できるようにしたことを特徴とする携帯用機器。

【請求項 4】 複数の項目を表示できる表示部を備え、第 1 キースイッチを単独で入力したときに前記表示部に表示された項目を順にカーソル移動し、第 1、第 2 キースイッチを同時に入力したときに、カーソル位置の項目の選択決定、カーソル位置の項目に対応する機能の実行またはカーソル位置の項目の消去を行うようにしたことを特徴とする請求項 3 に記載の携帯用機器。

【請求項 5】 通信を行う通信部と、情報を記憶する記憶部と、前記記憶部に記憶された電話番号を表示できる表示部とを備え、第 1 キースイッチを単独で入力したときに前記表示部に表示された電話番号を順にカーソル移動し、第 1、第 2 キースイッチを同時に入力したときに、前記通信部によりカーソル位置の電話番号を発信することを特徴とする請求項 3 に記載の携帯用機器。

【請求項 6】 表示画面に情報表示を行う表示部を備え、第 1 キースイッチを単独で入力したときに前記表示画面を所定の速度でスクロールし、第 1、第 2 キースイッチを同時に入力したときに前記表示画面をスクロールする速度を可変したことを特徴とする請求項 3 に記載の携帯用機器。

【請求項 7】 入力された文字を表示する表示部を備え、第 1 キースイッチを単独で入力したときに所定の文字を入力し、第 1、第 2 キースイッチを同時に入力したときに入力した文字を変換できるようにしたことを特徴とする請求項 3 に記載の携帯用機器。

【請求項 8】 請求項 1 または請求項 2 に記載のキースイッチ構造を備え、第 1 キースイッチを単独で入力したときに機能が実行されず、第 1、第 2 キースイッチを同

時に入力したときに所定の機能を実行できるようにしたことを特徴とする携帯用機器。

【発明の詳細な説明】

【0001】

【発明の属する技術分野】本発明は、押下により入力可能なキースイッチ構造及びそれを用いた携帯電話機等の携帯用機器に関する。

【0002】

【従来の技術】OA機器のキーボード等に設けられる複数のキースイッチを有するキースイッチ構造は、接点と電極とを有する押ボタンスイッチの上方に配されたキートップを押下することにより入力可能になっている。通常一つのキースイッチの入力により、所定の文字の入力や、カーソル移動等の割り当てられた一つの機能が実行されるようになっている。

【0003】このようなキースイッチ構造を携帯電話機等の携帯用機器に搭載すると、多くの機能を実行するために多くのキースイッチを設ける必要があり、携帯用機器が大型になって携帯性が損なわれる問題がある。

【0004】このため、限られたスペースで多くの機能を実行できるキースイッチ構造が種々提案されている。特開平8-2640969号公報に開示されたキートップ構造は、複数の接点に対して階段状に配される複数の電極が一つのキートップで覆われている。そして、キートップの押下量に応じて導通する接点の数により、カーソルの移動速度を可変できるようになっている。

【0005】

【発明が解決しようとする課題】しかしながら、上記の従来のキートップ構造によると、一つのキースイッチに対して複数の接点と電極とを設ける必要があり、部品点数が多く構造が複雑になるためコストが増大する問題がある。

【0006】本発明は、簡単な構造によって、一つのキースイッチの操作により複数の機能を実行することができ、低価格で小型化を図ることのできるキースイッチ構造及び携帯用機器を提供することを目的とする。

【0007】

【課題を解決するための手段】上記目的を達成するために本発明のキースイッチ構造は、第 1 の押圧力で押下することにより入力できる第 1 キースイッチと、第 1 キースイッチと隣接して配される第 2 キースイッチとを備え、第 1 キースイッチを第 1 の押圧力よりも強い第 2 の押圧力で押下することにより、第 2 キースイッチを同時に入力できるようにしたことを特徴としている。

【0008】この構成によると、第 1 の押圧力で第 1 キースイッチを押下すると第 1 キースイッチが入力され、第 1 の押圧力よりも強い第 2 の押圧力で第 1 キースイッチを押下すると第 1 キースイッチと第 2 キースイッチが同時に入力される。

【0009】また本発明は、上記構成のキースイッチ構

造において、第1キースイッチは、第1押ボタンスイッチと、第1押ボタンスイッチの上方に配されて手指により押下できる第1キートップとを有し、第2キースイッチは、第1押ボタンスイッチと隣接して配される第2押ボタンスイッチと、第2押ボタンスイッチの上方に配される第2キートップとを有し、第1キートップと第2キートップとを一体に形成するとともに、第1、第2押ボタンスイッチと第1、第2キートップとの間に可撓性の可撓性部材を設けたことを特徴としている。

【0010】この構成によると、第1の押圧力で第1キートップを押下すると、可撓性部材を介して第1押ボタンスイッチがONになる。これにより第1キースイッチの入力が完了する。第1の押圧力よりも強い第2の押圧力で第1キートップを押下すると、可撓性部材が圧縮されて第2キートップが下降し、可撓性部材を介して第1キースイッチと第2キースイッチが同時に入力される。ここで、可撓性部材は、第1、第2キートップの下方に夫々分割して形成してもよいし、一体に形成してもよい。また、第2キートップは手指により押下できるようにしてもよいし、押下できないように形成してもよい。

【0011】また本発明の携帯用機器は、上記構成のキースイッチ構造を備え、第1キースイッチをキースイッチを単独で入力したときと、第1、第2キースイッチを同時に入力したときとで、異なる機能を実行できるようにしたことを特徴としている。この構成によると、第1の押圧力で第1キースイッチを押下するときと、第1の押圧力よりも強い第2の押圧力で第1キースイッチを押下するときとで異なる機能が実行される。

【0012】また本発明は、上記構成の携帯用機器において、複数の項目を表示できる表示部を備え、第1キースイッチを単独で入力したときに前記表示部に表示された項目を順にカーソル移動し、第1、第2キースイッチを同時に入力したときに、カーソル位置の項目の選択決定、カーソル位置の項目に対応する機能の実行またはカーソル位置の項目の消去を行うようにしたことを特徴としている。

【0013】この構成によると、第1の押圧力で第1キースイッチを押下すると、表示部に表示された機能やデータ等の項目を順にカーソル移動して選択し、第1の押圧力よりも強い第2の押圧力で第1キースイッチを押下すると、カーソル位置の選択中の項目の選択決定、カーソル位置の選択中の項目に対応する機能の実行またはカーソル位置の選択中の項目の消去が行われる。

【0014】また本発明は、上記構成の携帯用機器において、通信を行う通信部と、情報を記憶する記憶部と、前記記憶部に記憶された電話番号を表示できる表示部とを備え、第1キースイッチを単独で入力したときに前記表示部に表示された電話番号を順にカーソル移動し、第1、第2キースイッチを同時に入力したときに、前記通信部によりカーソル位置の電話番号を発信することを特

徴としている。

【0015】この構成によると、第1の押圧力で第1キースイッチを押下すると、表示部に表示された電話番号を順にカーソル移動して選択し、第1の押圧力よりも強い第2の押圧力で第1キースイッチを押下すると、カーソル位置の選択中の電話番号が発信される。

【0016】また本発明は、上記構成の携帯用機器において、表示画面に情報表示を行う表示部を備え、第1キースイッチを単独で入力したときに前記表示画面を所定の速度でスクロールし、第1、第2キースイッチを同時に入力したときに前記表示画面をスクロールする速度を変化したことを特徴としている。この構成によると、第1の押圧力で第1キースイッチを押下すると、表示画面が例えば低速でスクロールされ、第1の押圧力よりも強い第2の押圧力で第1キースイッチを押下すると、表示画面が高速でスクロールされる。

【0017】また本発明は、上記構成の携帯用機器において、入力された文字を表示する表示部を備え、第1キースイッチを単独で入力したときに所定の文字を入力し、第1、第2キースイッチを同時に入力したときに入力した文字を変換できるようにしたことを特徴としている。この構成によると、第1の押圧力で第1キースイッチを押下すると、所定の文字が入力されて表示部に表示され、第1の押圧力よりも強い第2の押圧力で第1キースイッチを押下すると、入力した表示中の文字が大文字、小文字、漢字等に変換される。

【0018】また本発明の携帯用機器は、上記構成のキースイッチ構造を備え、第1キースイッチを単独で入力したときに機能が実行されず、第1、第2キースイッチを同時に入力したときに所定の機能を実行できるようにしたことを特徴としている。この構成によると、第1の押圧力で第1キースイッチを押下しても何も動作が行われず、第1の押圧力よりも強い第2の押圧力で第1キースイッチを押下すると、電源ONやマナーモード設定等の所定の機能が実行される。

【0019】

【発明の実施の形態】以下に本発明の実施形態を図面を参照して説明する。図1は一実施形態の携帯電話機の構成を示すブロック図である。携帯電話機は、マイクロコンピュータから成る制御部1により各部の制御が行われる。電源部5は制御部1の制御により各部に電圧を供給する。

【0020】キースイッチ部2は、複数のキースイッチ17を有し、十字キー15や、数値キー、電源キー、通話キー、機能キー等の入力キー16から成っている。十字キー15は、後述する液晶表示部4に表示される項目間を上下左右にカーソルを移動させるカーソル移動キー15aと、中央に配される選択決定キー15bにより選択を決定し、表示項目を順にカーソル移動させるカーソル移動キー15cにより選択を決定

できるようになっている。

【0021】数値キーは電話番号等を入力することができる。また、所定のキースイッチ17の操作により文字を入力できる文字キーとして機能させることができる。これにより電話帳に記憶する相手先の氏名の入力や、電子メールの作成等を行うことができるようになっている。

【0022】電源キーは、携帯電話機の電源のON、OFFを行う。通話キーは相手先の電話番号を入力または選択した後、押下することにより発信することができる。とともに、着信時に押下することで通話可能となる。機能キーは携帯電話機に搭載される種々の機能を出発させることができるようになっている。また、これらのキースイッチ17は使用の状況によって異なる機能を実行できるようになっている。各キースイッチ17の操作は制御部1に設けられたキーマトリックス部3によって判別される。

【0023】液晶パネルからなる液晶表示部4は携帯電話機の動作状況に応じて所定の画像を表示する。キースイッチ部2のキースイッチ17の入力があると、入力された電話番号等の内容を表示し、着信時には発信元の電話番号を表示する。また、後述するように、メモリ10に記憶された電話番号や機能の一覧表示を行う。

【0024】キースイッチ部2により入力される電話番号や相手先の名前等は、所定の操作によりメモリ10に記憶することができる。メモリ10に記憶された情報は所望の時期に呼出して液晶表示部4に表示し、表示された内容をキースイッチ部2のカーソル移動キー15aにより選択して発信することができ、これにより電話帳機能が構成されている。また、メモリ10は制御部1により実行されるプログラムの記憶や、制御部1による演算の一時記憶を行うことができる。

【0025】アンテナ（不図示）を有するRF部6は制御部1に接続され、制御部1の制御によって音声信号の送信と受信とを行うようになっている。音声処理部はマイク7により捉えられた音声を音声信号に変換するとともに、RF部6により受信した音声信号を変換してスピーカ8から出力する。また、スピーカ8はRF部6により受信信号が受信されると着信音を報知する。

【0026】上記構成の携帯電話機において、相手先の電話番号をキースイッチ部2の数値キーの操作により入力すると、電話番号が液晶表示部4に表示され、通話キーを押下することにより発信される。そして、RF部6により送受信を行い、マイク7とスピーカ8とによって音声による通話ができるようになっている。電話を受信した際には、着信音がスピーカ8から報知され、キースイッチ部2に設けられた通話キーを押下することにより通話が行われる。

【0027】キースイッチ部2の断面は図2に示すようになっている。プリント基板14上には接点と電極とを

有する複数の押ボタンスイッチ13が配列されている。押ボタンスイッチ13の上面には合成ゴムや軟質樹脂等から成る可撓性の可撓性部材12が配されている。可撓性部材12にはそれぞれの押ボタンスイッチ13に対峙する突起部12aが形成されている。

【0028】可撓性部材12の上方には、それぞれの押ボタンスイッチ13と対をなす複数のキートップ18が配されている。キートップ18は硬質樹脂等から成り、同図に示すように、入力キー16の場合は、隣接する2つのキートップ18が一体に成形されたキートップ部材19から成っており、十字キー15の場合は十字に並ぶ5つ（図1参照）のキートップ18が一体に成形されたキートップ部材20から成っている。

【0029】キートップ部材19、20は、押下部19a、20aと鏝部19b、20bとを有しており、キースイッチ部2は、押下部19a、20aが挿通される複数の孔部11aを有したキャビネット11によって覆われている。これにより、キースイッチ部2の表面に各キートップ18が突出して操作可能となり、鏝部19b、20bによってキートップ18の脱落が防止されている。

【0030】図3に示すように、入力キー16aのキートップ18aを押圧力P1により押下すると、その下方の可撓性部材12が撓み、可撓性部材12を介して押ボタンスイッチ13aが押下される。これにより、押ボタンスイッチ13aの接点と電極とが導通し、キーマトリックス3（図1参照）により入力キー16aが入力されたことを検知する。

【0031】入力キー16aのキートップ18aを押圧力P1よりも強い押圧力P2により押下すると、図4に示すように、可撓性部材12が更に圧縮されて押ボタンスイッチ13aが押下される。この時、キートップ部材19は押圧力P2によって中央よりも図中、右側に偏った位置を押圧されるので、キートップ部材19の左側の端部19cには、上昇力が働く。尚、可撓性部材12は押ボタンスイッチ13a、13b毎に分割されていても同様に作用する。

【0032】しかし、端部19cの鏝部19bとキャビネット11のA1部分とが当接するため、キートップ部材19の端部19cの上昇が規制される。このため、キートップ部材19はA1を支点に図中、右下がりに傾斜する。これにより、キートップ18aの下方の可撓性部材12の圧縮に伴って、キートップ18bが下降し、可撓性部材12を介して押しボタンスイッチ13bが押下される。

【0033】そして、押ボタンスイッチ13bの接点と電極とが導通して、キーマトリックス3（図1参照）により入力キー16bが入力されたことを検知する。また、同様に、入力キー16bを押圧力P1で押下すると

押ボタンスイッチ13bがONになり、入力キー16bを押圧力P2で押下すると押ボタンスイッチ13a、13bが同時にONになる。

【0034】これにより、入力キー16a、16bを単独で入力した場合と両方を同時に入力した場合とで異なる機能を実行するように割り当てておくことによって、入力キーを押圧力P1で押下したときと押圧力P2で押下したときとで異なる機能を実行させることができる。

【0035】次に、入力キー16a、16bを文字キーとして使用する場合の動作を図5のフローチャートを用いて説明する。所定のキースイッチ17の操作により文字入力モードになると、「文字入力処理」のフローチャートが呼出される。ステップ#141では文字キーの入力があるまで待機する。

【0036】文字キーとして機能する入力キー16aが押圧力P1で押下されると、キーマトリックス3で入力されたキースイッチを判別し、ステップ#142で入力キー16aに対応する文字がひらがなまたはカタカナで液晶表示部4に表示される。

【0037】ステップ#143では入力キー16aと入力キー16bとが同時に入力されているか否かを判断し、同時に入力されていない場合は、ステップ#141に戻って次の文字キーの入力を待機する。他の文字キーが押圧力P1で押圧されることにより液晶表示部4に文字が順に表示される。この時、並んで表示されるひらがなまたはカタカナは反転表示等を行って変換前であることを使用者が判別できるようになっている。

【0038】次に、例えば入力キー16aが押圧力P2で押下されると、ステップ#143でキーマトリックス3により入力キー16aと入力キー16bとが同時に入力されていることを判断し、液晶表示部4に並んで表示されたひらがなまたはカタカナを漢字変換する。そして、変換の候補文字をカーソル移動キー15a等で選択して確定することにより所望の漢字による表示が行われる。尚、変換の候補文字には、ひらがなやカタカナのままの状態も含まれている。

【0039】これにより、漢字変換用キーを別途設けて、これを押下しなくても漢字変換状態にすることができ、操作が簡素化されて操作性が向上する。また、アルファベットによる文字入力の際には、キースイッチを押圧力P2で押下することによって、隣接するキースイッチが同時に入力されたことをキーマトリックス3により判別し、アルファベットを小文字から大文字または大文字から小文字に変換させることもできる。

【0040】次に、電源キーの動作を図6のフローチャートを参照して説明する。ここで、電源キーは入力キー16aに割り当てられているものとする。まずステップ#181では、電源キー(入力キー16a)が入力されたことを検知するまで待機する。入力キー16aが押下されて入力を検知すると、ステップ#182に移行し、

隣接する入力キー16bが同時に入力されているか否かが判別される。

【0041】入力キー16aが押圧力P1で押下されている場合は、入力キー16bは押下されていないので、ステップ#181に戻ってステップ#181、#182の判別処理が繰り返される。入力キー16aが押圧力P2で押下されると、入力キー16bが同時に入力され、ステップ#183に移行して電源がONされる。

【0042】これにより、電源キーを強く押下したときのみ電源を入れることができるため、電源キーに不用意に接触した際に電源がONとならず、バッテリーの浪費を防止することができる。同様に、電源が入っている際には同一の操作によって電源をOFFにすることができ、着信待ちの際に不用意に電源OFFとなることを防止できる。

【0043】尚、入力キー16bのキートップ18bはキャビネット11から露出している。従って、入力キー16bを押圧力P1で押下して他の機能を実行することができ、入力キー16bを押圧力P2で押下すると、同時に入力キー16aが入力されて電源をON、OFFすることができる。

【0044】これによって、操作するキーを迷って使用者の混乱を招く場合には、入力キー16bのキートップ18bはキャビネット11で覆っても良い。このようにすると、キートップ18bは露出しないので、使用者が入力キー16bを押下することができず、誤認を防止することができる。

【0045】また、電源キーの場合と同様に、入力キー16aにマナーキーを割り当ててもよい。マナーキーは、着信音を報知せず振動等によって着信を使用者に知らせるマナーモードの切り替えを行う。このようにすると、入力キー16aを押圧力P1で押下した場合には何も機能を実行せず、入力キー16aを押圧力P2で押下した場合に、マナーモードの設定、解除を実行することもできる。これにより、マナーモードの設定、解除が使用者の意図に反して不用意に行われない。

【0046】また同様に、入力キー16aに録音キーを割り当て、入力キー16aを押圧力P1で押下した場合には何も機能を実行せず、入力キー16aを押圧力P2で押下した場合に、マイク7で捉えた音声をメモリ10に録音させるようにしてもよい。これにより、録音の開始が使用者の意図に反して不用意に行われず、電力浪費防止を図ることができる。

【0047】前述の図3において、十字キー15のカーソル移動キー15aのキートップ18cを押圧力P3により押下すると、その下方の可撓性部材12が撓み、可撓性部材12を介して押ボタンスイッチ13cが押下される。これにより、押ボタンスイッチ13cが導通し、キーマトリックス3により入力キー15aが入力されたことを検知する。

【0048】カーソル移動キー15aのキートップ18cを押圧力P3よりも強い押圧力P4により押下すると、図4に示すように、可撓性部材12が更に圧縮されて、押ボタンスイッチ13cが押下される。この時、キートップ部材20は押圧力P4によって中央よりも図中、右側に偏った位置を押圧されるので、キートップ部材20の左側の端部20cには上昇力が働く。

【0049】しかし、端部20cの鏝部20bとキャビネット11のA2部分とが当接するため、キートップ部材20の端部20cの上昇が規制される。このため、キートップ部材20はA2を支点に図中、右下がりに傾斜する。これにより、キートップ18cの下方の可撓性部材12の圧縮に伴ってキートップ18dが下降し、可撓性部材12を介して押ボタンスイッチ13dが押下される。

【0050】そして、押ボタンスイッチ13dの接点と電極とが導通し、キーマトリックス3（図1参照）により選択決定キー15bが入力されたことを検知する。従って、カーソル移動キー15aと選択決定キー15bとが同時に入力される。

【0051】この時の動作を図7の「選択決定処理」のフローチャートを参照して説明する。例えば、機能キーを押下することにより「選択決定処理」が呼出され、ステップ#101で、液晶表示部4に実行可能な機能が表示される。ステップ#102ではカーソル移動キー15aの入力があるまで待機する。

【0052】カーソル移動キー15aが押下されてキーマトリックス3によりカーソル移動キー15aの入力を検知すると、ステップ#103に移行して所定の方向へカーソルが移動する。続いてステップ#104で隣接する選択決定キー15bが同時に入力されているか否かが判別される。

【0053】カーソル移動キー15aが押圧力P3で押下されている場合は、選択決定キー15bは押下されていないので、ステップ#102に戻ってステップ#102、#103によりカーソル移動が繰り返される。カーソル移動キー15aが押圧力P4で押下されると、選択決定キー15bが同時に入力され、ステップ#105に移行してカーソル位置にある選択中の項目が選択決定される。そして、選択決定した項目の下層の項目が液晶表示部4に表示され、同様の操作によって選択決定する。

【0054】これにより、カーソル移動キー15aを押圧力P3で押下するとカーソルが移動し、カーソル移動キー15aを押圧力P4で押下することにより、選択決定キー15bを単独で押下した場合と同様に、カーソル位置の項目を選択決定することができる。従って、表示される項目を同じキーで順にカーソル移動し、そのまま手指を離さずに強く押下することで項目の決定ができるので、携帯電話機の操作性を向上させることができる。

【0055】また、機能やデータの項目が表示された状

態で、カーソル移動キー15aを押圧力P3で押下して順にカーソル移動し、押圧力P4で押下した場合に、カーソル位置の項目の実行や、データの消去を行うようにしても良い。このようにしても同様に、カーソル移動キー15aから手指を離さずに機能の実行やデータ消去を行うことができ、携帯電話機の操作性を向上させることができる。

【0056】次に図8は、電話帳機能により呼出した相手先の電話番号を発信する発信処理のフローチャートである。電話帳機能を出すと、ステップ#121でメモリ10に記憶された氏名及び電話番号が液晶表示部4に一覧表示される。ステップ#122ではカーソル移動キー15aの入力があるまで待機する。

【0057】カーソル移動キー15aが押下されてキーマトリックス3によりカーソル移動キー15aの入力を検知すると、ステップ#123に移行して所定の方向へカーソルが移動する。続いてステップ#124で隣接する選択決定キー15bが同時に入力されているか否かが判別される。

【0058】カーソル移動キー15aが押圧力P3で押下されている場合は、選択決定キー15bは押下されていないので、ステップ#122に戻ってステップ#122、#123によりカーソル移動が繰り返される。カーソル移動キー15aが押圧力P4で押下されると、選択決定キー15bが同時に入力され、ステップ#125に移行し、カーソル位置の相手先の電話番号に発信される。

【0059】これにより、カーソル移動キー15aを押圧力P3で押下するとカーソルが移動し、カーソル移動キー15aを押圧力P4で押下することにより発信できる。従って、表示される電話番号を同じキーで順にカーソル移動し、そのまま手指を離さずに強く押下することで発信できるので、携帯電話機の操作性を向上させることができる。

【0060】次にデータや機能等を閲覧する閲覧モードの場合には、液晶表示部4にカーソルが表示されず、カーソル移動キー15aは液晶表示部4の表示画面をスクロールさせるようになっている。画面スクロールの動作を図9の「画面スクロール処理」のフローチャートを参照して説明する。

【0061】まず、ステップ#161では、閲覧モードになると液晶表示部4にデータや機能等の情報が表示される。ステップ#162ではカーソル移動キー15aの入力があるまで待機する。カーソル移動キー15aが押下されてキーマトリックス3によりカーソル移動キー15aの入力を検知すると、ステップ#163に移行して所定の方向へ表示画面を1行分または列方向に所定量スクロールする。

【0062】続いて、ステップ#164で、カーソル移動キー15aが押されたままであるか否かが判断される。

カーソル移動キー15aが所定時間より短い期間でOFFとなった場合は、ステップ#162に戻ってカーソル移動キー15aの入力を待機する。カーソル移動キー15aが所定時間以上、押し続けられていた場合には、ステップ#165で表示画面が低速でスクロールされる。

【0063】そして、ステップ#166でカーソル移動キー15aが押し続けられているか否かが判断され、カーソル移動キー15aがOFFになっている場合はステップ#162に戻ってカーソル移動キー15aの入力を待機する。カーソル移動キー15aが更に押し続けられて

いる場合には、ステップ#167で隣接する選択決定キー15bが同時に入力されているか否かが判別される。

【0064】カーソル移動キー15aが押圧力P3で押下されている場合は、選択決定キー15bは押下されていないので、ステップ#165に戻って表示画面の低速によるスクロールが繰り返される。カーソル移動キー15aが押圧力P4で押下されると、選択決定キー15bが同時に入力され、ステップ#168に移行して表示画面が高速でスクロールされる。

【0065】ステップ#169では、選択決定キー15bがOFFになっているか否かが判断され、ONの状態であればステップ#168に戻って表示画面の高速によるスクロールが繰り返される。選択決定キー15bがOFFになった場合は、ステップ#165に戻って低速スクロールに切り換え、カーソル移動キー15aがOFFになったことをステップ#166で検出すると、ステップ#162に戻って待機する。そして、所定のキースイッチによる割込みがあると閲覧モードが終了するようになっている。

【0066】これにより、カーソル移動キー15aを押圧力P3で押し続けると低速で画面がスクロールし、カーソル移動キー15aを押圧力P4で押し続けることにより、高速で画面をスクロールさせることができる。従って、表示される情報を同じキースイッチにより速度を変えてスクロールできるので、閲覧時の操作性を向上させることができる。

【0067】以上の説明において、キースイッチ部2を携帯電話機に搭載した場合を例に説明したが、これに限られず、同様の構造のキースイッチ17を電子手帳、電子辞書、ヘッドホンステレオ、リモートコントローラー等の他の携帯用機器に搭載することができる。これにより、簡単な構造で限られたスペース内に配されるキースイッチ17により、多くの機能を実行させるとともに、携帯用機器の操作性を向上させることが可能となる。

【0068】

【発明の効果】本発明によると、キースイッチを押下する押圧力に応じて隣接するキースイッチをONにして、同一のキースイッチの操作により異なる機能を実行させ

ることができ、キースイッチ構造の低価格化及び省スペース化を図ることができる。また、隣接するキーのキートップを一体化してキートップと押ボタンスイッチとの間に可撓性部材を配してキースイッチ構造を構成することにより、部品点数を削減して簡単に隣接するキースイッチをONさせることができる。

【0069】また本発明によると、カーソル移動させるキースイッチを強く押下することによりカーソル位置の選択項目の決定、消去、実行や選択した電話番号の発信を行うので、手指を離すことなく同じキースイッチの操作により所定の動作をすることができ、携帯用機器の操作性が向上する。

【0070】また本発明によると、画面スクロールさせるキースイッチの押下の強弱によってスクロールの速度を変えられるので、携帯用機器の閲覧時の操作性を向上させることができる。

【0071】また本発明によると、文字入力を行うキースイッチを強く押下することにより、変換前の入力文字を大文字、小文字、漢字等に変換することができるので、変換用キーを別途設けて、これを押下しなくても変換することができ、操作が簡素化されて操作性が向上する。

【0072】また本発明によると、所定のキースイッチを強く押下して隣接するキースイッチが同時にONになったときのみ所定の動作を行うので、キースイッチに不用意に接触して電源ON等の設定が変更されてしまうことを防止することができる。

【図面の簡単な説明】

【図1】 本発明の実施形態の携帯電話機の構成を示すブロック図である。

【図2】 本発明の実施形態のキースイッチ構造を示す断面図である。

【図3】 本発明の実施形態のキースイッチ構造のキースイッチの入力動作を説明する断面図である。

【図4】 本発明の実施形態のキースイッチ構造のキースイッチの入力動作を説明する断面図である。

【図5】 本発明の実施形態の携帯電話機の文字入力処理を示すフローチャートである。

【図6】 本発明の実施形態の携帯電話機の開始処理を示すフローチャートである。

【図7】 本発明の実施形態の携帯電話機を選択決定処理を示すフローチャートである。

【図8】 本発明の実施形態の携帯電話機の発信処理を示すフローチャートである。

【図9】 本発明の実施形態の携帯電話機の画面スクロール処理を示すフローチャートである。

【符号の説明】

- 1 制御部
- 2 キースイッチ部
- 3 キーマトリックス

13

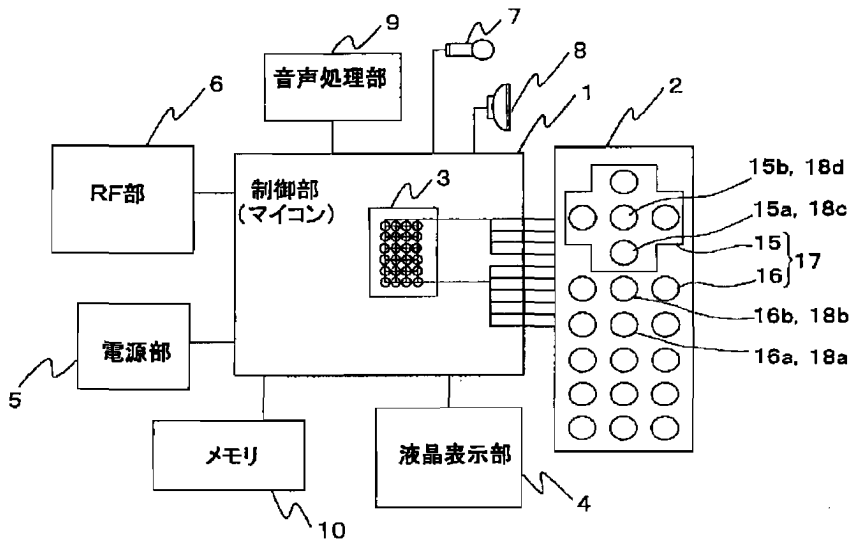
14

- 4 液晶表示部
- 5 電源部
- 6 RF部
- 7 マイク
- 8 スピーカ
- 9 音声処理部
- 10 メモリ
- 11 キャビネット
- 12 可撓性部材

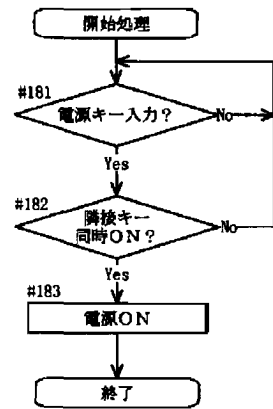
- * 13、13a~13d 押ボタンスイッチ
- 14 プリント基板
- 15 十字キー
- 15a カーソル移動キー
- 15b 選択決定キー
- 16、16a、16b 入力キー
- 18、18a~18d キートップ
- 19、20 キートップ部材

*

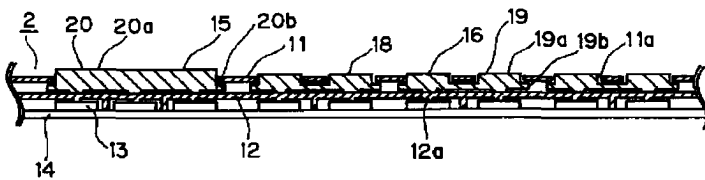
【図1】



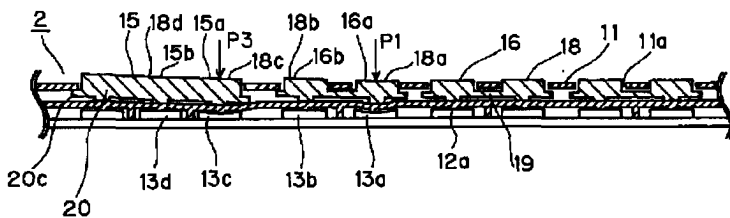
【図6】



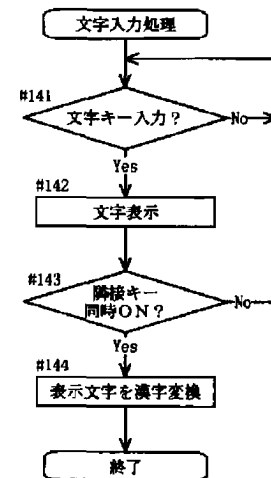
【図2】



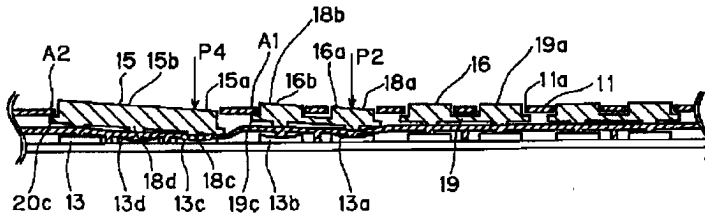
【図3】



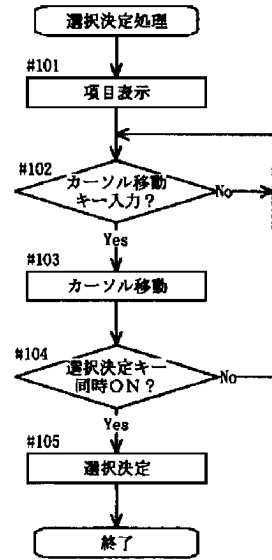
【図5】



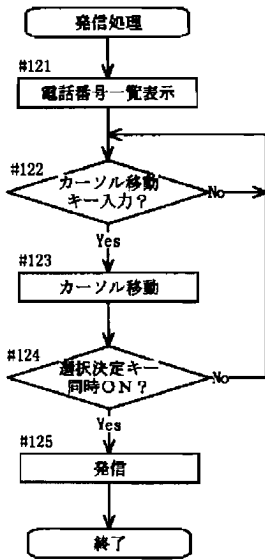
【図4】



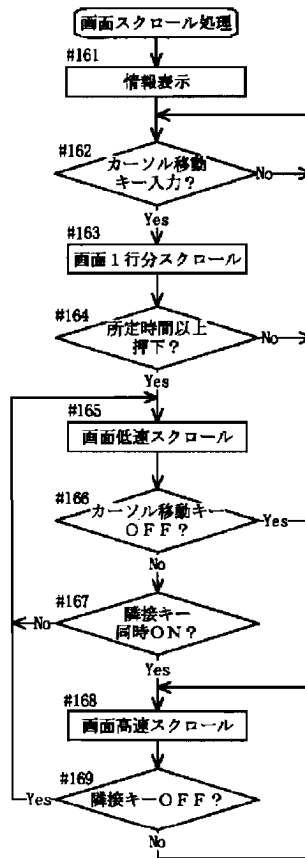
【図7】



【図8】



【図9】



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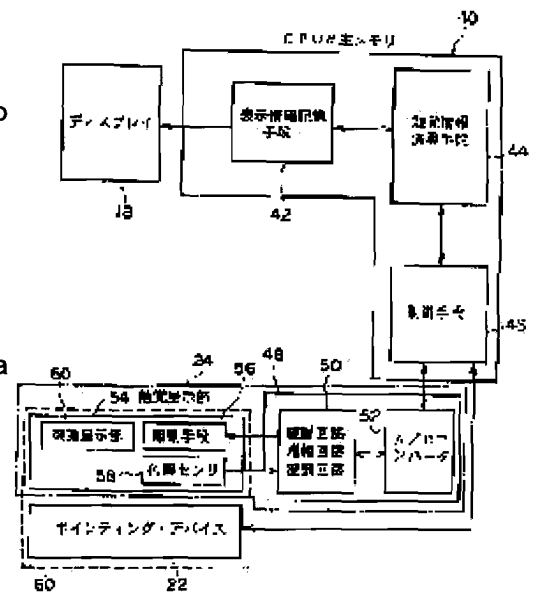
(72)Inventor : SAKAMAKI KATSUMI

(54) INFORMATION PROCESSOR

(57)Abstract:

PROBLEM TO BE SOLVED: To provide an information processor which can present information on the sense of touch according to color attribute information of an image.

SOLUTION: To present the information on the sense of touch to an operator, a sense-of-touch information arithmetic means 4 performs operation based upon color attribute information included in display information obtained from a display information storage means 42 and outputs a control signal to a control means 46 in sequence. The control means 46 receives the control signal from the arithmetic means 44 and outputs a driving signal, generated by computing a displacement quantity, a vibration frequency, or a control gain to be applied, to a sense-of-touch presenting means 24. Further, the driving signal is transmitted to a driving means 54 through a driving circuit of an A/D converter 52 and a driving control circuit part 50 to driven the sense-of-touch presenting means 24, thereby presenting the information on the sense of touch to the operator.



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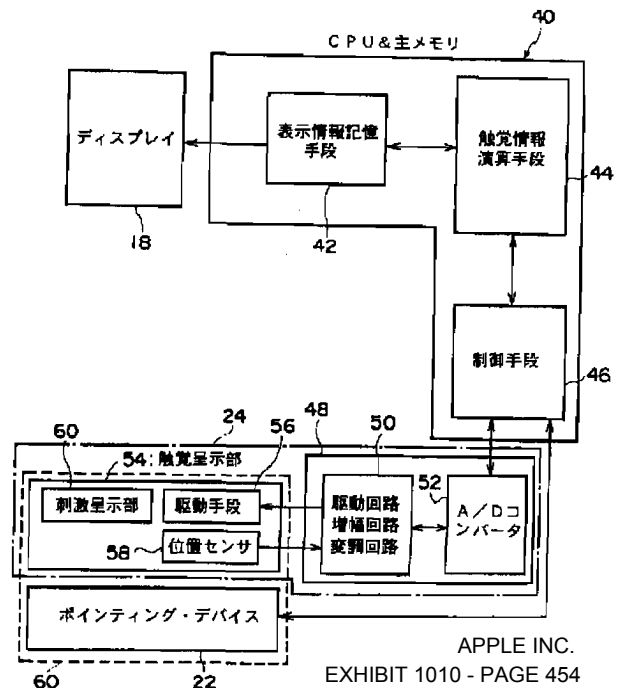
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(54) 【発明の名称】 情報処理装置

(57) 【要約】

【課題】 画像の色属性情報に基づいて触覚情報を呈示可能な情報処理装置を提供すること。

【解決手段】 触覚情報演算手段44は、操作者に触覚情報を呈示するために、表示情報記憶手段42から取得した表示情報に含まれる色属性情報に基づいて演算を行い、制御手段46に対して制御信号を逐次出力する。また、制御手段46は、触覚情報演算手段44からの制御信号を受信し、触覚呈示手段24に対して、印加すべき変位量や振動周波数或いは制御ゲインを演算して生成した駆動信号を出力する。さらに、駆動信号が、A/Dコンバータ52及び駆動制御回路部50の駆動回路を経由して駆動手段54へ伝達されることで、触覚呈示手段24が駆動され、操作者に対して触覚情報が呈示される。



【特許請求の範囲】

【請求項1】 画像を表示するディスプレイと、前記ディスプレイに表示された画像の一部を指示するポインティング手段と、操作者に対して触覚情報を呈示する触覚呈示手段と、前記触覚情報を呈示すべき画像部の色属性情報を予め記憶する記憶手段と、前記ポインティング手段により指示された画像部の色属性情報と、前記記憶手段に記憶された色属性情報とが一致した場合に、操作者に対して触覚情報を呈示するように前記触覚呈示手段を制御する制御手段と、を備えた情報処理装置。

【請求項2】 前記記憶手段は、前記触覚情報を呈示すべき画像部の複数の色属性情報と、該色属性情報の各々に対応した異なる触覚情報とを予め記憶することを特徴とする請求項1記載の情報処理装置。

【請求項3】 前記制御手段は、前記ポインティング手段により指示された画像部の色属性情報と、前記記憶手段に記憶された色属性情報とが一致しない場合に前記触覚呈示手段による触覚呈示を行わないことを特徴とする請求項1又は2に記載の情報処理装置。

【請求項4】 画像を表示するディスプレイと、前記ディスプレイに表示された画像の一部を指示するポインティング手段と、操作者に対して触覚情報を呈示する触覚呈示手段と、前記触覚情報を呈示すべき画像部の色属性情報の変化量を予め記憶する記憶手段と、前記ポインティング手段が指示する画像部の色属性情報の変化量と、前記記憶手段に記憶された色属性情報の変化量とに基づいて前記触覚呈示手段を制御する制御手段と、を備えた情報処理装置。

【請求項5】 前記記憶手段は、前記触覚情報を呈示すべき画像部の複数の色属性情報の変化量と、該色属性情報の変化量の各々に対応した異なる触覚情報とを予め記憶することを特徴とする請求項4記載の情報処理装置。

【請求項6】 前記制御手段は、前記ポインティング手段が指示する画像部の色属性情報の変化量が所定量以上の場合に触覚情報を呈示することを特徴とする請求項4又は5に記載の情報処理装置。

【請求項7】 前記制御手段は、前記ポインティング手段が指示する画像部の色属性情報の変化量が所定値未満の場合に前記触覚呈示手段による触覚呈示を行わないことを特徴とする請求項4乃至請求項6の何れか1項に記載の情報処理装置。

【請求項8】 前記色属性情報は、色相及び彩度の少なくとも1つ、または明度と、色相及び彩度の少なくとも1つとを組合せた属性値であることを特徴とする請求項1乃至請求項7の何れか1項に記載の情報処理装置。

するための載置面を有する載置部材を備え、該載置部材が該載置面に対して水平方向に前記制御手段により往復動されることによって、操作者に対して触覚情報を呈示することを特徴とする請求項1乃至請求項8の何れか1項に記載の情報処理装置。

【請求項10】 前記ポインティング手段はカーソルを移動するマウス型の入力装置であり、該入力装置の筐体の一部に前記触覚呈示手段が配置されていることを特徴とする請求項1乃至請求項9の何れか1項に記載の情報処理装置。

【発明の詳細な説明】

【0001】

【発明の属する技術分野】本発明は、情報処理装置に係り、特に、操作者に対して触覚情報による情報伝達が可能な情報処理装置に関する。

【0002】

【従来の技術】日常生活において、人間は、視覚情報、音声情報、触覚情報等の五感に基づく体感情報を利用して物事を判断することを自然に行っているが、しかし、現在のパーソナルコンピュータ（以下、パソコンという。）に代表される情報処理機器においては、音声情報の利用も見受けられるようになってきたが、依然として視覚情報が支配的に用いられている。従って、現在のパソコンは視覚情報に依存した制限のあるインタフェースになっていると言える。

【0003】例えば、画面に表示されるグラフィカルユーザインタフェースでは、ポインタの位置を常に目線で追いかける必要があり、また、クリック指定場所が小さい場合があるため、健常者では問題がないが、視力の衰えた高齢者や弱視者に対しては決して使用し易いインタフェースになっているとは言えない。また、インターネットで閲覧する写真などの画像情報・文字情報についても情報量の多さに対して視覚情報のみでメリハリをつけているため、画面が込み合った印象を受けるものが多い。

【0004】また、インターネット上で公開されているホームページにおいては、通常、そのファイル形式はHTML（Hyper Text Markup Language）で記述されたハイパーテキスト形式であり、ドキュメント上の関連文書名や関連URL（Uniform Resource Locator）を表すテキストに対してはハイパーリンク（単にリンクともいう。）が設定される。昨今のホームページに掲載されているテキストや画像情報量は多く、またホームページ上の各所にリンクを設定しているものも多い。ホームページ上でテキストが高密度で掲載されている場合（特に英文のページは小さい文字フォントで、テキストが高密度で掲載されているものが多い。）

テキストを読取作業は眼にかなりの負担となることがある。特に特定のテキストまたは画像部にリンクが設定されているものを判

知できるため、特に視線を集中する必要がある。

【0005】従来、上述のような問題を解決する方法として、情報機器の中で触覚情報を用いて画像情報やテキスト情報又は形状情報を伝達しようという試みがなされている。例えば、特開平7-77944号公報に記載の装置は、面状に配列された微小な接触子を任意の時間空間的パターンで駆動振動させてその面に対する接触感覚を変化可能にしている。

【0006】また、画像情報やテキスト情報などの視覚情報を触覚情報に変換する方法としては、特開平6-102997号公報の技術が知られている。ここで提示されているマウスデバイスは、マウスカーソルがウィンドウやボタンの境界上を通過したことを触覚情報によって知ることができるようなフィードバック手段を設けたポインティングデバイスである。このマウスデバイスの筐体には、上下に可動する(振動する)部材が設けられており、画面色の輝度情報を4階調あるいは2階調に処理して求めた触覚刺激値に基づいて上記の部材を動かすことで触覚情報を出力すると記載されている。

【0007】また、特開平10-207628号公報に記載の技術は、アプリケーションソフトウェアにおける構成要素の属性と触覚刺激とを対応させておく方法が述べられている。これは、画面中のウィンドウ枠など触覚情報を付加しようとする構成要素に対し、その属性を持つものに予め触覚刺激値を割り振っておく方法である。

【0008】さらに、画像情報をもとに触覚情報を演算する方法として、文献「池井寧、池野晃久、若松和史、福田収一：触覚ディスプレイにおける多階調表示、日本機械学会(No. 95-17)ロボティクス・メカトロニクス講演会'95講演論文集(Vol. A)、pp. 105-108」(以下、文献1という。)に記載された技術が知られている。この技術では、カラー画像をグレースケールに変換し、そのグレースケールの明度やコントラストを調整して触覚情報として用いている。すなわち、画像情報をグレースケール化して、あるいは、グレースケール化した輝度パターンを修正してその階調データから触覚情報を求めている。さらに、文献「若松和史、池井寧、福田収一：触覚テクスチャの表示におけるデータ依存特性、日本バーチャルリアリティ学会大会論文集Vol. 1(1996年10月)、pp. 185-188」(以下、文献2という。)に記載の技術では、実対象としての画像と再現する触覚感との適合を上げるため、画像の単なる輝度パターンとは異なる、画像の幾何形状を輝度に対応させた触覚情報パターンを数種類作成して、官能評価的に画像に合う触覚情報パターンを選択している。

【0009】

【発明が解決しようとする課題】しかしながら、上記のような従来の装置では次のような問題点がある。

術では、画像情報を単純に明るさのパターン情報と考えて、その輝度情報から振動刺激値を算出することは、画像あるいはテキスト情報の意味合いを無視した刺激呈示となり、適用範囲が狭くなり、また、同じ輝度でも色相が異なる場合については分離ができないという問題がある。

【0011】特開平10-207628号公報に記載の技術では、一つ一つの属性に予めその定義付けを施す必要があり、汎用的に任意の画像やテキストに利用することができないという問題がある。

【0012】文献1及び2に記載の技術では、略同一の明度を持つ異なる色が混在した画像については、階調性を得る事が困難であるという問題がある。また、文字と背景部から構成される比較的単純なテキスト文書において、特定の文字、例えば赤や青文字(これはインターネット上で公開されているホームページ上のリンク部分によく用いられる。)の箇所だけに強調の目的で触覚情報を呈示する場合に、文字と背景部のコントラストのみによる演算方式では、何れの文字でも触覚情報が出力されてしまう問題がある。

【0013】本発明は、上記のような事情に鑑みてなされたものであり、画像の色属性情報に基づいて触覚情報を呈示可能な情報処理装置を提供することを目的とする。

【0014】

【課題を解決するための手段】請求項1に記載の発明は、画像を表示するディスプレイと、前記ディスプレイに表示された画像の一部分を指示するポインティング手段と、操作者に対して触覚情報を呈示する触覚呈示手段と、前記触覚情報を呈示すべき画像部の色属性情報を予め記憶する記憶手段と、前記ポインティング手段により指示された画像部の色属性情報と、前記記憶手段に記憶された色属性情報とが一致した場合に、操作者に対して触覚情報を呈示するように前記触覚呈示手段を制御する制御手段と、を備えている。

【0015】請求項1に記載の発明によれば、記憶手段は、予め定めた、触覚情報を呈示すべき画像部の色属性情報を記憶する。また、制御手段は、ディスプレイに表示された画像において、ポインティング手段により指示された部分の色属性情報を取得する。さらに制御手段は、取得した色属性情報と記憶手段に記憶された色属性情報とが一致する場合に、操作者に対して触覚情報を呈示するように触覚呈示手段を制御する。これにより、操作者がポインティング手段によって、触覚情報を呈示するように予め定めた色属性情報を有する画像の一部分を指示した場合に、操作者に対して触覚情報を呈示することができる。

【0016】請求項2に記載の発明は、請求項1に記載の発明において、前記記憶手段は、前記触覚情報を呈示

々に対応した異なる触覚情報とを予め記憶することを特徴としている。

【0017】請求項2に記載の発明によれば、記憶手段は、触覚情報を呈示すべき画像部の複数の色属性情報と、それら色属性情報の各々に対応した異なる触覚情報とを予め記憶する。従って、この色属性情報と触覚情報との対応関係に基づいて、ディスプレイに表示された画像においてポインティング手段により指示される画像部の色属性情報に応じて、操作者に呈示する触覚情報を決定することができる。これにより、例えば、異なる色属性情報を有する複数の画像部について、各々異なる触覚情報を呈示することができる。

【0018】請求項3に記載の発明は、請求項1又は2に記載の発明において、前記制御手段は、前記ポインティング手段により指示された画像部の色属性情報と、前記記憶手段に記憶された色属性情報とが一致しない場合に前記触覚呈示手段による触覚呈示を行わないことを特徴としている。

【0019】請求項3に記載の発明によれば、制御手段は、ポインティング手段により指示された画像部の色属性情報が、記憶手段に記憶した色属性情報と一致しない場合には触覚情報を呈示しない。これにより、操作者は、触覚情報の呈示の有無によって、視覚情報に依存せずに、画像構成上の各部の違いを明確に識別することができる。

【0020】請求項4に記載の発明は、画像を表示するディスプレイと、前記ディスプレイに表示された画像の一部を指示するポインティング手段と、操作者に対して触覚情報を呈示する触覚呈示手段と、前記触覚情報を呈示すべき画像部の色属性情報の変化量を予め記憶する記憶手段と、前記ポインティング手段が指示する画像部の色属性情報の変化量と、前記記憶手段に記憶された色属性情報の変化量とに基づいて前記触覚呈示手段を制御する制御手段と、を備えている。

【0021】請求項4に記載の発明によれば、記憶手段は、予め定めた、触覚情報を呈示すべき画像部の色属性情報の変化量を記憶する。また、制御手段は、ディスプレイに表示された画像において、ポインティング手段により指示される部分の変化に伴う色属性情報の変化量を算出する。さらに、制御手段は、算出した色属性情報の変化量と記憶手段に記憶された色属性情報の変化量とに基づいて触覚呈示手段を制御する。これにより、操作者に対して、ポインティング手段によって指示される画像部の変化に伴う色属性情報の変化量に基づいて触覚情報を呈示することができる。

【0022】請求項5に記載の発明は、請求項4に記載の発明において、前記記憶手段は、前記触覚情報を呈示すべき画像部の複数の色属性情報の変化量と、該色属性

【0023】請求項5に記載の発明によれば、記憶手段は、触覚情報を呈示すべき画像部の複数の色属性情報の変化量と、その色属性情報の変化量の各々に対応した異なる触覚情報とを予め記憶する。従って、この色属性情報の変化量と触覚情報との対応関係に基づいて、ディスプレイに表示された画像においてポインティング手段により指示される部分の変化に伴う色属性情報の変化量に応じて、操作者に呈示する触覚情報を決定することができる。これにより、例えば、複数の異なる色属性情報の変化量に対して、各々異なる触覚情報を呈示することができる。

【0024】請求項6に記載の発明は、請求項4又は5に記載の発明において、前記制御手段は、前記ポインティング手段が指示する画像部の色属性情報の変化量が所定量以上の場合に触覚情報を呈示することを特徴としている。

【0025】請求項6に記載の発明によれば、制御手段は、ポインティング手段が指示する画像部の色属性情報の変化量が所定量以上の場合に触覚情報を呈示する。これにより、例えば、操作者が着目したい特定の画像構成に対応する色属性情報の変化量に基づいて予め所定量を定めることで、触覚情報の呈示の有無によって、その特定の部分を認識することができる。

【0026】請求項7に記載の発明は、請求項4乃至請求項6の何れか1項に記載の発明において、前記制御手段は、前記ポインティング手段が指示する画像部の色属性情報の変化量が所定値未満の場合に前記触覚呈示手段による触覚呈示を行わないことを特徴としている。

【0027】請求項7に記載の発明によれば、制御手段は、ポインティング手段により指示された画像部の色属性情報の変化量が所定値未満の場合には、触覚情報を呈示しない。これにより、ポインティング手段により指示される画像部の変化に伴い、操作者は、触覚情報の呈示の有無によって、視覚情報に依存せずに、画像構成上の変化を明確に認識することができる。

【0028】請求項8に記載の発明は、請求項1乃至請求項7の何れか1項に記載の発明において、前記色属性情報は、色相及び彩度の少なくとも1つ、または明度と、色相及び彩度の少なくとも1つとを組合せた属性値であることを特徴としている。

【0029】請求項8に記載の発明によれば、色相及び彩度の少なくとも1つの属性値、または明度と、色相及び彩度の少なくとも1つとを組合せた属性値を、画像部の色属性情報として用いる。これにより、画像部の色属性の任意の変化に対応して、高い自由度で触覚情報を呈示する条件の設定を行うことができる。

【0030】請求項9に記載の発明は、請求項1乃至請求項8の何れか1項に記載の発明において、前記触覚呈

向に前記制御手段により往復動されることによって、操作者に対して触覚情報を呈示することを特徴としている。

【0031】請求項9に記載の発明によれば、触覚呈示手段は、操作者が指を載置するための載置面を有する載置部材を備えている。この載置部材は、操作者の指の載置面に対して水平方向に可動のように構成されている。ポインティング手段の指示部の移動に伴って触覚情報の呈示を行うに当たり、制御手段は載置部材を操作者の指の載置面に対して水平方向に往復動させることにより、操作者に対して触覚情報を呈示する。これにより、操作者は、ポインティング手段の指示部の移動方向に沿って、実際に画像の表面をなぞっているような感覚で触覚情報を受感することができる。

【0032】請求項10に記載の発明は、請求項1乃至請求項9の何れか1項に記載の発明において、前記ポインティング手段はカーソルを移動するマウス型の入力装置であり、該入力装置の筐体の一部に前記触覚呈示手段が配置されていることを特徴としている。

【0033】請求項10に記載の発明によれば、ポインティング手段はカーソルを移動するマウス型の入力装置である。操作者は通常、カーソルを移動するに当たり、その筐体に手指を載置して操作を行う。従って、入力装置の筐体の手指を載置する部位に触覚呈示手段を配置することにより、入力装置を操作する操作者に対して、入力装置の操作性を損なわずに、触覚情報を呈示することができる。

【0034】

【発明の実施の形態】以下、本発明の実施の形態を図に基づいて説明する。

【0035】図1に示すように、本実施の形態に係る情報処理装置10は、マイクロ回路化されたCPU12と、BIOS等の固定情報を格納したROMや可変情報を格納するRAMを含んで構成された主メモリ14と、フロッピー（登録商標）・ディスク装置やハード・ディスク装置、CD-ROM装置、MO装置等で構成される外部記憶装置16と、画像を表示するCRTや液晶等で構成されるディスプレイ18と、入力手段であるキーボード20と、マウス、タッチパッド（フィンガーパッドとも呼ばれる）、トラックボール等のポインタ・カーソル（以下、カーソルという。）の移動を行うポインティング・デバイス22と、駆動力発生部（詳細は後述）を備えた触覚呈示手段24と、ネットワークを介して外部とのデータ通信を行う通信装置28とを備え、各々は互いにデータの授受が可能のようにバス26で相互に接続されている。さらに、通信装置28には、他の通信装置32や他のCPU34等を備えた情報伝達システム30がネットワークを介して接続され、互いに交信可能のように構成されている。

0の主要構成は、図2に示す機能ブロックに分類できる。CPU12及び主メモリ14により構成される制御部40は、表示情報記憶手段42と触覚情報演算手段44と制御手段46とを備えており、触覚情報演算手段44（詳細は後述）は、表示情報記憶手段42及び制御手段46とデータの授受が可能のように接続されている。

【0037】表示情報記憶手段42は、ディスプレイ18に接続されており、ディスプレイ18に表示するイメージやテキストを含む画像についての、色情報を含む属性情報、及び画面のレイアウトやウィンドウ境界等のデスクトップ環境についての属性情報等を含む表示情報を記憶するためのものである。

【0038】制御手段46は、ディスプレイ18の表示画像上におけるカーソルの位置座標を表す信号（以下、カーソル座標信号という。）を出力するポインティング・デバイス22と接続されており、現在のカーソル座標信号を受信し、触覚情報演算手段44へ送信するように構成されている。これにより、触覚情報演算手段44は、受信したカーソル座標信号で表されるカーソルの座標位置における表示情報を表示情報記憶手段42から取得できる。なお、ポインティング・デバイス22から出力されたカーソル座標信号は、CPU12で表示情報として加工され、表示情報記憶手段42により、カーソルの形態でディスプレイ18に表示される。

【0039】また、制御手段46は、触覚呈示部54と駆動力発生部48とを備えた触覚呈示手段24とデータの授受が可能のように接続されている。さらに、触覚呈示部54は、ユーザに対して直接触覚刺激を呈示する刺激呈示部60と、刺激呈示部60を駆動する駆動手段56と、駆動手段56の変位を検出する位置センサ58とを備えており、駆動力発生部48は、駆動回路、増幅回路、及び変調回路を含んで構成された駆動制御回路部50と、A/Dコンバータ52とを備えている。

【0040】駆動制御回路部50は、触覚呈示部54の駆動手段へ信号を出力可能のように接続され、かつ触覚呈示部54の位置センサ58からの信号を受信可能のように接続されており、さらに、A/Dコンバータ52を介して、制御手段46とデータの授受が可能のように接続されている。

【0041】なお、触覚呈示部54とポインティング・デバイス22とは、ポインティング・デバイス22に触覚呈示部54を搭載することで、入力デバイス62として構成されている。

【0042】ここで、本実施の形態に係る入力デバイス62について、その具体的な構成の一例を詳細に説明する。

【0043】図3(a)に示す入力デバイス62は、マウス型のポインティング・デバイス22Aに、駆動手段（図示せず）、位置セン

呈示部を搭載して構成されている。さらに、マウス筐体76には、刺激呈示部60Aが弾性取り付け部材78によって設置され、クリックボタンスイッチ70を押圧可能なように構成されている(図3(b)参照)。また、図3(c)に示すように、刺激呈示部60Aは、指の接触部の表面上において縦横方向(矢印80の方向)に可動なように構成されている。また、カーソルを移動するためのマウス部22Aは、ボール72の回転をエンコーダ部74で位置情報に変換してパソコン本体(図示せず)に信号を伝達するように構成されている。

【0044】次に本実施の形態の動作概略を、図4に示す処理ルーチンに沿って説明する。

【0045】まず、ステップ100では、本実施の形態に係る情報処理装置10のシステムが稼動中であるか否か、すなわち、システムがオンの状態であるか否かを判断する。ステップ100で否定判断の場合には、システムがオフであるので本処理ルーチンを終了する。一方、ステップ100で肯定判断の場合には、ステップ102へ進み、現在のシステムの稼動状況が起動時であるか或いは後述する触覚情報を呈示する条件の設定変更時であるかを判断する。ステップ102で肯定判断の場合には

ステップ104へ進み、触覚情報を呈示する最新の条件を読み込んで次のステップ106へ進む。一方、ステップ102で否定判断の場合には、ステップ106へ進む。ここでは、触覚情報を呈示する条件として、表示画像上の各座標位置での色属性情報を用いる。ここで色属性情報とは、例えば、修正マンセル色空間における、色相、明度、彩度の尺度を用いて、色の属性を表した情報である。

【0046】次のステップ106では、表示画像上におけるカーソル座標を検出して、ステップ108へ進み、表示画像でのカーソル指示部における色属性情報を取り込む。

【0047】次のステップ110では、触覚情報を呈示する条件として、上記ステップ104で読み込み設定した触覚を呈示する対象の色属性情報と、表示画像でのカーソル指示部における色属性情報とが一致するか否かを判断する。ステップ110で肯定判断の場合には、触覚呈示を開始すべき画像領域に入ったことになるので、ステップ112へ進み、触覚呈示動作が停止状態であるか否かを判断する。ステップ112で肯定判断の場合には、ステップ114へ進み、デバイス制御信号を出力して触覚呈示手段を駆動する。一方、ステップ114で否定判断の場合には、現在触覚呈示を行なっている状態であるので、上記ステップ100へ戻り、以後、上記の処理を繰り返す。

【0048】一方、ステップ110で否定判断の場合には、カーソル座標は未だ触覚呈示をすべき画像領域に入

示動作を行っている状態であるか否かを判断する。ステップ116で肯定判断の場合には、触覚情報の呈示を停止する必要があるため、ステップ118へ進み、デバイス制御信号を出力して触覚呈示手段の駆動を停止する。一方、ステップ116で否定判断の場合には、上記ステップ100へ戻り、以後、上記の処理を繰り返す。

【0049】以上の処理により、ユーザが操作するポインティング・デバイスのカーソルが指示する画像部の色属性情報が、予め触覚呈示条件として設定した色属性情報と一致する場合に、ユーザに対して触覚呈示手段により触覚情報を呈示することができる。

【0050】すなわち、本実施の形態に係る情報処理装置10では、触覚情報演算手段44は、ユーザに直接触覚刺激として所定の触覚情報を呈示するために、上述の表示情報記憶手段42から取得した表示情報に含まれる色属性情報に基づいて演算を行い、制御手段46に対して制御信号を逐次出力する。また、制御手段46は、触覚情報演算手段44からの制御信号を受信し、触覚呈示手段24に対して、印加すべき変位量や振動周波数或いは制御ゲインを演算して生成した駆動信号を出力する。さらに、駆動信号が、A/Dコンバータ52及び駆動制御回路部50の駆動回路を経由して駆動手段54へ伝達されることで、触覚呈示手段24が駆動される。このとき、触覚情報を刺激呈示部60により呈示する駆動手段56の変位は、位置センサ58によって逐次検出され、制御手段25に伝達されることで、フィードバック制御が行われ、触覚呈示部54の適切な駆動制御を行うことができる。

【0051】次に、図5を参照して本実施の形態に係る情報処理装置10の触覚呈示の具体例について説明する。

【0052】ディスプレイ18A、及び上述の入力デバイス62Aが装置本体90に接続されて構成された情報処理装置10Aにおいて、装置本体90内部に搭載されるCPUでは、図6に示す処理ルーチンが実行される。なお、図6の処理ルーチンにおいて、図5に示す処理ルーチンと同一の部分には同一符号を付して説明を省略する。

【0053】情報処理装置10Aのシステムが稼動中の状態において、システムが起動時、或いは触覚情報を呈示する条件の設定変更時である場合に、ステップ200では、予め定めた触覚情報を呈示する条件として用いる色属性情報を読み込む。ここで読み込む色属性情報とは、カーソルの移動前後の座標位置における各画像部に対応する色属性(色相、明度、彩度)値の変化量であり、カーソルの移動前後での各色属性値の差として算出した値である。算出した色相差、明度差、彩度差の各最小値を所定値として予め定め、触覚情報を呈示する条件として用いる。

ルの座標を常時検出し、主メモリ14等に記憶保持して、カーソルの移動及び移動後の最新の座標値に更新する。

【0055】次のステップ204では、カーソルの移動前後の座標位置における各画像部に対応する色属性値のうち明度の変化量を算出し、次のステップ206では、上記ステップ200で読み込んだ、明度差についての所定値以上であるか否かを判断する。

【0056】ステップ206で否定判断の場合には、ステップ208へ進み、カーソルの移動前後の座標位置における各画像部に対応する色属性値のうち色相の変化量を算出し、次のステップ210で、上記ステップ200で読み込んだ、色相差についての所定値以上であるか否かを判断する。

【0057】ステップ210で否定判断の場合には、ステップ212へ進み、カーソルの移動前後の座標位置における各画像部に対応する色属性値のうち彩度の変化量を算出し、次のステップ214で、上記ステップ200で読み込んだ、彩度差についての所定値以上であるか否かを判断する。

【0058】ステップ214で否定判断の場合には、3種の色属性値の明度、色相、彩度の何れの変化量も所定値以上ではないので、カーソルが触覚呈示をすべき画像領域中に存在しないか、或いは触覚呈示すべき領域から外れた状態であると判断でき、ステップ118で、デバイス制御信号を出力して触覚呈示手段の駆動を停止する。

【0059】一方、上記のステップ206、210、214の何れかで肯定判断の場合には、カーソルが触覚呈示を開始すべき画像領域内に入ったことになるので、ステップ212で、デバイス制御信号を出力して触覚呈示手段を駆動する。

【0060】なお、ユーザへ触覚情報を呈示するために触覚呈示手段が駆動されることにより、上述の入力デバイス62Aの刺激呈示部60A(図5参照)は、カーソルのX、Y移動方向に対応して反動する。これによりユーザはクリック部を形成する刺激呈示部60Aに指を載置することで触覚情報を受感することができる。

【0061】ここで、上記の処理により、表示画像に応じて触覚情報を呈示する具体例について説明する。

【0062】図5に示すような、修正マンセル色空間において、背景92が黄色で5Y、花びら96が赤紫で7.5RP、葉が黄緑で10GYという数値の色相であり、かつ全て同一の明度値である花の画像の場合では、花の各要素(背景、花びら、葉)間をカーソルが移動することにより、カーソル座標での色属性情報における色相の変化を検出することができ、触覚情報を呈示することができる。

【0063】おなわち、上述した図6に示す処理ルーチン

プ210での判断により、所定値以上である場合に、花の各要素(背景、花びら、葉)間の色相の違いを識別して触覚情報の呈示を行うことができる。

【0064】従って、ユーザは、花の各要素(背景、花びら、葉)の凹凸感や輪郭感を触覚情報によって認識することができる。

【0065】次に、表示画像に応じて触覚情報を呈示する他の具体例について説明する。

【0066】図7に示すような、インターネット上で公開されるホームページにおいて、文書を構成するテキストの表示色は黒であり、通常、リンクが設定されているテキスト(説明便宜上、アンダーラインを引いてある。)は黒文字ではなく青文字が多用される。つまり、図8に示すように、図7に示すホームページ上のテキストにおいて、リンクが設定されたテキスト領域R1、R2、R3は、通常、白い背景に対し青文字のテキストで表示される。これにより、本実施の形態に係る情報処理装置10を適用することによって、テキスト領域R1～R3内にカーソルが入った場合に、カーソル座標位置の色属性情報における色相の変化(ここでは、白色から青色への変化。)を検出して、触覚呈示手段によりユーザに対して触刺激を与えることができる。すなわち、上述した図6に示す処理ルーチンのステップ208で算出する色相の変化量が、ステップ210での判断により、所定値以上である場合に、通常のテキストとリンクが設定されているテキストとの表示色間での色相の違いを識別して触覚情報の呈示を行うことができる。これにより、ユーザはリンクが設定されているテキストを触覚情報から感知することができる。

【0067】また、本実施の形態に係る情報処理装置10を適用することによって、白い背景に通常の黒文字であるテキスト領域では触覚情報を出力しないように設定することで、リンクが設定されたテキストとリンクが設定されていないテキストとを触覚情報により識別することができる。また、文字の色によって異なる触覚情報を出力することも可能で、リンクが設定されたテキストの色を青色でなく、例えば、連絡先等へのリンクが設定されたテキスト領域R3のテキストの色を赤色にして、文字の色が青い場合とは異なる触覚情報を出力するように設定することもできる。

【0068】次に、表示画像に応じて触覚情報を呈示する、さらに他の具体例について説明する。

【0069】図9に示すような穴の開いた板98の画像において、穴部分98Aと板部分98Bとでは色属性情報において所定値以上の明度差を有し、板部分98Bの木目の明暗模様については、その明度差は所定値より小さい。

【0070】このような画像の場合では、本実施の形態に係る情報処理装置10を適用することによって、板

8 A及び板部分9 8 B間をカーソルが移動するときは、上述した図6に示す処理ルーチンのステップ2 0 4で算出する明度の変化量が、ステップ2 0 6で、所定値以上であると判断されるので、触覚情報を呈示する。一方、板部分9 8 Aのみや穴部分9 8 Bのみをカーソルが移動するときは、上述した図6に示す処理ルーチンのステップ2 0 4で算出する明度の変化量が、ステップ2 0 6で、所定値以上でないと判断されるので、触覚情報を呈示せず、ユーザは板9 8の凹凸感を視覚情報によらずに認識できる。

【0 0 7 1】以上の処理により、ユーザが操作するポインティング・デバイスのカーソルが移動する毎に、移動前後の各カーソル座標位置における画像部の色属性値である明度、色相、彩度の差に基づく演算により、触覚情報を呈示するか否かを決定することで、ユーザに対して触覚情報をリアルタイムに呈示できる。

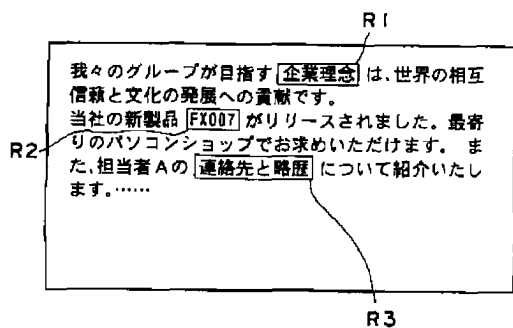
【0 0 7 2】なお、本処理ルーチンでは、カーソルの移動前と移動後の座標位置における各色属性値の変化量に基づく演算により、触覚情報を呈示するか否かを決定したが、これに限定されることはなく、カーソル座標位置における画像部の色属性の絶対値に基づく演算により、触覚情報を呈示するか否かを決定してもよい。

【0 0 7 3】以上のように、本実施の形態に係る情報処理装置によれば、従来のようにグレースケール等の明度のみの情報でなく、色相、彩度を含む色属性情報に基づく演算により触覚情報を呈示するので、触覚情報を生成するために意図的にグレースケールに変換する必要もなく、また、触覚情報を演算するために利用する視覚（画像）情報量を格段に増加することができ、多様で自由度の高い触覚情報の呈示及び呈示条件の設定を行うことができる。

【0 0 7 4】

【発明の効果】以上説明したように、本発明によれば、ディスプレイに表示される画像において、ポインティング手段によって指示された部分の色属性情報を取得し、取得した色属性情報が、予め定めて記憶手段に記憶した、触覚情報を呈示すべき色属性情報と一致する場合に*

【図8】



* 触覚情報を呈示するようにしたので、画像の色属性情報に基づいて触覚情報を呈示可能な情報処理装置を提供することができる、という優れた効果を有する。

【図面の簡単な説明】

【図1】本発明の実施の形態に係る情報処理装置の概略構成図である。

【図2】本発明の実施の形態に係る情報処理装置の主要構成を機能ブロックに分類した構成を示す概略図である。

10 【図3】本発明の実施の形態に係る入力デバイスの一例の構成を説明するための概略図である。

【図4】本発明の実施の形態に係る情報処理装置の動作概略を示すフローチャートである。

【図5】本発明の実施の形態に係る情報処理装置の触覚呈示の具体例を説明するための説明図である。

【図6】本発明の実施の形態に係る情報処理装置の触覚呈示の具体例の処理の流れを示すフローチャートである。

20 【図7】本発明の実施の形態に係る表示画像の他の例を説明するための図である。

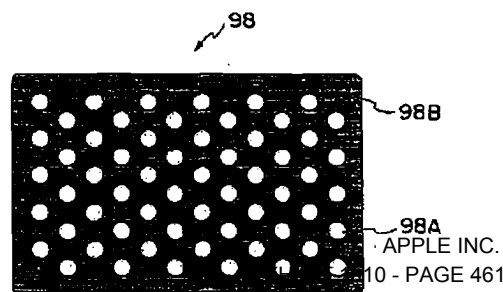
【図8】図7に示す表示画像情報を詳細に説明するための説明図である。

【図9】本発明の実施の形態に係る表示画像の他の例を説明するための図である。

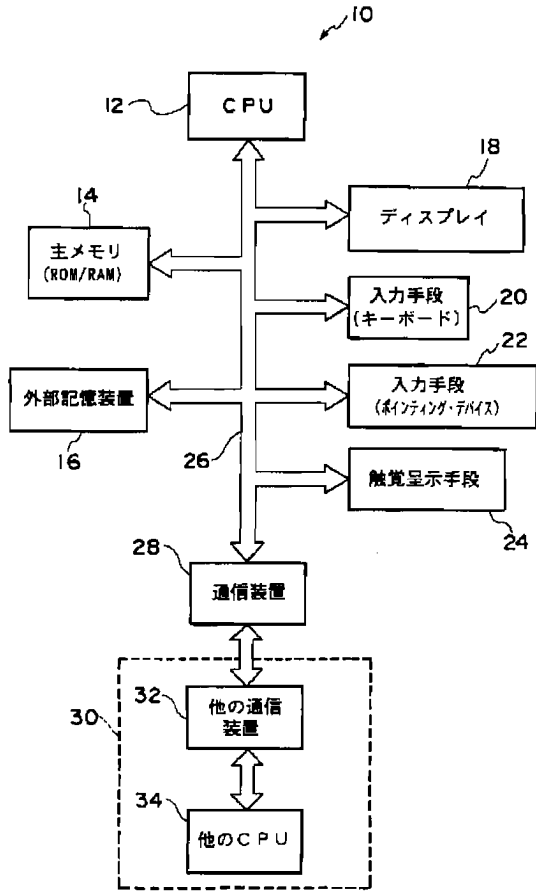
【符号の説明】

- 1 0 情報処理装置
- 1 2 CPU
- 1 4 主メモリ
- 1 8 ディスプレイ
- 2 2 ポインティング・デバイス
- 2 2 A マウス部
- 2 4 触覚呈示手段
- 4 2 表示情報記憶手段
- 4 4 触覚情報演算手段
- 4 6 制御手段
- 5 6 駆動手段
- 6 0 刺激呈示部

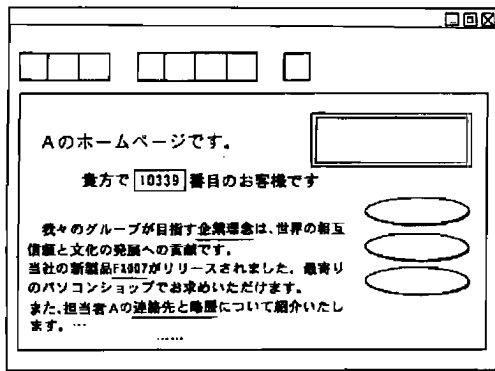
【図9】



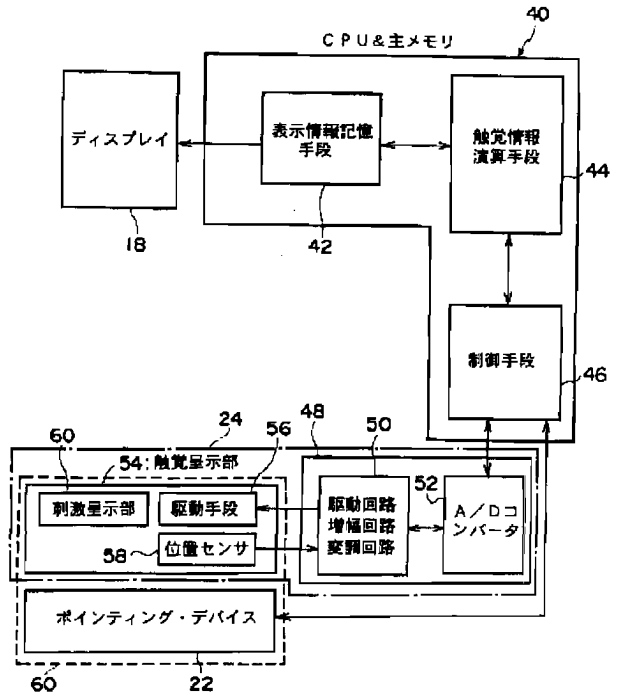
【図1】



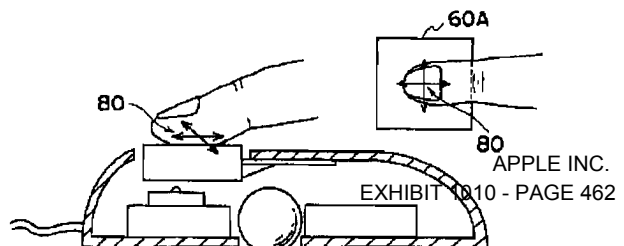
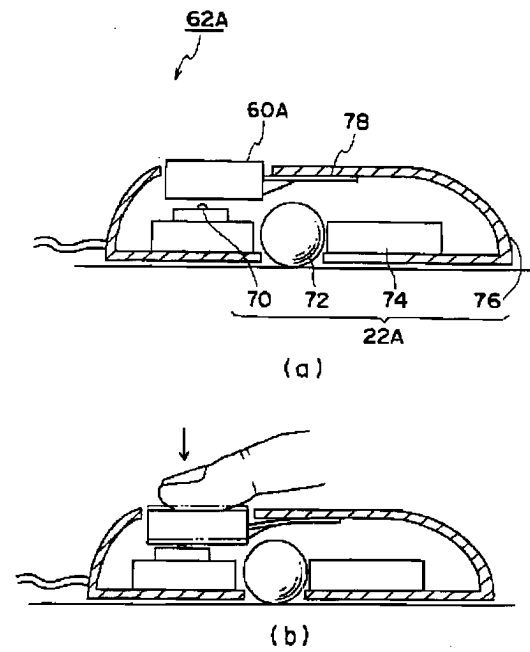
【図7】



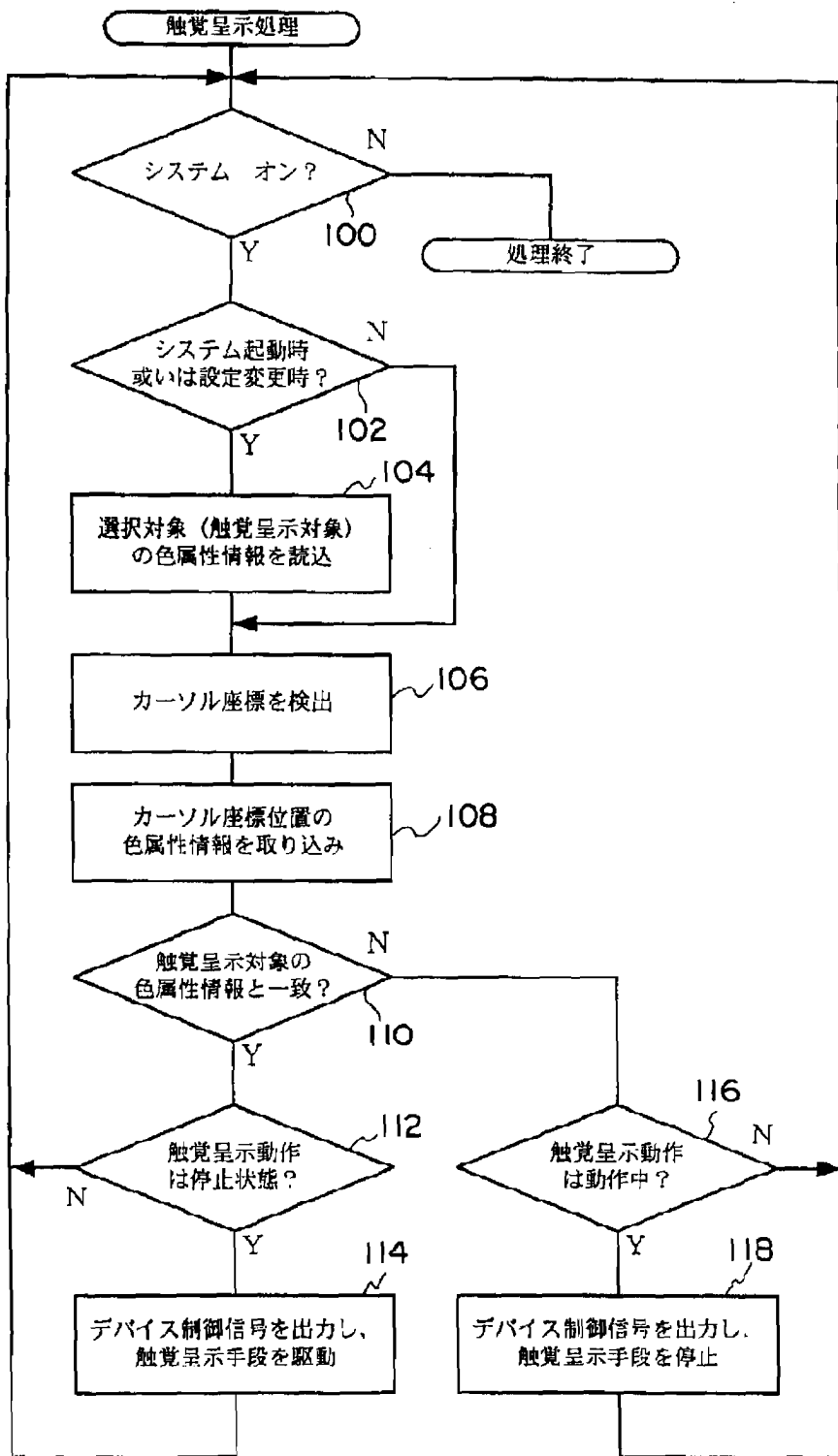
【図2】



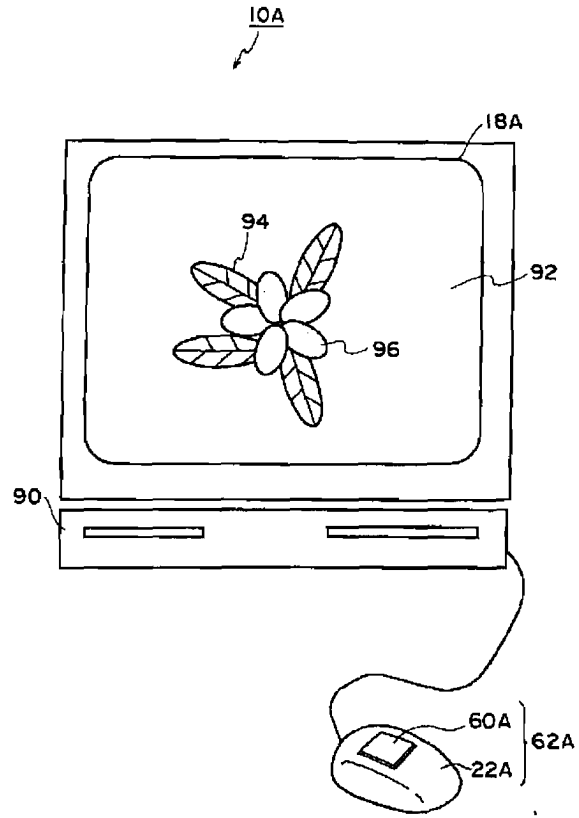
【図3】



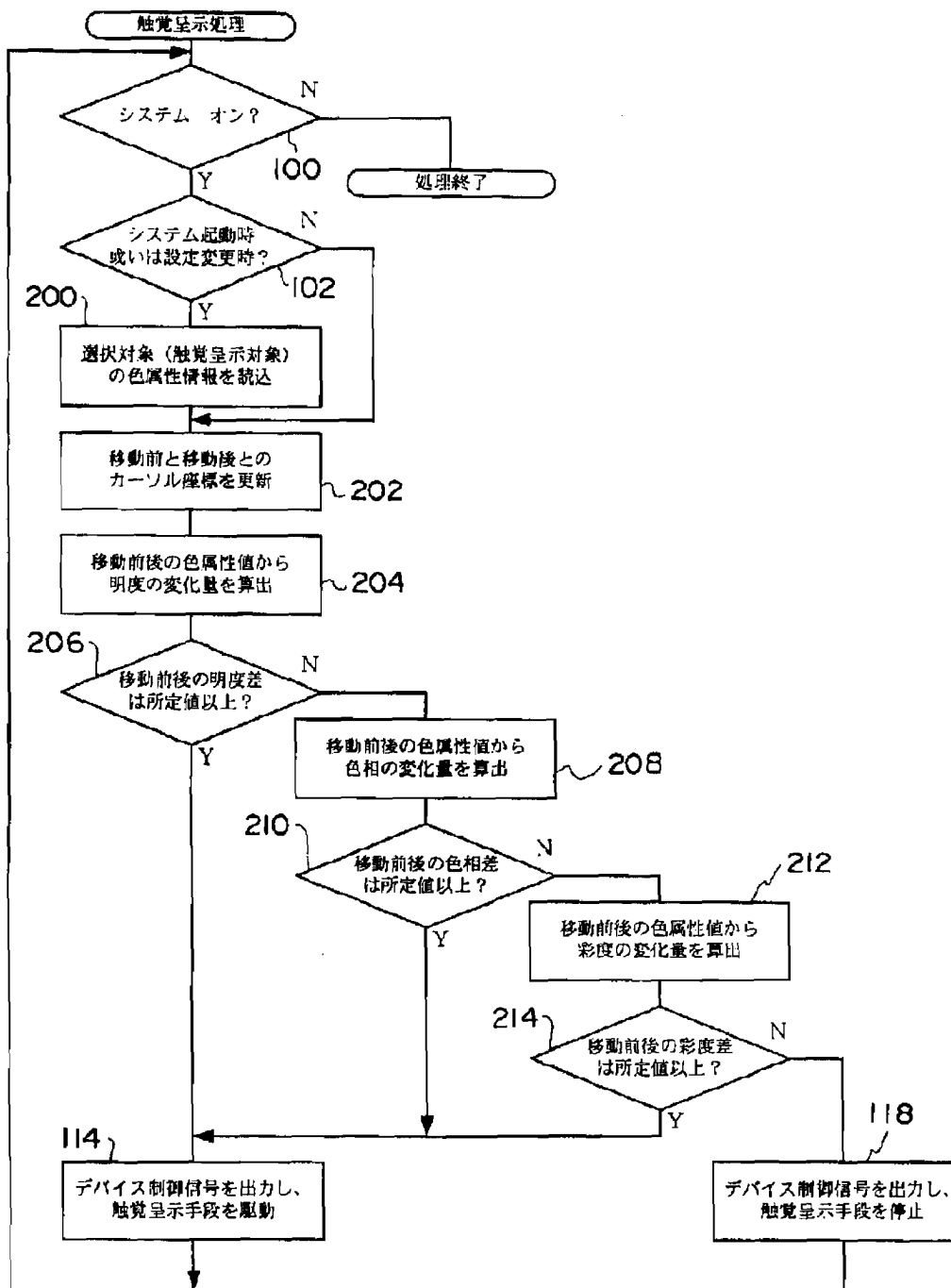
【図4】



【図 5】



【図6】



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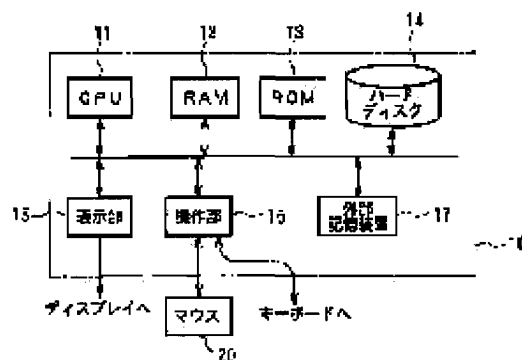
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SAKAMAKI KATSUMI

(54) TACTILE FORCE PRESENTING DEVICE AND RECORDING MEDIUM

(57)Abstract:

PROBLEM TO BE SOLVED: To provide a tactile force presenting device and a recording medium capable of properly presenting information by tactile force even when a user can not observe a display closely in this invention though there is a problem that proper presentation of information is impossible when the user can not keep on observing the display closely in the conventional case.

SOLUTION: The tactile force presenting device to present information by transferring a mouse pointer on a display according to a user's operation to a mouse 20 by a CPU 11, acquiring the information of an object pointed by the mouse pointer, outputting tactile force information according to the information contents and controlling a tactile force device integrally provided in the mouse 20 and the recording medium in which a program for the purpose is recorded are provided.



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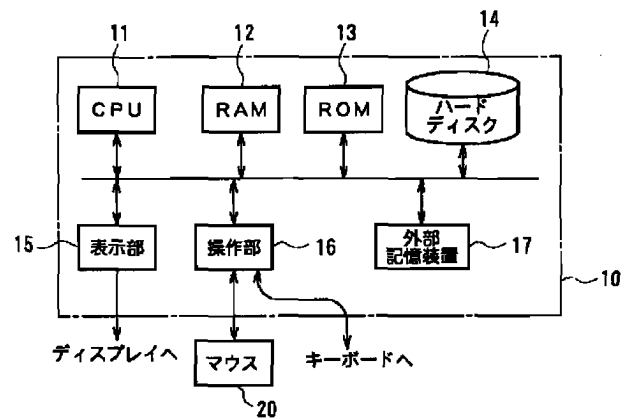
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(54) 【発明の名称】 触力覚呈示装置及び記録媒体

(57) 【要約】

【課題】 従来、ユーザがディスプレイを注視しつづけられない場合に適切な情報の提供をできないという問題点があったが、本発明では、ディスプレイを注視できなくても、触力覚により適切に情報を提供できる触力覚呈示装置及び記録媒体を提供する。

【解決手段】 CPU 11がマウス20に対するユーザの操作に応じてディスプレイ上のマウスポインタを移動させ、当該マウスポインタが指し示すオブジェクトの情報を取得して、その情報内容に応じて、触力覚情報を出力して、マウス20に一体に設けられた触力覚デバイスを制御して情報を提供する触力覚呈示装置及びそのためのプログラムを格納した記録媒体である。



【特許請求の範囲】

【請求項 1】 ポインティングデバイスとともに使用される触力覚呈示装置において、前記ポインティングデバイスの操作に応じて動作するポインタが画面上で指し示すオブジェクトを特定するオブジェクト特定手段と、前記特定されたオブジェクトのプロパティ情報を取得する取得手段と、前記取得したプロパティ情報を触力覚情報に変換する変換手段と、前記触力覚情報に応じ、触力覚を呈示する呈示手段と、を含むことを特徴とする触力覚呈示装置。

【請求項 2】 請求項 1 に記載の触力覚呈示装置において、前記変換手段は、前記オブジェクトに対する操作内容に従ってプロパティ情報を触力覚情報に変換することを特徴とする触力覚呈示装置。

【請求項 3】 請求項 1 又は 2 に記載の触力覚呈示装置において、前記呈示手段は、前記ポインティングデバイスに一体的に形成されてなることを特徴とする触力覚呈示装置。

【請求項 4】 ポインティングデバイスとともに使用される触力覚呈示装置において、前記ポインティングデバイスの操作を検出する操作検出手段と、前記検出した操作の内容を触力覚情報に変換する変換手段と、前記触力覚情報に応じ、触力覚を呈示する呈示手段と、を含むことを特徴とする触力覚呈示装置。

【請求項 5】 請求項 4 に記載の触力覚呈示装置において、さらに、ポインティングデバイスの操作に応じて動作するポインタが画面上で指し示すオブジェクトを特定するオブジェクト特定手段と、前記特定されたオブジェクトのプロパティ情報を取得する取得手段と、を含み、前記変換手段は、前記取得したプロパティ情報と、検出した操作の内容とに基づいて、触力覚情報を出力することを特徴とする触力覚呈示装置。

【請求項 6】 ポインティングデバイスとともに使用される触力覚呈示装置において、前記ポインティングデバイスの操作に応じて動作するポインタの位置情報を取得する位置情報取得手段と、前記取得した位置情報を触力覚情報に変換する変換手段と、前記触力覚情報に応じ、触力覚を呈示する呈示手段と、を含むことを特徴とする触力覚呈示装置。

【請求項 7】 ポインティングデバイスとともに使用される触力覚呈示装置において、前記ポインティングデバイスの操作に応じて動作するポインタの形態を監視する手段と、

前記監視の結果に応じて、触力覚情報を生成する手段と、前記触力覚情報に応じ、触力覚を呈示する呈示手段と、を含むことを特徴とする触力覚呈示装置。

【請求項 8】 請求項 1 から 7 のいずれかに記載の触力覚呈示装置において、前記呈示手段は、移動可能に支持され、指先が載置される受感部と、前記触力覚情報の入力を受ける入力部と、

10 前記入力部に入力された触力覚情報に応じて、前記受感部を移動させる駆動部とを備えたことを特徴とする触力覚呈示装置。

【請求項 9】 ポインティングデバイスの操作に応じて動作するポインタ自身及びポイント先の少なくとも一方に関連する原情報を取得する工程と、前記原情報に応じた触力覚情報を出力する工程と、を含むことを特徴とする触力覚呈示方法。

【請求項 10】 ポインティングデバイスの操作に応じて動作するポインタが画面上で指し示すオブジェクトを特定する工程と、

20 前記特定されたオブジェクトのプロパティ情報を取得する工程と、前記取得したプロパティ情報を変換して触力覚を呈示させるための情報を生成し、出力する工程と、を含むことを特徴とする触力覚呈示方法。

【請求項 11】 ポインティングデバイスの操作に応じて動作するポインタが画面上で指し示すことにより特定されたオブジェクトのプロパティ情報を取得する工程と、

30 前記取得したオブジェクトのプロパティ情報を変換して、触力覚を呈示させるための情報を生成し、出力する工程と、を含むことを特徴とする触力覚呈示方法。

【請求項 12】 請求項 10 又は 11 に記載の触力覚呈示方法において、前記触力覚を呈示させるための情報を生成して出力する工程は、前記オブジェクトに対する操作内容に従ってプロパティ情報を変換して、触力覚を呈示させるための情報を生成し、出力することを特徴とする触力覚呈示方法。

40 法。

【請求項 13】 請求項 10 から 12 のいずれかに記載の触力覚呈示方法において、前記出力された触力覚を呈示させるための情報に基づいて、触力覚を呈示するデバイスを駆動させる工程をさらに備えたことを特徴とする触力覚呈示方法。

【請求項 14】 ポインティングデバイスの操作に応じて動作するポインタ自身及びポイント先の少なくとも一方に関連する原情報を取得するモジュールと、前記原情報に応じた触力覚情報を出力する

50 と、

の少なくとも一方を含むプログラムを格納したことを特徴とするコンピュータ読み取り可能な記録媒体。

【発明の詳細な説明】

【0001】

【発明の属する技術分野】本発明は、ユーザインタフェースを触力覚で呈示する触力覚呈示装置及び記録媒体に関する。

【0002】

【従来の技術】近年、パーソナルコンピュータが広く普及し、生活のいろいろな場面で利用されるようになってきている。近年のパーソナルコンピュータは操作部としてのマウス及びキーボードと、表示部としてのディスプレイ、音声やサウンドを鳴動するサウンドデバイスなどが接続され、利用者はマウスやキーボードを操作して情報や要求を入力し、表示部等のデバイスを介して提供される情報を視覚的、聴覚的に受け取るのが普通である。

【0003】しかし一般的にマウス、キーボードなどの操作は視覚を通して得られる情報が不可欠である。すなわち、近年のパーソナルコンピュータは操作がグラフィカルユーザインタフェース（GUI）を介して行われるため、アイコンをクリック、ドラッグする等の操作は、アイコンにマウスポインタが重なるという視覚的情報を参照しつつ行われるのである。

【0004】したがってこのようなGUIによる操作を主とするパーソナルコンピュータでは、例えば視覚障害者にとって利用しにくい側面がある。また、視覚的インタフェースでは、ディスプレイを注視していなければならないし、聴覚的インタフェースは、例えばオフィスなどの多数の人物が音声によるコミュニケーションを行っている場では相応しくない。スピーカにより音声を鳴動すれば他の人物間のコミュニケーションの邪魔になり、ヘッドフォンなどを利用すれば、ユーザに対する呼びかけが聞こえなくなってしまうきらいがあるからである。

【0005】

【発明が解決しようとする課題】このように、上記従来のユーザインタフェースでは、例えばユーザに視覚障害がある場合や、ディスプレイを注視しつづけれられない場合に適切な情報の提供をできないという問題点があった。

【0006】また、上記従来のユーザインタフェースでは、視覚・聴覚のように人体の一部（頭部）に偏在する感覚器を通してのみ伝達される情報であって、また生物がその発生段階で直ちに獲得するものでなく、後天的学習を経て認識可能となる情報を提供するのみであるので、実体感やコミュニケーション性に欠けるという問題点があった。また、音声では外部のコミュニケーションを阻害しかねないという問題点があった。

【0007】そこで、ユーザに対し、極めて簡便な構成で効果的に触感（触覚）や抵抗・慣性感（力覚）を併せて触力覚として呈示可能なデバイスが研究されている。

かかるデバイスの一例は、特開平11-203040号公報、「触力覚呈示装置」等に開示されている。また、米国Immersion社とLogitech社とが共同開発した「Feel it Mouse（商標）」が知られている。この「Feel it Mouse（商標）」は、パーソナルコンピュータからの指示によりマウスデバイス自体に反力を与えることで抵抗感を表現するため、自由なポインティング動作が制限されてしまう。また、物体に触れた感じ（触感）を表すことができない。さらに、マウスデバイスが専用のマウス台の面から離れないため、操作が極めて困難であるという問題点がある。

【0008】本発明は上記実情に鑑みて為されたもので、触力覚を呈示して情報を提供できる触力覚呈示装置及び記録媒体を提供することを目的とする。

【0009】

【課題を解決するための手段】上記従来例の問題点を解決するための本発明は、ポインティングデバイスとともに使用される触力覚呈示装置において、前記ポインティングデバイスの操作に応じて動作するポインタが画面上で指し示すオブジェクトを特定するオブジェクト特定手段と、前記特定されたオブジェクトのプロパティ情報を取得する取得手段と、前記取得したプロパティ情報を触力覚情報に変換する変換手段と、前記触力覚情報に応じ、触力覚を呈示する呈示手段と、を含むことを特徴としている。

【0010】ここで変換手段は、前記オブジェクトに対する操作内容に従ってプロパティ情報を触力覚情報に変換することも好適である。また前記呈示手段は、前記ポインティングデバイスに一体的に形成されてなることが好適である。

【0011】上記従来例の問題点を解決するための本発明は、ポインティングデバイスとともに使用される触力覚呈示装置において、前記ポインティングデバイスの操作を検出する操作検出手段と、前記検出した操作の内容を触力覚情報に変換する変換手段と、前記触力覚情報に応じ、触力覚を呈示する呈示手段と、を含むことを特徴としている。

【0012】ここで、さらにポインティングデバイスの操作に応じて動作するポインタが画面上で指し示すオブジェクトを特定するオブジェクト特定手段と、前記特定されたオブジェクトのプロパティ情報を取得する取得手段と、を含み、前記変換手段は、前記取得したプロパティ情報と、検出した操作の内容とに基づいて、触力覚情報を出力することも好ましい。

【0013】また、上記従来例の問題点を解決するための本発明は、ポインティングデバイスとともに使用される触力覚呈示装置において、前記ポインティングデバイスの操作に応じて動作するポインタの位置情報を取得する位置情報取得手段と、前記取得した位置情報を触力覚情報に変換する変換手段と、前記触力覚情報に

力覚を呈示する呈示手段と、を含むことを特徴としている。

【0014】さらに上記従来例の問題点を解決するための本発明は、ポインティングデバイスとともに使用される触力覚呈示装置において、前記ポインティングデバイスの操作に応じて動作するポインタの形態を監視する手段と、前記監視の結果に応じて、触力覚情報を生成する手段と、前記触力覚情報に応じ、触力覚を呈示する呈示手段と、を含むことを特徴としている。

【0015】ここで、前記呈示手段は、移動可能に支持され、指先が載置される受感部と、前記触力覚情報の入力を受ける入力部と、前記入力部に入力された触力覚情報に応じて、前記受感部を移動させる駆動部とを備えるものであることが好適である。また、この呈示手段は、ポインティングデバイスとは別体として、ブレスレットや腕時計、着衣などとして手首部分や着衣部分を振動などさせて触力覚を呈示することも好ましい。

【0016】さらに上記従来例の問題点を解決するための本発明は、触力覚呈示方法において、ポインティングデバイスの操作に応じて動作するポインタ自身及びポイント先の少なくとも一方に関連する原情報を取得する工程と、前記原情報に応じた触力覚情報を出力する工程と、を含むことを特徴としている。ここで原情報は、例えばポインタ自身の形状や色、アニメーションなどであり、また、ポイント先の画素の情報やアイコン、ウインドウ、ボタンなどのユーザインタフェース部品などに関連づけられたプロパティ情報などである。

【0017】上記従来例の問題点を解決するための本発明は、触力覚呈示方法において、ポインティングデバイスの操作に応じて動作するポインタが画面上で指し示すオブジェクトを特定する工程と、前記特定されたオブジェクトのプロパティ情報を取得する工程と、前記取得したプロパティ情報を変換して触力覚を呈示させるための情報を生成し、出力する工程と、を含むことを特徴としている。

【0018】また、上記従来例の問題点を解決するための本発明は、触力覚呈示方法において、ポインティングデバイスの操作に応じて動作するポインタが画面上で指し示すことにより特定されたオブジェクトのプロパティ情報を取得する工程と、前記取得したオブジェクトのプロパティ情報を変換して、触力覚を呈示させるための情報を生成し、出力する工程と、を含むことを特徴としている。

【0019】これらの触力覚呈示方法において、前記触力覚を呈示させるための情報を生成して出力する工程は、前記オブジェクトに対する操作内容に従ってプロパティ情報を変換して、触力覚を呈示させるための情報を生成し、出力することが好ましい。また、前記出力された触力覚を呈示させるための情報に基づいて、触力覚を呈示するデバイスを駆動させる工程をさらに備えること

も好適である。

【0020】さらに、上記従来例の問題点を解決するための本発明は、コンピュータ読み取り可能な記録媒体であって、ポインティングデバイスの操作に応じて動作するポインタ自身及びポイント先の少なくとも一方に関連する原情報を取得するモジュールと、前記原情報に応じた触力覚情報を出力するモジュールと、の少なくとも一方を含むプログラムを格納したことを特徴としている。

【0021】

【発明の実施の形態】〔実施の形態1〕本発明の実施の形態について図面を参照しながら説明する。本発明の実施の形態に係る触力覚呈示装置は、図1に示すように、パーソナルコンピュータ10と、パーソナルコンピュータ10に接続されたマウス20とからなる。パーソナルコンピュータ10は、CPU11と、RAM12と、ROM13と、ハードディスク14と、表示部15と、操作部16と、外部記憶装置17とから構成され、各部はバス接続されている。マウス20は、図2に示すように、移動量検出部21と、操作ボタン22と、指先が載置され、移動可能に支持された受感部を含む触力覚デバイス23と、インタフェース部24とから主として構成されている。図2は、マウス20の断面図である。

【0022】パーソナルコンピュータ10は、例えばApple Computer (商標)社のMacintosh (商標)コンピュータや、Microsoft (商標)社が提供するWindows (商標)OSが動作するAT互換のコンピュータ装置であり、CPU11は、PowerPC (商標)やCeleron (商標)等のマイクロプロセッサである。このCPU11は、操作部16から入力される操作に応じて、各種の演算処理を行っており、表示部15に対し所定の表示出力処理を行っている。また、このCPU11は、マウス20の触力覚デバイス23を駆動する触力覚呈示処理を行っている。これらのCPU11の処理動作については、後に詳しく説明する。

【0023】RAM12は、CPU11のワークメモリとして動作している。ROM13は、主としてCPU11の起動時に必要なパラメータやソフトウェアモジュールを格納している。ハードディスク14は、Mac OS (商標)やWindows (商標)等のOSのほか、種々のアプリケーションを格納しており、これらのOSからコールされる各種のデバイスドライバソフトウェアがインストールされている。また、このハードディスク14は、後に説明するように、触力覚デバイス23を制御するためのパラメータを設定したテーブルを格納している。表示部15は、ディスプレイカード及びディスプレイ装置である。操作部16は、キーボードやマウスに接続されるインタフェースであり、具体的にはUSB等のシリアルインタフェース等である。この操作部16は、マウス20が接続されている。図1は、マウス20が接続されている。図2は、マウス20の断面図である。

には、このほかにキーボードなどが接続される。外部記憶装置17は、フロッピー（登録商標）ディスクや光磁気ディスクなど、電磁氣的、光学的にデータを格納するコンピュータ読み取り可能な記録媒体からデータを読み出して、CPU11に出力する。

【0024】マウス20の移動量検出部21は、具体的にはマウスボールBと、マウスボールBのX軸、Y軸の回転を検出するための2つのロータリエンコーダRとからなり、マウス20を動かしたときに、当該動きに合わせて回転するマウスボールBの回転をX軸、Y軸の各軸ごとに、対応するロータリエンコーダRが回転量を表すデータをインタフェース部24に出力する。

【0025】操作ボタン22は、スイッチSであり、この操作ボタン22をクリックする操作は、スイッチSの開閉によりインタフェース部24に伝達されている。スイッチSは、受感部に相当する触力覚デバイス23によってカバーされており、この触力覚デバイス23は、インタフェース部24に接続されている。また、触力覚デバイス23は、インタフェース部24から入力される制御の信号に従ってユーザの指Gに対し、触力覚を呈示する。この触力覚デバイス23の具体的構成については、後に詳しく説明する。

【0026】インタフェース部24は、移動量検出部21から入力されるマウス20の移動操作状況を検出してパーソナルコンピュータ10の操作部16に伝達する。また、このインタフェース部24は、操作ボタン22の押下状況をパーソナルコンピュータ10の操作部16に伝達する。さらに、このインタフェース部24は、操作部16から入力される触力覚情報に対応する制御信号を触力覚デバイス23に出力する。具体的にこのインタフェース部24は、触力覚情報として触力覚デバイス23を制御する力の値の入力を受けて、触力覚デバイス23を当該力で制御する。

【0027】ここで、CPU11の動作について詳しく説明する。CPU11は、オペレーティングシステムとしての処理と、デバイスドライバとしての処理と、アプリケーションプログラムの処理とを行う。具体的にこのCPU11は、オペレーティングシステムの処理として、主にアプリケーションプログラムごとのプロセス管理（処理スケジュールなどの管理）やメモリ管理の処理を行っている。また、このCPU11は、操作部16を介して入力されるマウス20やキーボードからの操作に関連する割り込み信号の入力を受けて、割り込み処理に移行して操作に関係したデバイスドライバの処理を行う。

【0028】ここで、このデバイスドライバの処理について説明すると、CPU11は、RAM12にマウスポインタの位置を格納しており、マウス20の移動量検出部21で検出されたマウス20の移動量に応じた信号をインタフェース部24を介して受けて、RAM12に格

納したマウスポインタの位置を更新する。このとき、CPU11は、過去のマウスポインタの位置からマウス20の移動速度 v と、移動加速度 a との情報を演算してRAM12に保持する。

【0029】また、このCPU11は、マウス20の操作ボタン22が押下（プレス）又はリリースされたことを表す信号の入力を受けて、それぞれオペレーティングシステムの該当する処理を行う。さらに、このCPU11は、オペレーティングシステム又はアプリケーションプログラムからの指示により、又はオペレーティングシステム又はアプリケーションプログラムの処理内容に応じて触力覚情報としての触力覚デバイス23を制御する力 F の情報を出力する。この処理内容に応じた処理は、例えばGUIにおけるアラートダイアログの表示時にこのダイアログを表示させるイベントメッセージをCPU11が検出して行う。

【0030】またここで力 F は、例えば触力覚デバイス23を移動させる力 F_0 に弾性力 F_e と、粘性 F_v と、抵抗力 F_f と、慣性力 F_i とからなる合力を加えたものであり、これらの弾性力、粘性、抵抗力、慣性は、各々、特定の点からのマウスポインタの変位 x と、RAM12に格納された速度 v 、加速度 a を利用し、次の(1)～(4)の数式により演算される。

【0031】

$$\text{【数1】 } F_e = k \times x \quad (1)$$

$$F_v = D \times v \quad (2)$$

$$F_f = f(x, \mu, N) \quad (3)$$

$$F_i = m \times a \quad (4)$$

【0032】ここで、 k 、 D 、 m 、 μ 、 N はそれぞれパラメータであり、アプリケーションプログラムから指定され、又は事前に設定され、ハードディスク14に格納された値が用いられる。すなわち、ハードディスク14には、図3に示すように、表現したい触力覚に対応する移動にかかる力 F_0 と、これらのパラメータとが例えば変換テーブルの形態でプリセットされている。

【0033】CPU11は、デバイスドライバの処理の間にアプリケーションプログラムやオペレーティングシステムからの指示に応じ、例えばマウスポインタの変位 x 、速度 v 、加速度 a と、このテーブルの値とから力 F を演算して、操作部16を介して触力覚情報として出力する。

【0034】ここで、触力覚デバイス23の具体的構成について説明する。図4(a)は、触力覚デバイス23の一例の平面図であり、図4(b)は、図4(a)の触力覚デバイス23の側面図である。触力覚デバイス23は、図4(a)に示すように、板状の基部31と、受感部32と、基部31と受感部32とを連結する弾性部材33a～dとが設けられている。

【0035】ここで基部31の中央部分を原点としてXY直交座標を便宜的に考えると、図5に示すように、基

部 31 の第 1 乃至第 4 の各象限にそれぞれ磁石 35 が配置され、この磁石 35 は、各象限ごとにその N 極と S 極とが交互になるように配置されている。図 5 は、図 4 (a) に対応する透視図である。

【0036】受感部 32 の底面には、第 1 第 4 象限をまたぐ第 1 コイル 36 a と、第 1 第 2 象限をまたぐ第 2 コイル 36 b と、第 2 第 3 象限をまたぐ第 3 コイル 36 c と、第 3 第 4 象限をまたぐ第 4 コイル 36 d とが形成されており、これらのコイル 36 にはそれぞれコイルに流れる電流を制御する電流制御部 37 a ~ d が設けられている。すなわち、この電流制御部 37 が、対応するコイル 36 に対する電流量を制御することで、受感部 32 の移動のための力 F を制御している。

【0037】尚、受感部 32 の底面と基部 31 の磁石 35 の間には、これらの間の摩擦を少なくして受感部 32 の移動を容易にすべく、低摩擦材料であるフッ素樹脂（例えばポリテトラフルオロエチレンなど）を用いた摺動層を挟むことも好適である。

【0038】さらに、受感部 32 には、その立体的移動を実現するためのアクチュエーターを含むことも好適である。

【0039】次に、本発明の実施の形態に係る触力覚呈示装置の動作について説明する。本実施の形態の触力覚呈示装置は、電源投入後に CPU 11 が ROM 13 に格納されている指示に従って、ハードディスク 14 に格納されたオペレーティングシステムを読み込み、このオペレーティングシステムの処理を開始する。やがて、オペレーティングシステムの起動処理が完了すると、ファインダ（商標）や、プログラムマネージャ（商標）等のビジュアル・シェル・アプリケーションが起動され、表示部 15 を介してディスプレイ上に様々なアプリケーションプログラムなどに対応するアイコンが表示されるようになる。そしてユーザは、マウス 20 を操作してマウスポインタを移動させ、ディスプレイ上に表示されたアイコンをクリックしたり、ドラッグしたり等の操作ができるようになる。

【0040】このとき CPU 11 は、マウス 20 の操作の速度 v と、加速度 a とを RAM 12 に格納している。そして CPU 11 が処理するアプリケーションプログラムやオペレーティングシステムが、触力覚を呈示しようとするときには、呈示したい触力覚を表す情報をデバイスドライバに伝達し、CPU 11 がデバイスドライバの処理として、呈示したい触力覚に対応する力 F をハードディスク 14 に格納されたテーブルを利用して演算し、触力覚情報として操作部 16 を介して出力する。そして、マウス 20 のインタフェース部 24 が、この触力覚情報に対応する制御を触力覚デバイス 23 に対して行って、ユーザの指に触力覚が伝達される。

【0041】すなわち、CPU 11 は、オペレーティングシステムやアプリケーションの処理として起動状態や

ハードディスクアクセス、入力待ち、ジョブ待ち、使用電源の種類、消費電力モード（動作状態、省電力状態、スリープ状態など）等の状態を検出して、各状態に対応して事前に設定された触力覚を呈示する。また、メールの着信やバッテリーの残量、他のコンピュータからのアクセスの有無等に対応して触力覚を呈示することとしてもよい。また、表示部 15 による表示や、スピーカーなどを介しての音声信号の鳴動に同期させて触力覚を呈示することとするのも好ましい。

【0042】尚、ここで、触力覚に対応する力 F は CPU 11 により演算されることとしているが、マウス 20 のインタフェース部 24 が CPU 11 から入力される指示に応じた触力覚に対応する力 F を演算して触力覚デバイス 23 を制御することとしても構わない。この場合には、インタフェース部 24 が触力覚に対応するパラメータを格納する ROM を備え、マウスポインタの移動速度や加速度を検出して、移動速度等やパラメータに応じた触力覚を演算し、触力覚デバイス 23 を制御する。

【0043】また、ここまでの説明では、本実施の形態の触力覚デバイスはハードディスクなどを備えたパーソナルコンピュータなどを想定して説明したが呈示しようとする触力覚に対応するパラメータを ROM 13 に設定したり、外部記憶装置 17 で読み出されるプログラムに従って設定すれば、例えばゲーム機等では、プログラムのロード中、データセーブ、ロードの間、画面の切替状態や画面のスクロール状態などに対応した触力覚を呈示できる。

【0044】また、マウス 20 内に CPU を備えて、マウス 20 に対する操作に応じて直接触力覚デバイスを制御するようにしてもよい。

【0045】さらに、CPU 11 は、プリンタにおける紙切れやスキャナからのデータ受信中等、ユーザの注意を喚起するための表示を行っている場合や、装置の状態を表したいときに、例えば触力覚デバイス 23 を大きく振動させたり、丸、三角などの記号、文字の形状をなぞるように移動させてもよい。

【0046】このように本実施の形態によれば、CPU 11 がマウスなどの操作、表示内容、装置の状態などに応じて、マウスなどの動きとは独立に触力覚を呈示可能な触力覚デバイス 23 を制御してユーザに触力覚を呈示するため、ユーザに視覚障害があったり、ディスプレイを注視し続けられない事情がある場合にも適切な情報提供をすることができる。

【0047】[実施の形態 2] 次に、本発明の第 2 の実施の形態に係る触力覚呈示装置について説明する。本実施の形態の触力覚呈示装置は、図 1 に示した第 1 の実施の形態に係るものと同様のものであるが、CPU 11 における処理内容が少々異なっている。

【0048】すなわち、本実施の形態の CPU 11 は、アプリケーションの処理として、EXHIBIT 10 の PAGES の配置

情報に対応するディスプレイ上のオブジェクト（例えばファイルやウィンドウなど）のプロパティ情報を取得し、このプロパティ情報に応じて触力覚情報を操作部16に出力する。

【0049】例えば、CPU11は、CADアプリケーションなどの処理としてCAD図形のグリッドへの吸着などの処理を行うとともに、当該CAD図形の吸着方向に対する触力覚を表す触力覚情報を操作部16に出力する。また、図形の削除、変形、置換、合成、分割など、種々の操作内容に応じて触力覚の呈示処理を行う。

【0050】また、CPU11は、オペレーティングシステムに対するシェルアプリケーションの処理として、GUIにおけるファイル操作に対応する触力覚情報を操作部16に出力する。具体的には、ディスプレイ上に表示されたファイルのアイコンに対する処理として、ファイルの移動・複製などの各操作に対応する触力覚情報をハードディスク14に変換テーブルとして格納しておく、対応する触力覚情報を操作部16に出力する。さらに、ファイルの移動処理中、複製処理中等の処理状況を表す触刺激を呈示してもよい。例えば移動処理の進行状況に応じて振幅を変化させつつ、振動の触力覚を呈示することが考えられる。このためには、CPU11が変換テーブルに格納された触力覚情報のパラメータを処理の進行状況に応じて調整しつつ操作部16に出力するようにしておく。

【0051】さらに、CPU11は、操作内容によりファイルが失われたり、改変される可能性のある場合に、触力覚を呈示することも好ましい。

【0052】さらに、CPU11は、ファイルのドラッグ移動時に、当該ファイルのサイズを取得し、[数1]の(1)に示したパラメータ k をファイルのサイズに応じて調整し、調整後の k を用いて触力覚に対応する力 F を演算し、この F を操作部16に出力することにより、ドラッグ方向と反対方向に対する触力覚を呈示することも好ましい。このようにすれば、マウス20と一体に形成された触力覚デバイス23の動きにより、例えばファイルのサイズが大きいときにマウス20があたかもドラッグに逆らっているような（マウス操作が重くなったような）印象をユーザに与えることができる。尚、ファイルのサイズのみならず、フォルダ（ディレクトリのGUIメタファ）をドラッグするときに、フォルダ内に含まれるファイルの数に応じてパラメータ k を調整し、ファイル数に対応した触力覚を呈示することとしてもよい。

【0053】さらに、ハードディスク14に図6(a)に示すようなファイル種別に応じた触力覚のパラメータを対応付けて変換テーブルとして格納しておく、CPU11が操作対象のファイルの種別を認識して、この変換テーブルを参照し、対応するパラメータにより触力覚に対応する力 F を演算して操作部16に出力してもよい。これにより、書類であれば抵抗感の小さい触力覚を呈示

し、アプリケーションであれば、抵抗感の大きい触力覚を呈示するなどの処理が可能となる。ここでさらに、ファイルの種別のみならず、当該ファイルに対しての操作内容にも応じて、触力覚を変化させることも好適である。この場合には図6(b)に示すようにファイル種別と操作との複数の条件に対応付けてパラメータを格納した変換テーブルをハードディスク14に設定し、CPU11がこの変換テーブルを参照してパラメータを取得し、触力覚情報を出力する。

10 【0054】またCPU11は、ドラッグ操作時のマウスポインタが指し示す位置にあるアイコンなどのオブジェクトによって呈示する触力覚を変化させてもよい。この場合には、ハードディスク14に格納された変換テーブルは、ドラッグ操作の対象となっているオブジェクトと、マウスカーソルの位置に対応する位置にあるオブジェクトとに対し、各パラメータを対応付けたものとなっていることが好ましい。この場合にはCPU11が操作対象オブジェクトと、位置に対応するオブジェクトとに対応するパラメータにより触力覚情報を演算し、操作部16に出力する。これにより、例えばアプリケーションのアイコンを「ごみ箱」のアイコンに重ねようとする

20 と、マウス操作が重くなったかのような触力覚を呈示したり、ドラッグ対象のファイルがドラッグ先のアプリケーションで開くことができないような場合に、そのドラッグ操作に逆らうような触力覚を呈示することで、ユーザにさらなる情報の提供をすることができる。

【0055】さらに、ここまでの説明では、ハードディスク14に格納された変換テーブルは、ファイルの種別等のオブジェクトのプロパティ情報や操作内容の情報に関連づけてパラメータを設定するものであったが、オブジェクトのプロパティ情報等に対し、「横振動」等の触力覚を表す情報を関連づけて設定する第1変換テーブルと、当該「横振動」等の触力覚を呈示するためのパラメータを関連づけて設定する第2変換テーブル（図3に示したようなもの）とをそれぞれハードディスク14に格納しておく、CPU11がまず、第1変換テーブルを参照して触力覚の情報を取得し、さらに当該触力覚を呈示するためのパラメータを第2変換テーブルを参照して取得して、このパラメータに基づいて触力覚を表す力 F を演算して操作部16に出力することとしてもよい。尚、この場合にも第1変換テーブルは、ファイル種別等のプロパティ情報のみならず、当該ファイルに対する操作内容の情報との組み合わせに対して触力覚の情報を関連づけておくことも好ましい。

【0056】さらに、CPU11は、GUIのオブジェクトとしてファイルアイコンに対する操作などの場合だけでなく、ウィンドウの表示面積や形状を変化させるときにその操作に応じた触力覚をユーザに呈示することも好ましい。ここで、当該ウィンドウが最も前面にあるか否かや、アクティブ（選択されている）APPLE INC.であるか否かに

よって異なる触力覚を呈示することも好適である。同様に、ウインドウの領域内にマウスポインタが入ったときや領域から出たときに触力覚を呈示してもよい。この場合には、ウインドウの背景画像（壁紙画像）の画像パターンを認識し、マウスポインタが指し示す位置の画素の情報が当該画像パターンに一致しているか否かの比較により、ウインドウ内にあるか否かを検知してもよいし、オペレーティングシステム内でのウインドウ情報が取得できる場合には、当該ウインドウ情報（ウインドウ表示位置の情報など）によって検知してもよい。また、アプリケーションプログラムなどで、ウインドウオブジェクトに関連するメッセージを受信したときに、対応する触力覚を呈示するようにしてもよい。この最後の場合には、アプリケーション側の処理として各メッセージに対応する触力覚情報を直接演算して出力することとしてもよいし、オペレーティングシステムに事前に設定された情報に従って、各メッセージに対応する触力覚情報を出力することとしてもよい。

【0057】さらに、ウインドウに対する操作としては、例えばアプリケーション及びオペレーティングシステムの処理として、ウインドウの表示面積を拡大する際に、当該ウインドウに対し、事前に設定された最大サイズを超える調整を行おうとする操作に対し、当該操作に抵抗感を示す触力覚を呈示してもよい。

【0058】さらに、ウインドウ内に表示された画像などのデータに応じて触力覚を呈示することも好ましい。例えば、山岳地図の画像データは、標高に応じて色相が変化するカラー画像データによることが多いため、CPU11が色相情報を抽出し、色相情報の変化に対応した触力覚情報を出力することで、標高の高い方向にマウス20を移動する操作に対しては、移動方向と反対方向の触力覚を呈示し、標高の低い方向にマウス20を移動する操作に対しては、移動方向に慣性感を与える触力覚を呈示することができ、あたかも立体地図をなぞるような触力覚を呈示できる。同様に、RGBデータのR濃度に比例した位置変位を生じる触力覚情報を出力することで、色彩を触覚によって表現できる。

【0059】さらに、ウインドウ内に表示された画像やテキストに対応してマウスポインタの形状や色、アニメーションなどが変化する場合には、当該形状や色、アニメーションなどの形態に対し、触力覚のパラメータをハードディスク14に変換テーブルとして設定しておき、CPU11がマウスポインタの形態を監視して、当該形態に対応する触力覚のパラメータを取得して触力覚情報を演算し、操作部16に出力することとしてもよい。この場合には、形態の情報に触力覚のパラメータを関連づけて設定しておき、CPU11が監視結果としてのマウスポインタの形態に関連づけられたパラメータを取得して、当該パラメータにより触力覚の情報を出力する。また、形態の変化に応じて触力覚を与える場合には、変化

前の形態の情報と、変化後の形態の情報とに触力覚のパラメータを関連づけて設定しておき、CPU11が変化前のマウスポインタの形態を保持し、監視結果としてのマウスポインタの形態変化に応じて、変化前の形態及び変化後の形態とに関連づけられた触力覚のパラメータを取得して触力覚情報を演算し、操作部16に出力するようにしておいてもよい。

【0060】さらに、ユーザの操作により、ディスプレイ上に表示されたメニューを選択するときに、CPU11が現在マウスポインタが指し示しているメニューに対応する触力覚情報を出力するようにしてもよい。この場合には、当該メニューを提供するアプリケーションが保持する変換テーブルをCPU11が参照する。これにより、アプリケーション固有の触力覚を呈示することができるようになる。尚、このアプリケーション固有の触力覚のパラメータに対応する変換テーブルは、ユーザが任意にカスタマイズ可能としておくのも好ましい。

【0061】このアプリケーション固有の触力覚としては、メニュー項目をなぞるときに、1つおきに振動の触力覚を呈示したり、印刷・保存など特定のメニュー項目上にマウスポインタがあるときに、特有の触力覚を呈示する等の処理がある。ここで特有の触力覚とは、例えば「保存」は縦の変位、「印刷」は横の変位、「削除」は振動などである。また、この場合にも、保存の処理進行状況、印刷の処理進行状況に応じて変位の大きさを調整することが好ましい。

【0062】**【発明の効果】**本発明によれば、ポインティングデバイスの操作に応じて動作するポインタが画面上で指し示すオブジェクトを特定し、当該特定したオブジェクトのプロパティ情報を取得し、取得したプロパティ情報を触力覚情報に変換し、触力覚情報に応じ、触力覚を呈示するので、ディスプレイを注視しつづけなくても適切に情報を提供できる。また、触力覚による呈示であるため、他のコミュニケーションを阻害することがない。

【0063】また、ポインティングデバイスの操作を検出し、当該操作の内容を触力覚情報に変換して、触力覚を呈示する本発明によれば、ディスプレイを注視しつづけなくても適切に情報を提供できる。また、触力覚による呈示であるため、他のコミュニケーションを阻害することがない。

【図面の簡単な説明】

【図1】 本発明の実施の形態に係る触力覚呈示装置の構成ブロック図である。

【図2】 マウスの断面を表す概略構成図である。

【図3】 変換テーブルの一例を表す説明図である。

【図4】 触力覚デバイスの一例を表す概略構成図である。

【図5】 図4(a)に対応する透視図である。

【図6】 変換テーブルの別の例を表す説明図である。

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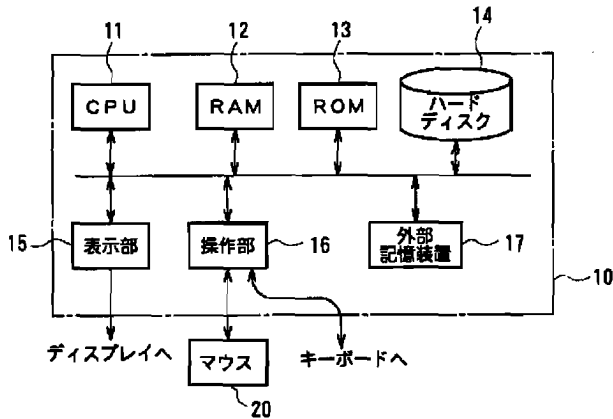
50

【符号の説明】

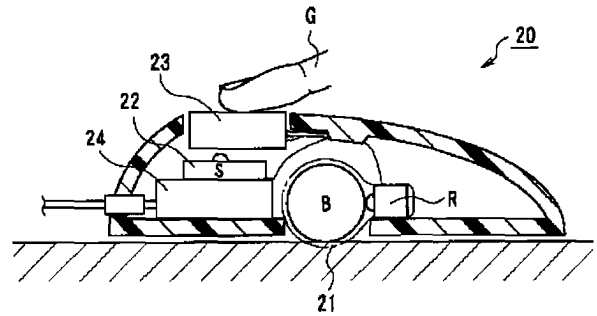
10 パーソナルコンピュータ、11 CPU、12 RAM、13 ROM、14 ハードディスク、15 表示部、16 操作部、17 外部記憶装置、20 マ*

*ウス、21 移動量検出部、22 操作ボタン、23 触力覚デバイス、24 インタフェース部、31 基部、32 受感部、33 弾性部材、35 磁石、36 コイル、37 電流制御部。

【図1】



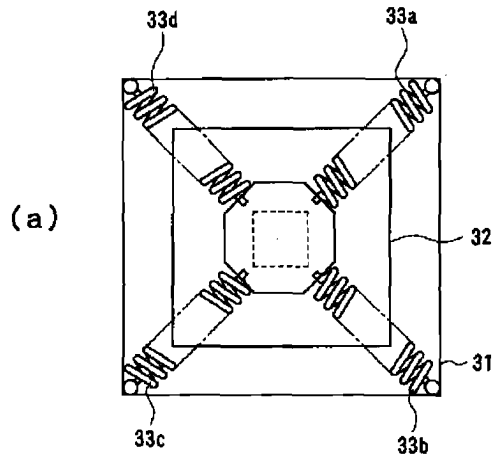
【図2】



【図3】

触力覚	Fo	k	D	m	μ	N
横振動	aaa	bbb	ccc	ddd	eee	fff..
⋮	⋮	⋮	⋮	⋮	⋮	⋮

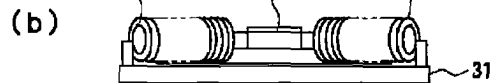
【図4】



【図6】

(a)

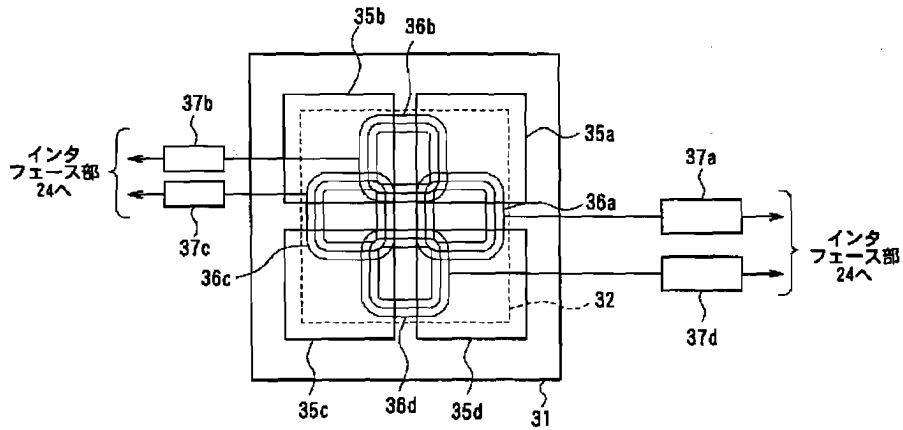
ファイル種別	Fo	k	D	...
書類	ppp	qqq	rrr	...
システム	⋮	⋮	⋮	⋮



(b)

ファイル種別	操作	Fo	...
書類	ドラッグ	xxx	...
	⋮	⋮	⋮

【図5】



フロントページの続き

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 CB07 CB09 DA11 DA13 EA05
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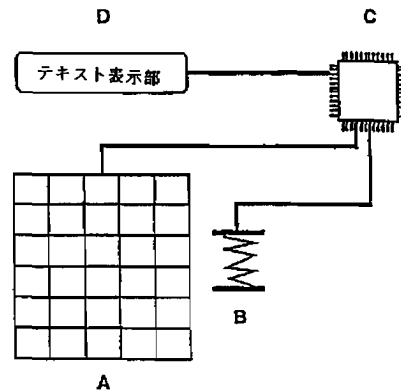
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(54)【発明の名称】 数値電話キーボードによりリストからテキストを早く選択するための装置と方法

(57)【要約】

電子記憶器から数値電話キーボードによりテキストを選択するための装置と方法を開発するというこの発明の課題は、一つまたはそれ以上のキーに働く押圧力を測定する少なくとも一つの圧力センサと、キー操作による入力を演算処理する制御電子回路と、テキスト表示部のある表示器を備えているデジタル電話キーボードを提案することにより解決されている。その場合、デジタル電話キーボードのキーに加わる費やされた加圧力は各キーの圧力センサで検出されて測定される。その時の圧力値は制御電子回路に与えられ、そこで演算処理される。測定された圧力値は表示器上に各キーに対して表示される。これにより操作されたキーに加わる圧力値を変え、表示器上に表示された正しい圧力値に達すると、操作された各キーに対する押圧圧力と選択されたキーに関する情報が他の測定値処理部へ供給される。



【特許請求の範囲】

【請求項1】 数値電話キーボードにおいて、デジタル電話キーボード（A）に一つまたはそれ以上のキーに働く押圧力を測定する圧力センサ（B）、キー操作による入力を演算処理する制御電子回路（C）およびテキスト表示部のある表示器（D）が装備されていることを特徴とする数値電話キーボード。

【請求項2】 圧力センサ（B）はキーに働く作動力を約 10 g ～ 1500 g の範囲で検出することを特徴とする請求項1に記載の数値電話キーボード。

【請求項3】 どのキーがどのような力で押下されているかに応じて、フィードバックはテキスト表示部によるかあるいは音響的に行われることを特徴とする請求項1と2に記載の数値電話キーボード。

【請求項4】 このキーボードは0～9までおよび特別な記号のキーで構成されていることを特徴とする請求項1に記載の数値電話キーボード。

【請求項5】 請求項1～4の電話キーボードによりリストに保管されている情報を選択したり呼び出す方法において、その都度調整された可変できる加圧力が順にデジタル電話キーボード（A）のキーに加わり、圧力センサ（B）NIより費やされる加圧力は操作された各キーに対して検出されて測定され、その時の圧力値を制御電子回路（C）に与え、そこで演算処理し、測定された圧力値を表示器（D）上に操作された各キーに対して表示し、それにより電話キーボード（B）の操作者が操作されたキーの各々に対して加えた圧力値を必要な場合に可変し、キーの操作を終えた後に表示器（D）に表示される正しい圧力値に達したら、操作された各キーの押圧力および選択されたキーに関する情報が他の測定値処理部へ供給されることを特徴とする方法。

【請求項6】 関連する測定値を決めたり選択するため、連続する少なくとも二つの測定サイクルに対する押圧力を検出し、一定の時間間隔内に測定を行うことを特徴とする請求項5に記載の方法。

【請求項7】 測定値を求めることは二回、つまりキーを操作する場合と、操作したキーにより加圧を止める時に行われることを特徴とする請求項5に記載の方法。

【発明の詳細な説明】**【0001】**

この発明は、数値電話キーボードによりリストからテキストを早く選択するための方法および電子電話帳から文字を早く簡単に選択する構造物に関する。

【0002】

数値キーボードで文字を入力するため、通常複数の文字にその都度一つの数字キーが付属している。

【0003】

今日では表示器のある電子電話に電子電話帳が備えているのが普通であり、これにより約百の名前を付属する電話番号と共に記憶することができる。習慣、コストおよび簡潔な箇所は数字入力に対してのみ想定されている元の数字キーボードが更に使用されることを与える。

【0004】

文字や国際的な特別な文字を入力するのに必要とするより少ないキーがあるので、数値キーを多重化する必要がある。このため、統一的なアルファベット順が設定されている。

【0005】

電子目録から任意の記入事項を呼び出すため、以下の過程が必要となる。つまり、

—機能「電話帳」を選ぶ、

—望む人物の一つまたは複数の初期文字を入力する。結果が確実にするにはできる限り多くの文字が望ましい。しかし、文字入力は多重にしていることにより手間がかかる。二つの文字を入力するには8つのキーまでを操作する必要がある。

—キー「入力」は入力を終え、目録表示に切り換わる。この過程は多くの解決策で処理を短縮するために省かれている。しかし、これにより入力モードが複雑になる。この場合、矢印キーが入力順かあるいは目録リストを指しているのか曖昧である。

—目録にはテキスト入力に対してアルファベットで次の記入事項が強調されている

る。これは望む記入事項であるなら、これを直接選択できる。そうでなければ、矢印キーを用いて目録を捲る必要がある。これは“Miller J”（ミラー・ジェー）や“Miller P”（ミラー・ペー）のような似た名前の初めを持つ人物あるいは“Esso Hamburg”（エッソ・ハンブルグ）や“Esso Hannover”（エッソ・ハノーバー）のような会社名が存在する時に起こる。

【0006】

この方法の代わりとして、以下の解決策もある。即ち、

- 大抵の電話製造メーカーは代替りのものとして短縮選択を提示している。その場合、記入事項を番号で選択する（記憶するのに難しい）か、あるいは既存のキーを多重に組み合わせる（もっと複雑になる）。拡張された選択繰返（最後のN回の選択過程は一つリストから呼び出せる）も全目録と置き換えることができない。
- 製造メーカーは「ジョグダイヤル」（Jog Dial），つまり目録を電子的にめくるダイヤルを提示している。これはキーボードを用いるより早く、ダイヤルは異なった速度に作用する。この解決策も簡単であると理解できる。しかし、指を用いて更にダイヤルに切り換える必要があるので、時間の利点が重要でない。
- 他の提供者は音声入力に反応する移動電話を提示している。これにより、音声認識の確実さが不確実であること（特に途中でバックグラウンド雑音を伴う難しい条件の場合）に直面して、目録の下位の小さなリストから選ぶことのみが可能である。従って、この解決策は現時点では実際に使用されていない。
- 他の製造メーカーは、キーボードの代わりにデジタイザーを伴うLCD画面を組み込んだ他のものを製造している。これはペン入力を用いる出力能力のある図形ソフトウェア面を可能にする。経費が高いにもかかわらず、この簡単な数字入力はキーボードを用いるものよりも面倒である。残念ながらただ一本の指で（恐らく親指でも）名前を早く選択できない。

【0007】

この発明は、約二十と数百の間の範囲のリストから数値電話キーボードを用いて選択するため、できる限り早くて簡単に理解できる操作性と、簡単で早い作業と、低い製造コストを有する低装置経費を目指している。

【0008】

この発明の課題は、数値電話キーボードを用いて電子記憶器の形のリストから早くテキストを選択する方法を開発することにある。

【0009】

この課題は従属請求項の特徴部分にある構成で解決されている。

【0010】

この発明により形成された電話キーボードは、4つの構成要素、つまり通常のデジタルキーボードA、キーに作用する力を約10g～約1000gの範囲で検出する圧力センサB、入力を処理する制御電子回路C、およびテキスト表示部を有する表示器D（図3）から成る。

【0011】

圧力センサBは各キーに対して個々の存在する。これ等のキーが機械的に関係し、同時にハウジングに対してグループとして僅かに移動する場合には、任意のキーの押圧力を測定するのに一つの個別圧力センサで充分である。それ故、これはキーの動作開始と押圧力を互いに別々に検出するので可能である。

【0012】

キーを作動させると、Aの電気接点が閉じる。更に、このキーの作動がセンサBを働かせ、選択されたキーと同時に測定された押圧力に関する情報を制御部Cに受け渡す。キーをより長く保持すると、押圧力が一秒当たり何度も新たに測定され、その値が制御部に受け渡される。制御部Cは選択されたキーと加わっている力に応じて、異なった記入事項を記憶されたリストから呼び出し、<1sの応答時間で表示するように入力を評価する。この制御部は操作を楽にし、他方で震えにも余り早く応答しないように、早く応答しなければならない。

【0013】

この構造物を利用する人物は、キーを加圧し始めた後に、表示部と対話し、押圧力を高めるか低める、あるいは望む記入事項を表示するまで他のキーも選択することができる。キーを離すと、最後に選択された記入事項が表示部に残っている。

【0014】

他の過程では、選択された記入事項を動作させる。例えば、数字選択キーにより望む人物が呼び出される。この構造物の応用は、特に記憶されている電話帳から記入事項を選択することにあるが、数字キーボードにより補助的にテキストを記入することにもある。表示器の代わりに、他の形のフィードバックも行え、例えば合成音声による音響フィードバックも行える。

【0015】

短時間でしかも同時に他の作業のために操作すべき小さな電子装置では、キーボードは手で操作するのに有用な対象物である。しかし、人には手で単なるボタンとしてデジタル的にタッチすることを何回も行える。対象物を引き、押圧し、回転し、摺動させる等ができる。電子キーボードのうちの通常のキーボードは可否の情報を受け取る。テキストまたは数字を入力する場合、これは完全に充分でもある。

【0016】

指で約 10 g から約 1500 g までの力を可変して加えることができるが、この力は粗く与えることができるに過ぎない。フィードバックなしに、僅かな過程しか確実に操作できない。つまり、約「強く」、「緩く」および「全く簡単に」押圧できる。この状況は早く見えるか、または音響によるフィードバックが得られれば変わる。大抵の人は困難性なく、例えばバランスさせて数グラムの望む圧力を加えて、数秒間維持できる。この関係はこの発明にとって重要である。

【0017】

圧力センサは遊戯コンソールや電子音楽装置で使用されるが、入力キーボードの多重性に関連して、これ等の圧力センサは有効に利用されていない。

【0018】

電子制御部は望む操作性の容易さを得るためにただ一つの入力を評価する必要がある。その場合、特に以下の難点に注意する必要がある。

一反応速度： 選択されたリスト記入事項を約 100 ms 以内に表示するように測定と評価を早く行う必要がある。他方、小さな変動あるいはジッタは即座に作用することはない。これは多数の測定値を 50 ~ 500 ms の時間間隔にわたり平均化して達成できる。更に、表示された選択はそれに応じて得られてい

きである。

- 力の配分およびリスト記入事項の付属： どれだけ多くのリスト記入事項があるかに応じて、押圧力の段階付けが大きくなったり小さくなる。段階付け、例えば 30 g ~ 100 g ~ 300 g ~ 600 g はアルゴリズムによりその都度計算するか、それとも表から取り出す。
- 小さなドリフト（押圧力のゆっくりとし意図的でない僅かな減少または上昇）を小さく維持するため、圧力の変化が生じる前に変化・しきい値以上となる必要がある。
- ただ一つの個別圧力センサを使用する場合には、それに応じてキーボード上のキーの空間的な位置を圧力値あるいは修正に関して考慮する必要がある。例えば、圧力センサを電話のキーボードの下の中央に取り付けるなら、中間のキー「5」は外側のキー「1」、「3」、「7」と「9」の場合よりも小さい圧力で既に小さなレバー作用により反応する必要がある。
- 経費を少なく維持するため、圧力センサの絶対精度は低くてもよい。しかし、使い易さを保証するためセンサと制御部は圧力の相対変化に正確に応答する必要がある。これは、例えば実際に作用する力に対して自動的に調整してまたは合わせることにより達成できる。

【0019】

この発明により構成された数値電話キーボードを用いると、記憶されたリストからの記入事項は文字切換の通常の多重作動を用いるよりも充分少ない過程で選択できる（表、図5）。アルファベット順に分類されている名簿に少ない文字で記入事項を入れるため、通常のキーボードでは若干の器用さが必要である。同一の初期文字を有する記入事項がどれだけ存在するかに応じて、一つ、二つまたは非常に多くが特定される。この発明により構成されている圧力に敏感な数値電話キーボードにより、ただ一つの可変圧力で任意の記入事項を選択できる。通常のテキスト入力の場合の利点は幾分顕著さが少ないが必ず存在する。

例の記号列： “EXAMPLE”

テキスト入力の周知の方法： 339926755533

テキスト入力の提案する方法： 3.9.2675..3.

【0020】

テキストの入力は単に簡単に行えるだけでなく、早く行うこともできる。何故なら、電話キーボードの操作者の指は何時でもキーから離しておく必要がないからである。

【0021】

押圧測定値を評価するのに適当なアルゴリズムを以下に説明する。どの測定値を選択のために使用するかを定めるには二つの簡単な規則がある。即ち、
-連続する少なくとも二つの測定サイクルの間に維持する最強の押圧力が決定される。測定は特定な時間間隔 $intv$ に対して行われる。
-しかし、その後、小さい押圧力を特定な回数の測定サイクル $oktime$ あるいはそれより長い間維持するならば、この小さい押圧力が成立する。
-これにより、系はキーを離す場合よりも早くキーを押圧する（圧力を高める）場合により早く反応する。これはキー等をゆっくりと滑らせることにより乱れた結果を防止する。

【0022】

$intv$ に対する典型的な値は 80 ms であり、 $oktime$ に対して 10 インターバル ($10 * intv = 800$ ms に相当する) である。時間 $intv$ は僅かに反応時間以下であり、 $oktime * intvl$ は大体それ以上である。訓練された利用者がこの装置を幾分早く操作するので、利用者により粗いステップでこの両方の変数を可変できる。これはコンピュータのマウスでマウス速度と二重クリック時間の設定に相当する。

【0023】

図7のリストはパスカルに似たプログラム言語の擬似コードでアルゴリズムを記載している。このアルゴリズムは以下の要請を満たしている。即ち、
-有効になるには、測定値が少なくとも二回連続して生じる必要がある。これはランダムな変動、例えば（例えば自動車走行中の）ジッタあるいは揺動による乱れを防止する。
-何時も結果が生じる。一つのキーを押下し、最初の測定で押圧センサが零の押圧値を出力するという稀な場合、選択、零が通報される。

- 表示器の速度がそれに対して充分であるなら、表示器は何時でも押圧力に一致する。評価が認識するより早く押圧力が変わるなら、表示は幾分遅れる。つまり、表示器は幾つかの値を落とす。しかし、この表示器は入力を遅くすることはない。何故なら、それにもかかわらず値が登録されるからである。
- 一つのキーを離すと、アルゴリズムが直ちに（つまり測定間隔内で）決まる。
- 強い押圧力は必ず直ぐに（次の測定間隔で）考慮され、少なくとも表示器のスクロールバーが使用される。
- 一定の圧力は遅くとも時間間隔 *oktime* の後に対応する表示を保証する。
- キーを早く離すと、表示値が保持されている。
- これに反してゆっくりと離すと（押圧力の範囲に対して最小の *oktime*）低い押圧力のステップも選択できる。これは戻しスクロールに相当する。
- このアルゴリズムは最小の計算出力しか使用していない。平行して進む計算処理はただ僅かに負担となり、マイクロプロセッサはエネルギーを節約して動作する。

【0024】

図5には操作中のセンサ測定値の変化に対する若干の例が示してある。この場合、黒い点は強いあるいは長い押圧力により新しい測定値が新しい選択になる（リストには#1と#2でマークされている列を通過する）ところを示す。白い点は変化する押圧力を記録し、表示器でスクロールバーが動作するが、選択は変化しない（リストの#1）ところを意味する。最終的には、グラフ中の最も右にある黒い点でマークされている圧力が何時も有効になる。詳しくは、グラフは以下の場合を表している。即ち、

- ゆっくりと戻し、次に大きすぎる強い押圧力。訓練していない利用者により図4の点1の目標値を走査することに対応する。
- 目標値まで押圧し、次いで図4の点2で離す。これは、押圧力に対する感触が発達しているが、表示を一緒に行うために圧力をゆっくりと充分高める利用者に相当する。
- 図4の点3による早く狙いの押圧力と離し。このように短い押圧では、全ての中間値を表示するには時間が充分でない。押下した時でも白い点である。

れでも正しい値が得られる。

一図4の点4でのゆっくりとした押圧、非常にゆっくり離す。これにより全ての中間段階が表示される。つまり、例えば記入事項を検査できる。最後に、最小の押圧ステップが選択される。

【0025】

これ等の曲線から、キーの押圧過程を選択されたステップに割り当てることが複雑な過程であることが分かる。このアルゴリズムはセンサの情報と経過時間に応じて何時も表示器にフィードバックを供給する必要がある。この入力システムイに対する慣れ期間はそれを最適に操作できるように必要である（これは通常の入力システムにも当て嵌まる）。

【0026】

図6には表示器の設計に対する若干の例が与えてある。表示の右縁のスクロールバーにより加えた圧力に対する目視されるフィードバックが提供される。スクロールバーの白い長方形はより高い圧力で下に更に移動する。このスクロールバーはキーを押下しているまで目視できる。

【0027】

【図面の簡単な説明】

- 【図1】 付属する文字を有する電話キーボード、
- 【図2】 電話キーボードの機械的配置の断面、
- 【図3】 この発明により形成された電話キーボードの部品図、
- 【図4】 押圧測定による例示的なキー操作のグラフ、
- 【図5】 文字に対する数字コードの表
- 【図6】 画面表示部としての単一／多重表示器、
- 【図7】 センサ情報を評価する処理過程のリストを示す。

【図1】

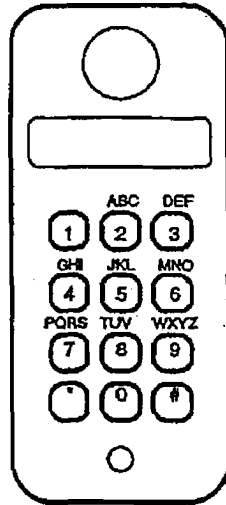


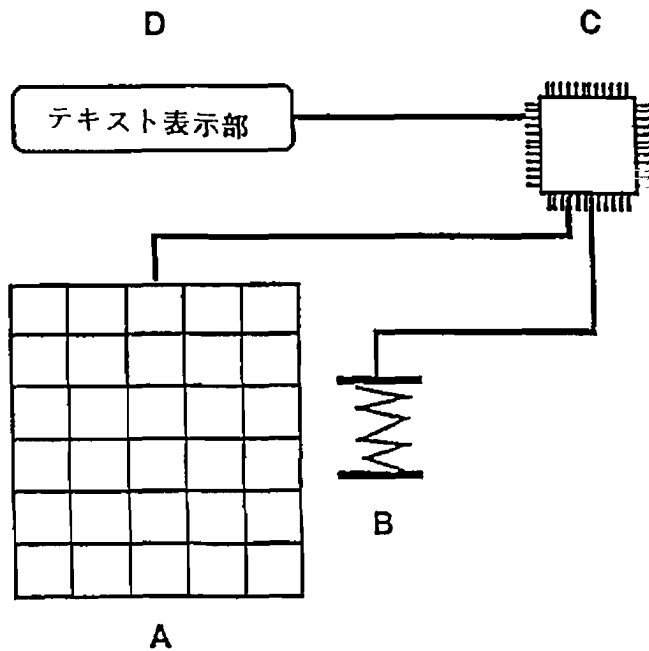
Fig. 1

【図2】

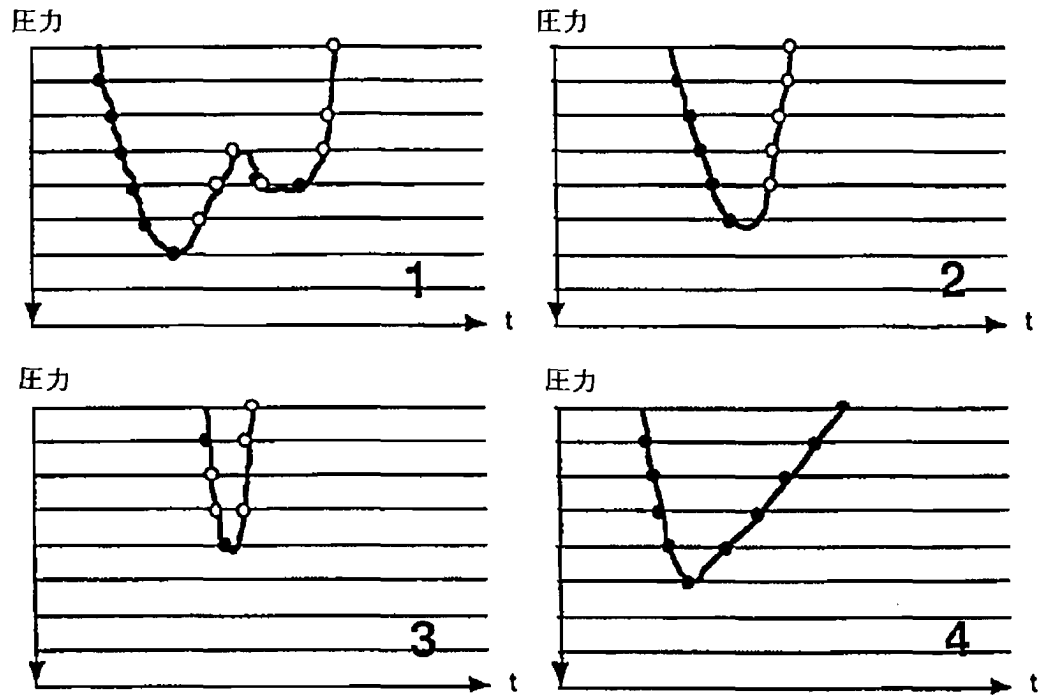


Fig. 2

【図3】



【図4】



【図5】

表：文字に対する数字コードの入力

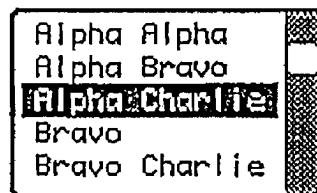
記入事項	文字	通常の符号	新しい系
Bertrand	BE	2233	2
Claudia	CL	22555	2.
Dieter	DI	3444	3
Ernst	ER	33777	3..
Esso Hamburg	ES	337777	3...
Esso Hannover	ESv	337777v	3....
Fritz	FR	33777	3.....
Ina	IN	44466	4
Meier	ME	633	6
Miller P	MI	6444	6.
Miller S	MIv	6444v	6..
Miller T	MIvv	6444vv	6...
Oliver	OL	666555	6....
...			
Schmidt	SC	7777222	7...
Schulze	SCv	7777222v	7....
Ulla	UL	88555	8
Ulrich	ULv	88555v	8.
Viktor	VI	888444	8..
Werner	WE	933	9
Zander	ZA	99992	9.

v = カーソルキー矢印下に

. = 高めた押圧

【図6】

Fig. 6



【図7】

センサ情報を評価する処理ステップのリスト

```
procedure keypress();
  // uses getpress(), display(), scrollbar(), blip()
  const intvl:= 50; // interval between measurements in ms
  const oktime:= 15; // minimum no. of intervals
  int choice:= 0; // current selection
  int p:= 0; // pressure now
  int oldp:= 0; // pressure before
  int t:= 0; // time (no. of intervals)
  loop // repeat as long as pressure is applied
    p:= getpress(); // determine pressure
    if p=0 then exitloop(); // user lifts finger, finished
    if p<>oldp then // pressure was changed
      begin // #1
        oldp:= p;
        t:= 0; // restart timer
        blip(); // short click sound for audible feedback
        scrollbar(p); // make new pressure visible
      end;
    else // pressure is same for at least 2 intervals
      begin
        t:= t+1; // increment timer
        if (p<>choice) then // this pressure could change selection
          if (p>choice) or (t>oktime) then // higher or longer pressure
            begin // #2
              choice:= p; // change selection
              display(choice); // show it
            end;
          end;
        sleep(intvl); // give other processes time;
      endloop;
      scrollbar(0); // hide scrollbar
    end procedure;
```

【国際調査報告】

INTERNATIONAL SEARCH REPORT

International Application No. PCT/EP 99/08050		
A. CLASSIFICATION OF SUBJECT MATTER IPC 7 H04M1/23 H04M1/247 H04M1/274		
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B. FIELDS SEARCHED Minimum documentation searched (classification system followed by classification symbols) IPC 7 H04M 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)		
C. DOCUMENTS CONSIDERED TO BE RELEVANT		
Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	GB 2 299 302 A (FRAZER CONCEPTS LTD) 2 October 1996 (1996-10-02) abstract; figure 2 page 4, line 30 -page 5, line 6 page 7, line 15-26	1, 3
A	GB 2 048 531 A (STANDARD TELEPHONES CABLES LTD) 10 December 1980 (1980-12-10) page 1, line 15-24; figures 1,3	1
A	US 5 311 175 A (WALDMAN HERBERT) 10 May 1994 (1994-05-10) column 3, line 41-58; figure 1 column 2, line 37-67 column 7, line 19-36; figure 4	1
	-/-	
<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.
* Special categories of cited documents :		
"A" document defining the general state of the art which is not considered to be of particular relevance		"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
"E" earlier document but published on or after the international filing date		"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
"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)		"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.
"O" document referring to an oral disclosure, use, exhibition or other means		"&" document member of the same patent family
"P" document published prior to the international filing date but later than the priority date claimed		
Date of the actual completion of the international search 10 March 2000		Date of mailing of the international search report 22/03/2000
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INTERNATIONAL SEARCH REPORT

International Application No
PCT/EP 99/08050

C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT		
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1

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Information on patent family members

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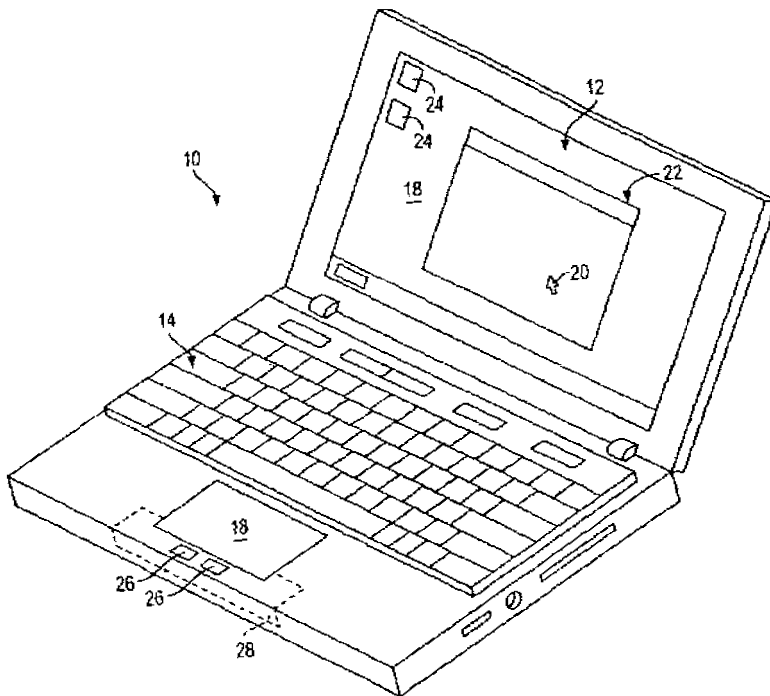
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(54) Title: HAPTIC FEEDBACK FOR TOUCHPADS AND OTHER TOUCH CONTROLS



(57) Abstract: A haptic feedback planar touch control used to provide input to a computer (10). A touch input device includes a planar touch surface that inputs a position signal to a processor of the computer (10) based on a location of user contact on the touch surface. The computer (10) can position a cursor in a graphical environment (8) based at least in part on the position signal, or perform a different function. At least one actuator is also coupled to the touch input device and outputs a force to provide a haptic sensation to the user contacting the touch surface. The touch input device can be a touchpad separate from the computer's display screen (12), or can be a touch screen. Output haptic sensations on the touch input device can include pulses, vibrations, and spatial textures. The touch input device can include multiple different regions to control different computer functions.



WO 01/54109 A1

HAPTIC FEEDBACK FOR TOUCHPADS AND OTHER TOUCH CONTROLS

BACKGROUND OF THE INVENTION

The present invention relates generally to the interfacing with computer and mechanical devices by a user, and more particularly to devices used to interface with computer systems and electronic devices and which provide haptic feedback to the user.

Humans interface with electronic and mechanical devices in a variety of applications, and the need for a more natural, easy-to-use, and informative interface is a constant concern. In the context of the present invention, humans interface with computer devices for a variety of applications. One such application is interacting with computer-generated environments such as games, simulations, and application programs. Computer input devices such as mice and trackballs are often used to control a cursor within a graphical environment and provide input in these applications.

In some interface devices, force feedback or tactile feedback is also provided to the user, collectively known herein as "haptic feedback." For example, haptic versions of joysticks, mice, gamepads, steering wheels, or other types of devices can output forces to the user based on events or interactions occurring within the graphical environment, such as in a game or other application program.

In portable computer or electronic devices, such as laptop computers, mice typically too large a workspace to be practical. As a result, more compact devices such as trackballs are often used. A more popular device for portable computers are "touchpads," which are small rectangular, planar pads provided near the keyboard of the computer. The touchpads senses the location of a pointing object by any of a variety of sensing technologies, such as capacitive sensors or pressure sensors that detect pressure applied to the touchpad. The user contacts the touchpad most commonly with a fingertip and moves his or her finger on the pad to move a cursor displayed in the graphical environment. In other embodiments, the user can operate a stylus in conjunction with the touchpad by pressing the stylus tip on the touchpad and moving the stylus.

One problem with existing touchpads is that there is no haptic feedback provided to the user. The user of a touchpad is therefore not able to experience haptic sensations that assist and inform the user of targeting and other control tasks within the graphical environment. The touchpads of the prior art also cannot take advantage of existing haptic-enabled software run on the portable computer.

signal and at least one other region provides a signal that is used by the computer to control a different function, such as rate control function of a value or a button press. Different regions and borders between regions can be associated with different haptic sensations.

The present invention advantageously provides haptic feedback to a planar touch control device of a computer, such as a touchpad or touch screen. The haptic feedback can assist and inform the user of interactions and events within a graphical user interface or other environment and ease cursor targeting tasks. Furthermore, the invention allows portable computer devices having such touch controls to take advantage of existing haptic feedback enabled software. The haptic touch devices disclosed herein are also inexpensive, compact and consume low power, allowing them to be easily incorporated into a wide variety of portable and desktop computers and electronic devices.

These and other advantages of the present invention will become apparent to those skilled in the art upon a reading of the following specification of the invention and a study of the several figures of the drawing.

DETAILED DESCRIPTION OF PREFERRED EMBODIMENTS

FIGURE 1 is a perspective view of a portable computer 10 including a haptic touchpad of the present invention. Computer 10 is preferably a portable or "laptop" computer that can be carried or otherwise transported by the user and may be powered by batteries or other portable energy source in addition to other more stationary power sources. Computer 10 preferably runs one or more host application programs with which a user is interacting via peripherals.

Computer 10 may include the various input and output devices as shown, including a display device 12 for outputting graphical images to the user, a keyboard 14 for providing character or toggle input from the user to the computer, and a touchpad 16 of the present invention. Display device 12 can be any of a variety of types of display devices; flat-panel displays are most common on portable computers. Display device 12 can display a graphical environment 18 based on application programs and/or operating systems that are running, such as a graphical user interface (GUI), that can include a cursor 20 that can be moved by user input, as well as windows 22, icons 24, and other graphical objects well known in GUI environments. Other devices may also be incorporated or coupled to the computer 10, such as storage devices (hard disk drive, DVD-ROM drive, etc.), network server or clients, game controllers, etc. In alternate embodiments, the computer 10 can take a wide variety of forms, including computing devices that rest on a tabletop or other surface, stand-up arcade game machines, other portable devices or devices worn on the person, handheld or used with a single hand of the user, etc. For example, host computer 10 can be a video game console, personal computer, workstation, a television "set top box" or a "network computer", or other computing or electronic device.

Touchpad device 16 of the present invention preferably appears externally to be similar to the touchpads of the prior art. Pad 16 includes a planar, rectangular smooth surface that can be positioned below the keyboard 14 on the housing of the computer 10, as shown, or may be positioned at other areas of the housing. When the user operates the computer 10, the user may conveniently place a fingertip or other object on the touchpad 16 and move the fingertip to correspondingly move cursor 20 in the graphical environment 18.

In operation, the touchpad 16 inputs coordinate data to the main microprocessor(s) of the computer 10 based on the sensed location of an object on (or near) the touchpad. As with many touchpads of the prior art, touchpad 16 can be capacitive, resistive, or use a different type of sensing. Some existing touchpad embodiments are disclosed, for example, in U.S. Patent Nos. 5,521,336 and 5,943,044. Capacitive touchpads typically sense the location of an object on or near the surface of the touchpad based on capacitive coupling between capacitors in the

Using one or more actuators coupled to the touchpad 16, a variety of haptic sensations can be output to the user who is contacting the pad. For example, jolts, vibrations (varying or constant amplitude), and textures can be output. Forces output on the pad can be at least in part based on the location of the finger on the pad or the state of a controlled object in the graphical environment of the host computer 10, and/or independent of finger position or object state. Such forces output on the touchpad 16 are considered "computer-controlled" since a microprocessor or other electronic controller is controlling the magnitude and/or direction of the force output of the actuator(s) using electronic signals. Preferably, the entire pad 16 is provided with haptic sensations as a single unitary member; in other embodiments, individually-moving portions of the pad can each be provided with its own haptic feedback actuator and related transmissions so that haptic sensations can be provided for only a particular portion. For example, some embodiments may include a touchpad having different portions that may be flexed or otherwise moved with respect to other portions of the pad.

In other embodiments, the touchpad 16 can be provided in a separate housing that is connected to a port of the computer 10 via a cable or via wireless transmission and which receives force information from and sends position information to the computer 10. For example, Universal Serial Bus (USB), Firewire, or a standard serial bus can connect such a touchpad to the computer 10. In such an embodiment, the computer 10 can be any desktop or stationary computer or device and need not be a portable device.

One or more buttons 26 can also be provided on the housing of the computer 10 to be used in conjunction with the touchpad 16. The user's hands have easy access to the buttons, each of which may be pressed by the user to provide a distinct input signal to the host computer 12. Typically, each button 26 corresponds to a similar button found on a mouse input device, so that a left button can be used to select a graphical object (click or double click), a right button can bring up a context menu, etc. In some embodiments, one or more of the buttons 26 can be provided with tactile feedback and/or kinesthetic force feedback. Other features of these disclosures may also be used with the present invention.

Furthermore, in some embodiments, one or more moveable portions 28 of the housing of the computer device 10 can be included which is contacted by the user when the user operates the touchpad 16 and which can provide haptic feedback. Thus, both the housing can provide haptic feedback (e.g., through the use of an eccentric rotating mass on a motor coupled to the housing) and the touchpad 16 can provide separate haptic feedback. This allows the host to control two different tactile sensations simultaneously to the user; for example, a vibration of a low frequency can be conveyed through the housing to the user and a higher frequency vibration can be conveyed to the user through the touchpad 16. Each other button or other control provided with haptic feedback can also provide tactile feedback independently from the other controls.

manipulated to control the cursor in two dimensions. The touchpad 16 includes the ability to output haptic sensations to the user as described herein, based on a controlled value or event. For example, a volume level passing a mid-point or reaching a maximum level can cause a pulse to be output to the touchpad and to the user.

In one application, the controlled apparatus can be a computer system such as Web-TV from Microsoft Corp. or other computing device which displays a graphical user interface and/or web pages accessed over a network such as the Internet. The user can control the direction of the cursor by moving a finger (or other object) on the touchpad 16. The cursor can be used to select and/or manipulate icons, windows, menu items, graphical buttons, slider bars, scroll bars, or other graphical objects in a graphical user interface or desktop interface. The cursor can also be used to select and/or manipulate graphical objects on a web page, such as links, images, buttons, etc. Other force sensations associated with graphical objects are described below with reference to Fig. 7.

FIGURE 3 is a perspective view of a first embodiment 40 of a touchpad 16 of the present invention for providing haptic feedback to the user. In this embodiment, one or more piezoelectric actuators 42 are coupled to the underside of the touchpad 16. The piezoelectric actuator 42 is driven by suitable electronics, as is well known to those skilled in the art. In one embodiment, a single piezoelectric actuator 42 is positioned at or near the center of the touchpad 16, or off to one side if space constraints of the housing require such a position. In other embodiments, multiple piezoelectric actuators 42 can be positioned at different areas of the touchpad; the dashed lines show one configuration, where an actuator 42 is placed at each corner of the pad 16 and at the center of the pad.

The piezoelectric actuators 42 can each output a small pulse, vibration, or texture sensation on the touchpad 16 and to the user if the user is contacting the touchpad. The entire touchpad 16 is preferably moved with the forces output by actuator(s) 42. Preferably, the forces output on the touchpad are linear (or approximately linear) and along the z-axis, approximately perpendicular to the surface of the touchpad 16 and the top surface of computer 10. In a different embodiment, as mentioned above, forces can be applied to the touchpad 16 to cause side-to-side (e.g., x-y) motion of the pad in the plane of its surface in addition to or instead of z-axis motion. For example, one linear actuator can provide motion for the x-axis, and a second linear actuator can provide motion for the y-axis and/or the x-axis.

The frequency of a vibration output by an actuator 42 can be varied by providing different control signals to an actuator 42. Furthermore, the magnitude of a pulse or vibration can be controlled based on the applied control signal. If multiple actuators 42 are provided, a stronger vibration can be imparted on the touchpad by activating two or more actuators simultaneously. Furthermore, if an actuator is positioned at an extreme end of the touchpad and is the only actuator that is activated, the user may experience a stronger vibration on the side of

microprocessor and any circuitry required to convert the microprocessor signal to an appropriate signal for use with the actuator 42.

FIGURE 5 is a side elevational view of another embodiment 50 of the present invention, in which the touchpad 16 is positioned on one or more springs 52. The springs 52 couple the touchpad 16 to the rigid housing of the computer 10 and allow the touchpad 16 to be moved along the z-axis 56. Only a very small range of motion is required to produce effective pulses (jolts) or vibrations on the pad 16. Stops (not shown) can be positioned to limit the travel of the touchpad 16 to a desired range along the z-axis.

An actuator 54 is also coupled to the touchpad 16 to impart forces on the touchpad and cause the touchpad 16 to move along the z-axis. In the present embodiment, actuator 54 is a linear voice coil actuator, where the moving portion (bobbin) of the actuator is directly coupled to the touchpad 16. The actuator 54 is grounded to the computer 10 housing and outputs a linear force on the touchpad 16 and thus drives the touchpad along the z-axis. A short pulse or jolt can be output, or the moving portion of the actuator can be oscillated to provide a vibration having a particular desired frequency. The springs 52 cause the touchpad 16 to return to a rest position after a force from the actuator causes the touchpad to move up or down. The springs can also provide a compliant suspension for the touchpad 16 and allow forces output by the actuator 54 to be amplified as explained above. Different types of spring elements can be used in other embodiments to couple the touchpad 16 to the rigid housing, such as leaf springs, foam, flexures, or other compliant materials.

In some embodiments, the user is able to push the touchpad 16 along the z-axis to provide additional input to the computer 10. For example, a sensor can be used to detect the position of the touchpad 16 along the z-axis, such as an optical sensor, magnetic sensor, Polhemus sensor, etc. The position on the z-axis can be used to provide proportional input to the computer, for example. In addition, other types of forces can be output along the z-axis, such as spring forces, damping forces, inertial forces, and other position-based forces. In addition, 3-D elevations can be simulated in the graphical environment by moving the pad to different elevations along the z-axis. If the pad 16 can be used as an analog input depending on the distance the entire pad is moved along the z-axis, and/or if kinesthetic (force) feedback is applied in the z-axis degree of freedom, then a greater range of motion for the pad 16 along the z-axis is desirable. An elastomeric layer can be provided if the touchpad 16 is able to be pressed by the user to close a switch and provide button or switch input to the computer 10 (e.g. using contact switches, optical switches, or the like). If such z-axis movement of the pad 16 is allowed, it is preferred that the z-axis movement require a relatively large amount of force to move the pad at least initially, since such z-axis movement may not be desired during normal use of the pad by the user.

actuator can be used, where the rotary output force is converted to a linear force approximately along the z-axis. For example, the rotary force can be converted using a flexure.

In the preferred linear force implementation, the direction or degree of freedom that the force is applied on the touchpad with respect to the inertial mass is important. If a significant component of the force is applied in the planar workspace of the touchpad (i.e., along the X or Y axis) with respect to the inertial mass, a short pulse or vibration can interfere with the user's object motion in one or both of those planar degrees of freedom and thereby impair the user's ability to accurately guide a controlled graphical object, such as a cursor, to a given target. Since a primary function of the touchpad is accurate targeting, a tactile sensation that distorts or impairs targeting, even mildly, is undesirable. To solve this problem, the touchpad device of the present invention applies inertial forces substantially along the Z axis, orthogonal to the planar X and Y axes of the touchpad surface. In such a configuration, tactile sensations can be applied at a perceptually strong level for the user without impairing the ability to accurately position a user controlled graphical object in the X and Y axes of the screen. Furthermore, since the tactile sensations are directed in a third degree of freedom relative to the two-dimensional planar workspace and display screen, jolts or pulses output along the Z axis feel much more like three-dimensional bumps or divots to the user that come "out" or go "into" the screen, increasing the realism of the tactile sensations and creating a more compelling interaction. For example, an upwardly-directed pulse that is output when the cursor is moved over a window border creates the illusion that the user is moving a finger or other object "over" a bump at the window border.

FIGURE 7 is a top elevational view of the touchpad 16 of the present invention. Touchpad 16 can in some embodiments be used simply as a positioning device, where the entire area of the pad provides cursor control. In other embodiments, different regions of the pad can be designated for different functions. In some of these region embodiments, each region can be provided with an actuator located under the region, while other region embodiments may use a single actuator that imparts forces on the entire pad 16. In the embodiment shown, a central cursor control region 70 is used to position the cursor.

The cursor control region 70 of the pad 16 can cause forces to be output on the pad based on interactions of the controlled cursor with the graphical environment and/or events in that environment. The user moves a finger or other object within region 70 to correspondingly move the cursor 20. Forces are preferably associated with the interactions of the cursor with displayed graphical objects. For example, a jolt or "pulse" sensation can be output, which is a single impulse of force that quickly rises to the desired magnitude and then is turned off or quickly decays back to zero or small magnitude. The touchpad 16 can be jolted in the z-axis to provide the pulse. A vibration sensation can also be output, which is a time-varying force that is typically periodic. The vibration can cause the touchpad 16 or portions thereof to oscillate back and forth on the z axis, and can be output by a host or local microprocessor to simulate a particular effect that is occurring in a host application.

can be stronger than others to indicate importance or frequency of use, i.e., the most used menu choices can be associated with higher-magnitude (stronger) pulses than the less used menu choices. Also, currently-disabled menu choices can have a weaker pulse, or no pulse, to indicate that the menu choice is not enabled at that time. Furthermore, when providing tiled menus in which a sub-menu is displayed after a particular menu element is selected, as in Microsoft Windows™, pulse sensations can be sent when a sub-menu is displayed. This can be very useful because users may not expect a sub-menu to be displayed when moving a cursor on a menu element. Icons can be associated with textures, pulses, and vibrations similarly to the windows described above. Drawing or CAD programs also have many features which can be associated with similar haptic sensations, such as displayed (or invisible) grid lines or dots, control points of a drawn object, etc.

In other related interactions, when a rate control or scrolling function is performed with the touchpad (through use of the cursor), a vibration can be displayed on the device to indicate that scrolling is in process. When reaching the end of a numerical range that is being adjusted (such as volume), a pulse can be output to indicate that the end of the range has been reached. Pulse sensations can be used to indicate the location of the "ticks" for discrete values or settings in the adjusted range. A pulse can also be output to inform the user when the center of the range is reached. Different strength pulses can also be used, larger strength indicating the more important ticks. In other instances, strength and/or frequency of a vibration can be correlated with the adjustment of a control to indicate current magnitude of the volume or other adjusted value. In other interactions, a vibration sensation can be used to indicate that a control function is active. Furthermore, in some cases a user performs a function, like selection or cutting or pasting a document, and there is a delay between the button press that commands the function and the execution of the function, due to processing delays or other delays. A pulse sensation can be used to indicate that the function (the cut or paste) has been executed.

Furthermore, the magnitude of output forces on the touchpad can depend on the event or interaction in the graphical environment. For example, the force pulse can be a different magnitude of force depending on the type of graphical object encountered by the cursor. For example, a pulses of higher magnitude can be output when the cursor moves over windows, while pulses of lower magnitude can be output when the cursor moves over icons. The magnitude of the pulses can also depend on other characteristics of graphical objects, such as an active window as distinguished a background window, file folder icons of different priorities designated by the user, icons for games as distinguished from icons for business applications, different menu items in a drop-down menu, etc. The user or developer can also preferably associate particular graphical objects with customized haptic sensations.

User-independent events can also be relayed to the user using haptic sensations on the touchpad. An event occurring within the graphical environment, such as an appointment reminder, receipt of email, explosion in a game, etc., can be signified using a vibration, pulse, or

physically marked with lines, borders, or textures on the surface of the pad 16 (and/or sounds from the computer 10) so that the user can visually, audibly, and/or or tactilely tell which region he or she is contacting on the pad.

For example, scroll or rate control regions 62a and 62b can be used to provide input to perform a rate control task, such as scrolling documents, adjusting a value (such as audio volume, speaker balance, mouitor display brightness, etc.), or panning/tilting the view in a game or virtual reality simulation. Region 62a can be used by placing a finger (or other object) within the region, where the upper portion of the region will increase the value, scroll up, etc., and the lower portion of the region will decrease the value, scroll down, etc. In embodiments that can read the amount of pressure placed on the pad 16, the amount of pressure can directly control the rate of adjustment; e.g., a greater pressure will cause a document to scroll faster. The region 62b can similarly be used for horizontal (left/right) scrolling or rate control adjustment of a different value, view, etc.

Particular haptic effects can be associated with the control regions 62a and 62b. For example, when using the rate control region 62a or 62b, a vibration of a particular frequency can be output on the pad 16. In those embodiments having multiple actuators, an actuator placed directly under the region 62a or 62b can be activated to provide a more localized tactile sensation for the "active" (currently used) region. As a portion of a region 62 is pressed for rate control, pulses can be output on the pad (or region of the pad) to indicate when a page has scroll by, a particular value has passed, etc. A vibration can also be continually output while the user contacts the region 62a or 62b.

Other regions 64 can also be positioned on the touchpad 16. For example, each of regions 64 provides a small rectangular area, like a button, which the user can point to in order to initiate a function associated with the pointed-to region. The regions 64 can initiate such computer functions as running a program, opening or closing a window, going "forward" or "back" in a queue of web pages in a web browser, powering the computer 10 or initiating a "sleep" mode, checking mail, firing a gun in a game, cutting or pasting data from a buffer, selecting a font, etc. The regions 64 can duplicate functions and buttons provided in an application program or provide new, different functions.

Similarly to regions 62, the regions 64 can each be associated with haptic sensations; for example, a region 64 can provide a pulse sensation when it has been selected by the user, providing instant feedback that the function has been selected. Furthermore, the same types of regions can be associated with similar-feeling haptic sensations. For example, each word-processor related region 64 can, when pointed to, cause a pulse of a particular strength, while each game-related region can provide a pulse of different strength or a vibration. Furthermore, when the user moves the pointing object from one region 62 or 64 to another, a haptic sensation (such as a pulse) can be output on the pad 16 to signify that a region border has been crossed.

overlaid on the screen 80, where the film can detect pressure from an object contacting the film. The sensor devices for implementing touch screens are well known to those skilled in the art.

The user can select graphically-displayed buttons or other graphical objects by pressing a finger or a stylus to the screen 82 at the exact location where the graphical object is displayed. Furthermore, some embodiments allow the user to "draw" or "write" on the screen by displaying graphical "ink" images 85 at locations where the user has pressed a tip of a stylus, finger, or other object. Handwritten characters can be recognized by software running on the device microprocessor as commands, data, or other input. In other embodiments, the user can provide input additionally or alternatively through voice recognition, where a microphone on the device inputs the user's voice which is translated to appropriate commands or data by software running on the device. Physical buttons 84 can also be included in the housing of the device 80 to provide particular commands to the device 80 when the buttons are pressed. Many PDA's are characterized by the lack of a standard keyboard for character input from the user; rather, an alternative input mode is used, such as using a stylus to draw characters on the screen, voice recognition, etc. However, some PDA's also include a fully-functional keyboard as well as a touch screen, where the keyboard is typically much smaller than a standard-sized keyboard. In yet other embodiments, standard-size laptop computers with standard keyboards may include flat-panel touch-input display screens, and such screens (similar to screen 12 of Fig. 1) can be provided with haptic feedback according to the present invention.

In the present invention, the touch screen 82 provides haptic feedback to the user similarly to the touchpad 16 described in previous embodiments. One or more actuators 86 can be coupled to the underside of the touch screen 82 to provide haptic feedback such as pulses, vibrations, and textures; for example, an actuator 86 can be positioned near each corner of the screen 82, as shown in Fig. 8a. Other configurations of actuators can also be used. The user can experience the haptic feedback through a finger or a held object such as a stylus 87 that is contacting the screen 82.

As shown in Fig. 8b, the touch screen 82 is preferably coupled to the housing 88 of the device 80 by one or more spring or compliant elements 90, such as helical springs, leaf springs, flexures, or compliant material (foam, rubber, etc.) The compliant element allows the touch screen 82 to move approximately along the z-axis, thereby providing haptic feedback similarly to the touchpad embodiments described above. Actuators 86 can be piezo-electric actuators, voice coil actuators, or any of the other types of actuators described above for the touchpad embodiments. As shown in Fig. 8b, the actuators 86 are directly coupled to the touch screen 82 similarly to the touchpad embodiment of Fig. 3; alternatively, an inertial mass can be moved to provide inertial feedback in the z-axis of the touch screen, similarly to the touchpad embodiment of Fig. 6. Other features described above for the touchpad are equally applicable to the touch screen embodiment 80.

CLAIMS

1. A haptic feedback touch control for inputting signals to a computer and for outputting forces to a user of the touch control, the touch control comprising:

a touch input device including an approximately planar touch surface operative to input a position signal to a processor of said computer based on a location on said touch surface which said user contacts, said position signal representing a location in two dimensions, wherein said computer positions a cursor in a graphical environment displayed on a display device based at least in part on said position signal; and

at least one actuator coupled to said touch input device, said actuator outputting a force on said touch input device to provide a haptic sensation to said user contacting said touch surface, wherein said actuator outputs said force based on force information output by said processor, said actuator outputting a force directly on said touch input device.

2. A haptic feedback touch control as recited in claim 1 wherein said touch input device is a touchpad, said touchpad being separate from a display screen of said computer.

3. A haptic feedback touch control as recited in claim 1 wherein said touch input device is included in a display screen of said computer as a touch screen.

4. A haptic feedback touch control as recited in claim 1 wherein said touch input device is integrated in a housing of said computer.

5. A haptic feedback touch control as recited in claim 4 wherein said computer is a portable computer.

6. A haptic feedback touch control as recited in claim 1 wherein said touch input device is provided in a housing that is separate from said computer.

7. A haptic feedback touch control as recited in claim 1 wherein said user contacts said touch surface with a finger of said user.

8. A haptic feedback touch control as recited in claim 1 wherein said user contacts said touch surface with a physical object held by said user.

9. A haptic feedback touch control as recited in claim 8 wherein said physical object is a stylus.

position signal and at least one other region provides a signal that is used by said computer to control a different function.

23. A haptic feedback touch control as recited in claim 22 wherein said different function includes a rate control function of a value.

24. A haptic feedback touch control as recited in claim 22 wherein said different function includes a button press.

25. A haptic feedback touch control as recited in claim 22 wherein at least one of said regions is associated with a different haptic sensation output on said touch input device than another one of said regions.

26. A haptic feedback touch control as recited in claim 22 wherein a haptic sensation is output when said user moves a contacting object from one of said regions to another one of said regions.

27. A haptic feedback touch control as recited in claim 1 further comprising a sensor for detecting motion or position of said touch input device approximately perpendicularly to said touch surface, wherein an input signal based on said detected motion or position is sent to said computer.

28. A haptic feedback touch control as recited in claim 1 wherein said processor outputs said force information to provide said haptic sensation in accordance with an interaction of said cursor with a graphical object in said graphical environment.

29. A haptic feedback touch control as recited in claim 1 wherein a menu is displayed in said graphical environment, wherein when said cursor is moved between menu elements in said menu, a pulse is output on said touch input device, said pulse causing said touch input device to move along said z-axis and conveying said pulse to said user contacting said touch surface.

30. A haptic feedback touch control as recited in claim 1 wherein an icon is displayed in said graphical environment, wherein when said cursor is moved over said icon, a pulse is output on said touch input device, said pulse causing said touch input device to move along said z-axis and conveying said pulse to said user contacting said touch surface.

31. A haptic feedback touch control as recited in claim 1 wherein a menu is displayed in said graphical environment, wherein when said cursor is moved between menu elements in said menu, a pulse is output on said touch input device, said pulse causing said touch input device to move along said z-axis and conveying said pulse to said user contacting said touch surface.

32. A haptic feedback touch control as recited in claim 1 wherein a web page is displayed in said graphical environment and a hyperlink is displayed on said web page, wherein

providing an actuator coupled to said touch input device, said actuator receiving control signals derived from force information output by said computer device, wherein said force information causes said actuator to output a force on said touch input device, said force being correlated with an interaction occurring in said graphical environment between said cursor and a different graphical object.

38. A method as recited in claim 37 wherein said force output on said touch input device is a linear force approximately perpendicular to said surface of said touch input device.

39. A method as recited in claim 37 wherein a touch device microprocessor, separate from a host processor of said computer device, receives said force information from said host processor and causes said control signals to be sent to said actuator.

40. A method as recited in claim 37 wherein said interaction occurring in said graphical environment includes a collision between said cursor and said different graphical object.

41. A method as recited in claim 37 wherein said interaction occurring in said graphical environment includes a selection of said different graphical object by said cursor, wherein said different graphical object is one of an icon, a window, and a menu item.

42. A method as recited in claim 37 wherein said touch input device is moveable along an axis approximately perpendicular to said planar surface of said touch input device, wherein said movement along said axis is sensed and information representative of said movement is sent to said computer device.

43. A method as recited in claim 37 wherein said computer device is portable, said touch input device is integrated in a housing of said computer device, and said actuator is a piezo-electric actuator.

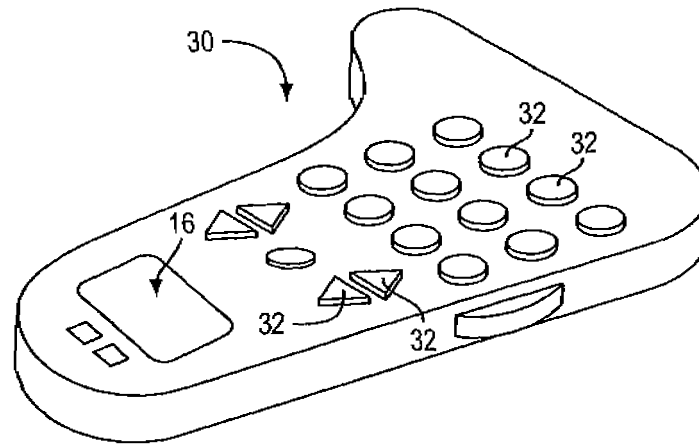


FIG. 2

SUBSTITUTE SHEET (RULE 26)

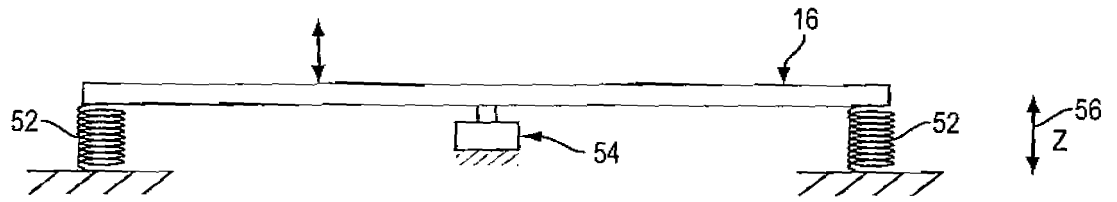


FIG. 5

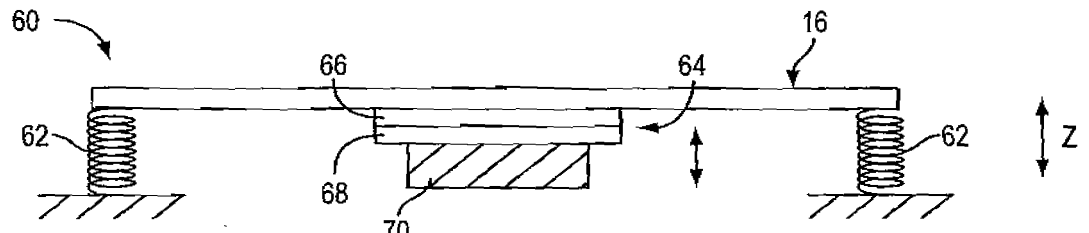


FIG. 6

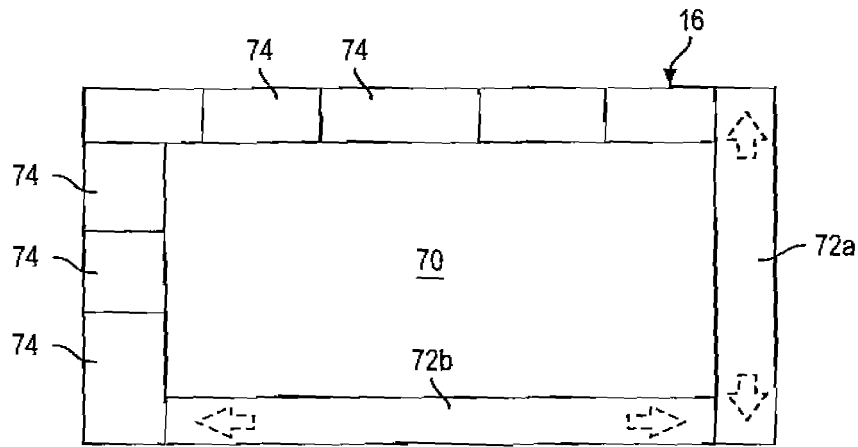


FIG. 7

SUBSTITUTE SHEET (RULE 26)

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US01/01486

A. CLASSIFICATION OF SUBJECT MATTER

IPC(7) : G09G 5/00
US CL : 345/156, 157, 163, 169 173, 179, 184
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)
U.S. : 345/156, 157, 163, 169 173, 179, 184

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 practicable, search terms used)
WEST, EAST, NPL, STN

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 5,625,576 A (MASSIE et al) 29 April 1997, see abstract.	1-43
A	US 6,131,097 A (PEURACH et al) 10 October 2000, see abstract.	1-43
A	US 5,956,016 A (KUENZNER et al) 21 September 1999, see col. 4, lines 12-65.	1-43
A	US 6,147,422 A (DELSON et al) 14 November 2000, see abstract.	1-43

Further documents are listed in the continuation of Box C. 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	*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
E earlier document published on or after the international filing date	*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
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)	*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
O document referring to an oral disclosure, use, exhibition or other means	*G* document member of the same patent family
P document published prior to the international filing date but later than the priority date claimed	

Date of the actual completion of the international search 08 MARCH 2001	Date of mailing of the international search report 13 APR 2001
Name and mailing address of the ISA/US Commissioner of Patents and Trademarks Box PCT Washington, D.C. 20231 Facsimile No. (703) 305-3230	Authorized officer RONALD LANEAU <i>Rugenia Zogan</i> Telephone No. (703) 305-3977

Form PCT/ISA/210 (second sheet) (July 1998) *



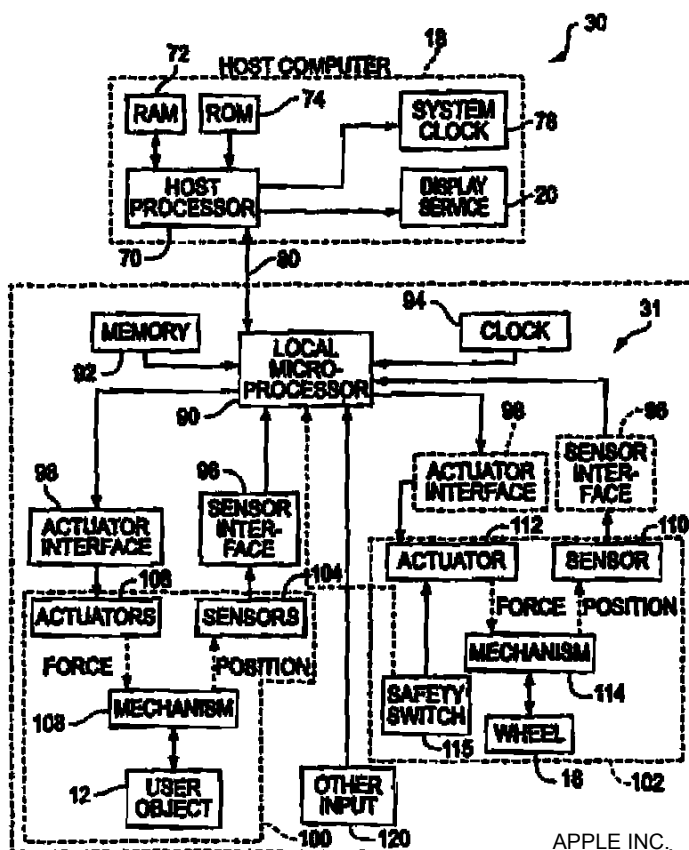
INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

<p>(51) International Patent Classification ⁶ : G09G</p>	<p>A2</p>	<p>(11) International Publication Number: WO 99/49443 (43) International Publication Date: 30 September 1999 (30.09.99)</p>
<p>(21) International Application Number: PCT/US99/06510 (22) International Filing Date: 24 March 1999 (24.03.99) (30) Priority Data: 09/049,155 26 March 1998 (26.03.98) US 09/179,382 26 October 1998 (26.10.98) US (71) Applicant: IMMERSION CORPORATION [US/US]; 2158 Paragon Drive, San Jose, CA 95131 (US). (72) Inventors: ROSENBERG, Louis, B.; 5002 Felter Road, San Jose, CA 95132 (US). SCHENA, Bruce, M.; 414 Pope Street, Menlo Park, CA 94025 (US). (74) Agent: HICKMAN, Paul, L.; Hickman Stephens & Coleman, LLP, P.O. Box 52037, Palo Alto, CA 94303-0746 (US).</p>		<p>(81) Designated States: AU, CA, CN, 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: FORCE FEEDBACK CONTROL WHEELS AND KNOBS

(57) Abstract

A force feedback wheel or knob is provided on a mouse or other device to be manipulated by a user. In one embodiment, a rotatable wheel is mounted upon a manipulandum, such as a mouse, and rotates about a wheel axis, where a wheel sensor provides a wheel signal to a host computer indicating a rotary position of the wheel, and a wheel actuator coupled to the rotatable wheel applies a computer-modulated force to the wheel about the wheel axis. The force applied to the wheel can correspond with an event or interaction displayed in a host graphical environment. In other embodiments, a knob on a device allows a user to control functions of the device. The knob is rotatable in a rotary degree of freedom and can be moved in a transverse direction perpendicular to the axis of rotation and/or moved in a linear degree of freedom, allowing the knob to be pushed or pulled by the user. Force feedback is preferably provided using an actuator coupled to the knob. The device controlled by the knob can be, for example, an audio device, a video device, etc. Detent forces can be provided for the knob by overlapping and adjusting ranges of closely-spaced detents in the rotary degree of freedom of the knob.



FORCE FEEDBACK CONTROL WHEELS AND KNOBS

BACKGROUND OF THE INVENTION

5 The present invention relates generally to interface devices for allowing humans to interface with electronic and computer devices, and more particularly to mechanical computer interface devices that allow the user to provide input to electronic systems and provide force feedback to the user.

10 Electronic and computer devices are used in a wide variety of applications. For many devices, a user desires to provide input to a device using a simple, intuitive mechanical control. Control wheels and knobs provide such an intuitive input device for many applications.

15 In one application, control wheels and knobs are useful to provide input to computer systems. For example, users can interact with a visual environment displayed by a computer on a display device to perform functions on the computer, play a game, experience a simulation or “virtual reality” environment, use a computer aided design (CAD) system, browse the World Wide Web, or otherwise influence events or images depicted on the screen. One visual environment that is particularly common is a graphical user interface (GUI). GUI's present visual images which describe various graphical metaphors of a program or operating system implemented on the computer. Common GUI's include the Windows® operating system from Microsoft Corporation, the MacOS® operating system from Apple Computer, Inc., and the X-
20 Windows GUI for Unix operating systems. The user typically moves a user-controlled graphical object, such as a cursor or pointer, across a computer screen and onto other displayed graphical objects or screen regions, and then inputs a command to execute a given selection or operation. Other programs or environments also may provide user-controlled graphical objects such as a
25 cursor and include browsers and other programs displaying graphical “web pages” or other environments offered on the World Wide Web of the Internet, CAD programs, video games, virtual reality simulations, etc.

30 A common interface device for providing user input to a GUI is a mouse or trackball. A mouse is moved by a user in a planar workspace to move a graphical object such as a cursor on the 2-dimensional display screen in a direct mapping between the position of the user manipulandum and the position of the cursor. This is typically known as “position control”, where the motion of the graphical object directly correlates to motion of the user manipulandum. One drawback to traditional mice is that functions such as scrolling a document in a window and zooming a view displayed on the screen in or out are typically awkward to perform, since the
35 user must use the cursor to drag a displayed scroll bar or click on displayed zoom controls.

5 Some control knobs have been provided with "force feedback." Force feedback devices can provide physical sensations to the user manipulating the knob. Typically, a motor is coupled to the knob and is connected to a controller such as a microprocessor. The microprocessor receives sensor signals from the knob and sends appropriate force feedback control signals to the motor so that the motor provides forces on the knob. In this manner, a variety of programmable feel sensations can be output on the knob, such as detents, spring forces, or the like.

10 One problem occurring in control knobs of the prior art is that the knobs are limited to basic rotary motion. This limits the control options of the user to a simple, one-degree-of-freedom device that does not allow a variety of selection options. In addition, if force feedback is provided on the knob, the limited force feedback and control functionality of the knob limits the user from fully taking advantage of the force feedback to provide more control over desired functions.

provided at a predetermined user-preferred rotational position of the wheel, and a sensor that senses rotation of the wheel and provides a wheel signal to the electronic device indicating a rotary position of the wheel. The wheel can be included on a remote control device for remotely sending signals to the electronic device, or on the housing of the electronic device itself. The electronic device can be any of a variety of devices or appliances; for example, a radio can include the force wheel for providing user-preferred detents at radio station frequencies spaced irregularly about the rotational range of the wheel.

In an embodiment of a knob controller device of the present invention, a knob is coupled to a grounded surface. The knob is rotatable in a rotary degree of freedom about an axis extending through the knob, and the knob also moveable in a transverse direction approximately perpendicular to the axis. A rotational sensor detects a position of the knob in the rotary degree of freedom, and a transverse sensor detects a position of the knob in the transverse direction. An actuator is coupled to the knob to output a force in the rotary degree of freedom about the axis, thus providing force feedback. In a preferred embodiment, the knob is moveable in multiple transverse directions. For example, the transverse sensor includes a switch that detects when the knob is moved in a transverse direction; the switch can be a hat switch having multiple individual switches, for example. In one embodiment, the knob is moveable in four transverse directions spaced approximately orthogonal to each other.

Furthermore, a local microprocessor can be included to control the force feedback on the knob. The microprocessor receives sensor signals from the rotary and transverse sensors and controls a function of a device in response to the sensor signals. The device can also include a display, wherein an image on said display is changed in response to manipulation of the knob in the transverse direction. A method of the present invention for controlling functions of a device from input provided by a knob similarly uses sensor signals from a rotary sensor and a transverse sensor to control at least one function of a device, such as adjusting a frequency of a radio tuner or updating a displayed image based on at least one of the sensor signals.

In another aspect of the present invention, a knob is coupled to a grounded surface, where the knob is rotatable in a rotary degree of freedom about an axis extending through the knob. The knob is also moveable in a linear degree of freedom approximately parallel to the axis. A rotational sensor and a linear sensor detect positions of the knob in the respective degrees of freedom. An actuator is also coupled to the knob and operative to output a force in the rotary degree of freedom about the axis, thereby providing force feedback to the knob. The linear degree of freedom of the knob allows it to be pushed and/or pulled by the user, where the push or pull motion is detected by the linear sensor. A transverse degree of freedom and a local microprocessor can also be included.

These and other advantages of the present invention will become apparent to those skilled in the art upon a reading of the following specification of the invention and a study of the several figures of the drawing.

Figure 13c is a side elevational view of the embodiment of Fig. 13a;

Figure 14 is a perspective view of a linear slider control of the present invention;

Figures 15a-15d illustrate nonoverlapping, overlapping, and hysteresis features of force detent profiles;

5 Figures 16a-16e are graphs illustrating the creation of detent force profiles from periodic waves according to the present invention; and

Figure 17 is a block diagram of a control system for the control knob of the present invention.

approximately spherical object) provided in a socket in mouse 12, and which can be moved in both X- and Y- directions and have forces applied thereto.

Furthermore, in some embodiments, wheel 16 may be depressed by the user as indicated by arrow 19. The wheel, when pressed, causes contacts to be electrically connected and provides a signal to host computer 18. Wheel 16 thus can also operate as an additional mouse button 15. A mechanical/electrical interface (not shown) is preferably included to sense manipulations of the wheel 16 and transmit force to the wheel. In the preferred embodiment, power is provided to actuators over bus 17 (e.g. when bus 17 includes a USB interface). The structure and operation of wheel 16 and the interface is described in greater detail with respect to Figures 5-9.

Host computer 18 is preferably a personal computer or workstation, such as an IBM-PC compatible computer or Macintosh personal computer, or a SUN or Silicon Graphics workstation. For example, the computer 18 can operate under the Windows™ or MS-DOS operating system in conformance with an IBM PC AT standard. Alternatively, host computer system 18 can be one of a variety of home video game systems commonly connected to a television set, such as systems available from Nintendo, Sega, or Sony. In other embodiments, host computer system 18 can be a "set top box" which can be used, for example, to provide interactive television functions to users, or a "network-" or "internet-computer" which allows users to interact with a local or global network using standard connections and protocols such as used for the Internet and World Wide Web. Host computer preferably includes a host microprocessor, random access memory (RAM), read only memory (ROM), input/output (I/O) circuitry, and other components of computers well-known to those skilled in the art.

Host computer 18 preferably implements a host application program with which a user is interacting via mouse 12 and other peripherals, if appropriate. The application program includes force feedback functionality to provide appropriate force signals to mouse 12. For example, the host application program can be a GUI, simulation, video game, Web page or browser that implements HTML or VRML instructions, scientific analysis program, virtual reality training program or application, or other application program that utilizes input of mouse 12 and outputs force feedback commands to the mouse 12. Herein, for simplicity, operating systems such as Windows™, MS-DOS, MacOS, Unix, etc. are also referred to as "application programs." In one preferred embodiment, an application program utilizes a graphical user interface (GUI) to present options to a user and receive input from the user. Herein, computer 18 may be referred as displaying "graphical objects" or "computer objects." These objects are not physical objects, but are logical software unit collections of data and/or procedures that may be displayed as images by computer 18 on display screen 20, as is well known to those skilled in the art. A displayed cursor, a view displayed by a GUI window, a portion of a document displayed in the window, or a simulated cockpit of an aircraft can all be considered graphical objects. The host application program checks for input signals received from the mouse 12, displays updated

position control paradigm, the position (or change in position) of a user-controlled graphical object, such as a cursor, in host frame 30 corresponds to a position (or change in position) of the mouse 12 in the local frame 28.

Rate control is also used as a control paradigm. This refers to a mapping in which the displacement of a user manipulandum along one or more provided degrees of freedom is abstractly mapped to motion or rate of a computer-simulated object under control. There is not a direct physical mapping between physical object (mouse) motion and computer object motion.

The mouse 12 is useful for both position control ("isotonic") tasks and rate control ("isometric") tasks. For example, as a traditional mouse, the position of mouse 12 in its local frame 30 workspace can be directly mapped to a position of a cursor in host frame 28 on display screen 20 in a position control paradigm. Also, the mouse wheel 16 can be rotated in its degree of freedom against an opposing output force to command rate control tasks in an isometric mode. Wheel 16 can also be used for position control tasks, as described in greater detail below.

FIGURE 2 is a perspective view of a second embodiment 30 of a mouse device using the force feedback mouse wheel 16 of the present invention. Force feedback mouse interface system 30 is capable of providing input to a host computer based on the user's manipulation of the mouse and capable of providing force feedback to the system based on events occurring in a program implemented by the host computer. Mouse device 30 includes added force feedback functionality over the embodiment 12 of Figure 1 in that the planar degrees of freedom of mouse 32 are provided with force feedback in addition to the wheel 16 being provided with force feedback. Mouse system 30 includes an interface device 31 including a mouse 32 and an interface 34; and a host computer 18.

Mouse 32, similar to mouse 12 of Figure 1, is an object that is preferably grasped or gripped and manipulated by a user. In the described embodiment, mouse 32 is shaped so that a user's fingers or hand may comfortably grasp the object and move it in the provided degrees of freedom in physical space. One or more buttons 15 allow the user to provide additional commands to the computer system. A thumb button (not shown) can also be provided on mouse 32. One or more of the buttons 15 may command specific force feedback features of the system 30, as described below. Mouse 32 is preferably supported upon a grounded pad 42, which is supported by grounded surface 44.

It will be appreciated that a great number of other types of user manipulandums ("user manipulatable objects" or "physical objects") can be used with the method and apparatus of the present invention in place of or in addition to mouse 32. For example, such objects may include a sphere, a puck, a joystick, cubical- or other-shaped hand grips, a receptacle for receiving a finger or a stylus, a flat planar surface like a plastic card having a rubberized, contoured, and/or

Host computer 18 is described above with reference to Figure 1. The host application program checks for input signals received from the mouse 32, and outputs force values and/or commands to be converted into forces on mouse 32 and on wheel 16. Suitable software drivers which interface force feedback application software with computer input/output (I/O) devices are available from Immersion Human Interface Corporation of San Jose, California.

Mouse system 30 can be used for both position control and rate control. Under a position control mapping, the positions of mouse 32 and a graphical object such as a cursor are directly mapped, as in normal mouse operation. "Ballistics", as described above, can also be provided, and these adjustments can be used in mouse system 30 if desired. Mouse system 30 can also provide a rate control mode in which the displacement of mouse 32 in a particular direction against an opposing output force can command rate control tasks in an isometric mode, as described in U.S. Patent no. 5,825,308, incorporated by reference herein. Furthermore, mouse wheel 16 can also control position and/or rate control tasks independently of the position of the mouse 32 in its workspace, as described in greater detail below.

The mouse system 10 can also include an indexing function or "indexing mode" which allows the user to redefine the offset between the positions of the mouse 32 in the local frame 30 and a user-controlled graphical object, such as a cursor, in the host frame 28. A hand weight safety switch can also be provided as described in greater detail in patent 5,825,308. Other features of the present invention are also provided using force feedback functionality. For example, a thumb button (not shown) or other button 15 can toggle a force functionality mode in which designated graphical objects or regions displayed on screen 20 have other functions enabled by force feedback to wheel 16. This is described in greater detail with respect to Figure 9.

FIGURES 3a and 3b illustrate other embodiments of an interface device and user manipulandum which can incorporate the features of the present invention. In Figure 3a, a handheld remote control device 50 can be used to access the functions of an electronic device or appliance remotely by a user. For example, remote control 50 can be used to select functions of a television, video cassette recorder, sound stereo system, home computer, kitchen appliance, etc. Such control devices typically provide wireless operation by transmitting input signals using an electromagnetic beam that is detected by a detector on the electronic device. Or, remote control 50 can select functions of an internet or network computer connected to a television. For example, one popular device is Web-TV™, which is connected to a television and displays internet information such as web pages on the television screen. Remote control 50 may include buttons 52 for selecting options of the device or appliance, of the application program running on the device, of web pages, etc. Herein, the term "electronic device" is intended to include all such devices as well as a host computer 18 as described above.

same knob, such as volume, tone, balance, etc. Alternatively, different sets of detent force profiles can be stored in a memory device on the radio and a particular set can be provided on the knob 54 by a microprocessor in the radio.

Figure 3b shows another embodiment in which a gamepad controller 60 is provided with a force feedback wheel. Controller 60 is intended to be held by both hands of a user. The controller 60 can include the standard input devices of game controllers, such as buttons 62, a directional game pad 64, and a fingertip joystick 66. The joystick 66 can in some embodiments be provided with force feedback. A finger wheel 68 can also be provided on controller 60 at any of various locations on the controller. Wheel 68 can operate similarly to the mouse wheel 16 described with reference to Figures 1 and 2, or to the knob 54 described with reference to Figure 3a. For example, wheel 68 can operate as a throttle or thrust control in a game for a simulated vehicle and include force feedback in an isometric mode or isotonic mode, or the wheel can be used to guide a pointer or other object on the screen.

FIGURE 4 is a block diagram illustrating an interface of the mouse system 30 of Figure 2 suitable for use with the present invention. Mouse system 30 includes a host computer 18 and interface device 31. A similar force feedback system including many of the below components is described in detail in U.S. patent nos. 5,734,373 and 5,825,308, which are incorporated by reference herein in their entirety.

Host computer 18 is preferably a personal computer, workstation, video game console, or other computing or display device, as explained with reference to Figure 1. Host computer system 18 commonly includes a host microprocessor 70, random access memory (RAM) 72, read-only memory (ROM) 74, a clock 78, and a display device 20. Host microprocessor 70 can include a variety of available microprocessors from Intel, AMD, Motorola, or other manufacturers. Microprocessor 108 can be single microprocessor chip, or can include multiple primary and/or co-processors. Microprocessor 108 preferably retrieves and stores instructions and other necessary data from RAM 72 and ROM 74 as is well known to those skilled in the art. In the described embodiment, host computer system 18 can receive sensor data or a sensor signal via a bus 80 from sensors of system 10 and other information. Microprocessor 70 can receive data from bus 120 using I/O electronics, and can use the I/O electronics to control other peripheral devices. Host computer system 18 can also output commands to interface device 31 via bus 120 to cause force feedback.

Clock 78 is a standard clock crystal or equivalent component which can be used by host computer 18 to provide timing to electrical signals used by host microprocessor 70 and other components of the computer system 18. Display device 20 is described with reference to Figure 1. Other types of peripherals can also be coupled to host processor 70, such as storage devices

embodiment, the microprocessor 90 can independently process sensor signals to determine appropriate output actuator signals by following the instructions of a "force process" that may be stored in local memory and includes calculation instructions, formulas, force magnitudes, and/or other data. The force process can command distinct force sensations, such as vibrations, textures, jolts, or even simulated interactions between displayed objects. The host can send the local processor a spatial layout of objects in the graphical environment so that the microprocessor has a mapping of locations of graphical objects like enclosures and can determine interactions with the cursor locally. Such operation of local microprocessor in force feedback applications is described in greater detail in patent nos. 5,734,373 and 5,825,308. In an alternate embodiment, no local microprocessor 90 is included in interface device 31, and host computer 18 directly controls and processes all signals to and from the interface device 31.

A local clock 92 can be coupled to the microprocessor 90 to provide timing data, similar to system clock 78 of host computer 18 to, for example, compute forces to be output by actuators 106 and 112. In alternate embodiments using the USB communication interface, timing data for microprocessor 90 can be retrieved from the USB interface. Local memory 94, such as RAM and/or ROM, is preferably coupled to microprocessor 90 in interface device 31 to store instructions for microprocessor 90, temporary and other data, calibration parameters, adjustments to compensate for sensor variations can be included, and/or the state of the force feedback device.

Sensor interface 96 may optionally be included in device 31 to convert sensor signals to signals that can be interpreted by the microprocessor 90 and/or host computer system 18. For example, sensor interface 96 can receive signals from a digital sensor such as an encoder and convert the signals into a digital binary number. An analog to digital converter (ADC) can also be used. Such circuits, or equivalent circuits, are well known to those skilled in the art. Alternately, microprocessor 90 or host computer 18 can perform these interface functions. Actuator interface 98 can be optionally connected between the actuators 106 and 112 and microprocessor 90 to convert signals from microprocessor 90 into signals appropriate to drive the actuators. Interface 98 can include power amplifiers, switches, digital to analog controllers (DACs), and other components, as well known to those skilled in the art. In alternate embodiments, interface 98 circuitry can be provided within microprocessor 90 or in the actuators.

In a preferred embodiment, power is supplied to the actuators 106 and 112 and any other components (as required) by the USB. Alternatively, power from the USB can be stored and regulated by device 31 and thus used when needed to drive actuators 106 and 112. Or, a power supply can optionally be coupled to actuator interface 98 and/or actuators 106 and 112 to provide electrical power.

mouse but can alternatively be a joystick, remote control, or other device or article, as described above.

Mechanical portion 102 interfaces the wheel 16 with the host computer 18. Portion 102 includes a sensor 110, an actuator 112, a mechanism 114, and wheel 16. Sensor 110 can be any suitable sensor for detecting the rotary motion of wheel 16, such as an optical encoder, potentiometer, or other varieties as described above for sensors 104. Alternatively, sensor 110 can be a linear sensor that senses linear motion of mechanism 114 converted from the rotary motion of wheel 16. Sensor 110 can be an absolute sensor, where absolute positions of the wheel in the range of motion are reported to host computer 18; or a relative sensor, in which changes in position from a previous position are reported to the host computer. Sensor 110 can be directly coupled to the user object 12 or 32, be coupled through a drive mechanism, or can be decoupled from the user object (e.g. by sensing motion using electromagnetic beam detectors and emitters).

Actuator 112 is any suitable actuator for providing rotary forces on wheel 16 and produces "computer-modulated" forces as referred to above similarly to actuators 106. In the preferred embodiment, actuator 112 is a DC current control motor that has a small enough size to fit into a small manipulandum such as a mouse and a small enough weight as to not interfere with mouse planar movement. Thus, the forces provided on wheel 16 may be small, but since the finger of a user is typically quite sensitive, small magnitude forces are sufficient to convey a variety of force sensations. In other embodiments, different types of active or passive actuators can be used as described above with reference to actuators 106. For example, passive actuators such as a magnetic particle brake, a friction brake, an electrorheological fluid actuator, or a magnetorheological fluid actuator, are quite suitable for use as actuator 112 due to their smaller size and weight and reduced power requirements. If such passive actuators are used, then a desired amount of play can be provided between actuator and wheel 16 to allow sensing of the wheel when the actuator is activated, as described in greater detail in patent nos. 5,721,566 and 5,767,839.

Also, a drive mechanism such as a capstan drive mechanism can be used to provide mechanical advantage to the forces output by actuator 112. Some examples of capstan drive mechanisms are described in patents 5,731,804 and 5,767,839. Alternatively, a belt drive system can be used as described below with reference to Figure 8.

In the described embodiment, the sensor 110 can input signals to a single sensor interface 96 used also for sensors 104 as described above. Actuator 112 can similarly use the actuator interface 98 also used by actuators 106. Alternatively, sensor 110 and/or actuator 112 can be provided with their own dedicated interfaces separate from interfaces 96 and 98.

coupled to actuator 112 by a shaft 128; thus, when the actuator applies rotary force to shaft 128 about axis A, the user's finger 130 on wheel 16 will feel the rotary force about axis A. It should be noted that if the user is applying sufficient force in the opposite direction of the rotary force, the actuator operates in a stalled condition where the wheel 16 will not physically rotate, but the user will feel the rotational force.

Sensor 110 is coupled to the shaft 128 (or a portion of actuator 112 coupled to shaft 128) to measure the rotation of the shaft about axis A and thus the rotation of the wheel 16. Sensor 110 senses the rotation of wheel 16 even when no forces are applied to the wheel by actuator 112. In the embodiment of Figure 5, the actuator 112 is provided between the sensor 110 and the wheel 16. FIGURE 6 is a perspective view of a second embodiment 102' of mechanical portion 102, where the wheel 16 is positioned between the sensor 110 and actuator 112. Embodiment 102' is more appropriate than embodiment 102 when a desired play is introduced between actuator and wheel 16, since the sensor is desired to be rigidly coupled to wheel 16 without play in such an embodiment. In other respects, the embodiment 102' functions similarly to the mechanical portion 102.

FIGURE 7 is a perspective view of a third embodiment 102'' of mechanical portion 102 for force feedback mouse wheel 16. Wheel 16 is coupled to a pulley 132 by a rotatable shaft 134, where pulley 132, shaft 134, and wheel 16 rotate about axis B. In this embodiment, the pulley 132, shaft 134, and wheel 16 are preferably fixed at their rotation location, i.e., axis B is fixed with respect to mouse 12 or 32. Pulley 132 is coupled to a pulley 136 by a belt 138. Pulley 136 is rigidly coupled to a shaft 140, which is coupled to actuator 112 and to sensor 110, where pulley 136, actuator 112, and sensor 110 rotate about axis C. Mechanical portion 102'' thus operates similarly to the embodiment 102, except that the belt transmission system 142 that includes pulley 132, belt 138, and pulley 134 is used to scale the motion of wheel 16 and forces applied to wheel 16. For example, pulley 136 preferably has a smaller diameter than pulley 132 to allow the rotational motion of wheel 16 to be converted to a greater number of rotations of shaft 140, thus increasing the sensing resolution. Furthermore, a smaller rotation of shaft 140 translates to a greater amount of rotation of shaft 134, thus providing mechanical advantage to forces output by actuator 112 and allowing a smaller actuator to be used in mouse 12 or 32. In other embodiments, belt 138 can be a cable, or belt transmission system 142 can be a capstan drive system. Other mechanical transmission systems may also be used.

FIGURE 8 is a perspective view of a fourth embodiment 102''' of mechanical portion 102 for force feedback mouse wheel 16. Embodiment 102''' is similar to embodiment 102'' except that axis B is floating, i.e., may be rotated about axis C. Thus, the assembly including pulley 132, shaft 134, and wheel 16 may be rotated about axis C. This motion allows the wheel 16 to move approximately vertically with reference to the horizontal planar orientation of the

wheel from a reference position (when viewing wheel coincident with axis of rotation), at a force magnitude of 10% of maximum force output (magnitude can also be expressed in other terms). Additional angle parameters can define additional detents located at different angles around the wheel in a range of 360 degrees, irregularly or regularly spaced as desired. Alternatively, "N pulses per revolution" can be a parameter to command N regularly-spaced force detents per revolution of the wheel. If a local microprocessor 90 is used, the microprocessor can implement the detents independently of control of the host based on the received host command.

For example, one standard GUI feature is a pull-down menu 206. Individual menu items 208 in the pull down menu 206 may be selected by the user using cursor 204. Once the pull-down menu has been displayed, the selection of a menu item 208 can be controlled by wheel 16 moving cursor 204 (and, optionally, vertical motion of mouse 12 or 32 can be disabled while the menu is displayed). For example, a menu item selection bar 209 (or highlighter) can be moved up or down menu 206 by rotating the wheel 16. The force detents can be output on wheel 16 to correspond with the spacing of menu items 208. Thus, the selection of a menu item is made easier from the use of detent forces, which substantially reduces the tendency of the user to overshoot a menu item when moving a cursor down the list of menu items. Furthermore, since the force detents are programmable, the user or software developer can set a rotational distance between detents to a particular preference, and can also set the magnitude of detent forces, e.g. for the "depth" of the detent which controls how easily the user may move the wheel past or out of a detent.

Detent forces can similarly be used for other GUI or application program features. For example, the spacing of objects on a document can be synchronized with force detents. As the document is scrolled using wheel 15, each time a particular object is scrolled past a predetermined location in a window, a force detent can be output. For example the spacing of lines 214 of text in a text document 212 can be synchronized with force detents so that if these text lines are scrolled by the cursor or other location in the window using the wheel 16, a force detent is output on the wheel 16. Similarly, the grid spacing on a spreadsheet or the links on a web page can be associated with force detents. The force detents can be spaced to correspond with the spacing of the text or other features to provide the user with greater feedback concerning the graphical features. Thus, a text document having single-spaced lines would cause force detents to be output in quick succession as the document is scrolled, while a text document having double-spaced lines would cause force detents to be output twice the rotational distance apart as the single spaced document. In other embodiments in which the wheel 16 is used to position the cursor 204 (described below), force detents can be output on wheel 16 when the cursor is moved over a particular graphical object, such as a text word, an icon, or a menu item 208. The flexibility of characterizing the computer-controlled actuator force detents makes

screen. For example, each time a page break in a text document scrolls by the cursor 204 or scrolls past the bottom of the displayed window, a jolt can be output on wheel 16. Other objects such as web page links, images, etc. can also be associated with jolts. A jolt differs from a detent in that a jolt is time-based rather than spatially based; the jolt is output irrespective of the position of the wheel 16, and does not attract or repel the wheel from a particular rotational position.

A different force sensation that can be output on wheel 16 is a vibration. Like the jolt force, this type of force "effect" is time based, not based on the rotational position of the wheel. The vibration force can be commanded with a command such as WHEEL_VIBRATION (Frequency, Waveform, Magnitude) to characterize the vibration force, where "Waveform" can be a sine wave, square wave, triangle wave, or other-shaped wave. The vibration can be associated with particular graphical objects displayed on the screen, or be output based on events that occur in a host application. For example, a vibration can be output on wheel 16 when a warning or alert message is given, such as when the user receives new mail or when an error in a program occurs.

Other force sensations that can be output on wheel 16 are inertia, friction, and/or damping force. An inertia force is based on a simulated mass of an object, where the larger the mass, the greater the force resisting motion of the object. For example, a document can be assigned a simulated mass based on a characteristic of the document, such as the file size of the document, the font used in the document, etc. A document having a larger mass has a greater inertia force associated with it, so that the wheel 16 is more difficult to rotate when scrolling a large document as compared to scrolling a smaller document. The user can perceive the force on the wheel 16 and readily discern the size of the scrolled document. A friction force depends on a predefined coefficient of friction which causes a drag force on the user manipulandum. A damping force sensation is based on the velocity of an object, where the greater the velocity, the greater the damping force. This force feels like resistance to motion through a viscous liquid. The faster wheel 16 is rotated, the greater the damping force on the wheel. This can be used, for example, to provide areas of a document where scrolling is desired to be slower or controlled to a more fine degree, or to alert the user of a particular portion of the document as it scrolls by.

Another use for wheel 16 is for "coupled control." Coupled control refers to the position of cursor 204 on screen 20 being controlled both by the position of mouse 12 or 32 in its planar workspace as well as by the rotational position of wheel 16 about its axis. In one embodiment, the Y (vertical) screen coordinate of the cursor 204 is determined by the Y position of the mouse added to the Y position of the wheel 16, as summarized by the following:

$$Y_{\text{CURSOR}} = Y_{\text{MOUSE}} + Y_{\text{WHEEL}}$$

associated with the motion of the cursor and/or the interaction of the cursor with other graphical objects in GUI 200. Also, one or more of these forces can be combined with one or more other forces to create compound force sensations on wheel 16.

Furthermore, force profiles may be used to control the forces on wheel 16. Force profiles are sequences of individual force magnitudes that have been stored in a storage device such as local memory 92, host RAM 74, a hard disk drive, floppy disk, CD-R or CD Rewritable, DVD, or other storage device. The force magnitudes can be output by microprocessor 90 to the actuator 112 in sequence to apply a particular force sensation characterized by the force profile. The microprocessor can output the force profile magnitudes (or a subset thereof) at different rates or with different offsets from the stored magnitudes as commanded by host computer 18 and/or as a function of characteristics, such as wheel velocity/acceleration/current position, time, etc.

The force feedback functionality of wheel 16 described above can also be provided in different modes of the interface device 12 or 31, where the user, microprocessor 90, and/or host computer 18 can control which mode is currently active. Examples of two preferred modes are isotonic mode and isometric mode. Example of similar isometric and isotonic modes for mouse 12 or 32 are also described in U.S. Patent No. 5,825,308.

Isotonic mode is a position control mode for wheel 16, where the forces output on the wheel are synchronized or associated with the position of the wheel, and where the position of the wheel, when changed, incrementally changes the position or state of a graphical object provided by the host computer. For example, when a position control scrolling is provided by wheel 16, a document is scrolled by an amount corresponding to the amount the wheel is rotated. Similarly, the coupled control described above is a position control function, since a cursor is incrementally moved based on incremental rotations of the wheel 16.

Force sensations that are appropriate for such a position control wheel mode include force detents. For example, as explained above, force detents are output on the wheel depending on when text lines or spread sheet cells are scrolled by, where each detent is incrementally output as a document is scrolled, zoomed, panned, etc. Damping, friction, and inertia forces are also position control mode forces, where the force depends on the velocity (which is position based) or the position of the wheel and the cursor, document, or other object which is directly controlled by the wheel. Obstruction forces which represent hard stops to the wheel can be used in position control mode to represent the end of travel of the wheel; for example, when the end of a document is reached during a scrolling function, a hard stop force can be output to indicate this condition and resist further scrolling. Alternatively, a wall obstruction force on wheel 16 indicates that a wheel-controlled cursor has hit a wall. Texture forces are also appropriate in the position control mode, where the texture force is dependent on the position of the wheel; for

is active. For example, when the mode is not active, the cursor can be moved normally through the border or edge of a window, with no force sensations associated with the movement over the window. However, when the force mode is active (such as by pressing or holding a particular button 15), a spring force will be output on mouse 32 and/or on wheel 16 opposing the movement of the cursor through the window border, i.e. the window border becomes an "isometric surface." This force is used as for "pressure scrolling" or as a "scroll surface", where the amount of penetration of the mouse against the spring force controls the speed of scrolling, zooming, etc. of a document displayed in that window (similar to isometric mode described above). In a "pressure clicking" or "click surface" embodiment, if the cursor is moved against the border of an icon or other object and the force functionality mode is active, a force will be output resisting motion of the cursor into the icon; when the mouse 32 and/or wheel 16 moves against the force a threshold distance, the icon is selected as if the cursor had clicked or double-clicked on the icon. These types of features are especially applicable to wheel 16 when in the coupled cursor control embodiment described above. In other embodiments, other input devices besides or in addition to buttons 15 can control the force functionality mode. Or, different input devices can control different modes.

FIGURE 10 illustrates an application for a control knob embodiment of the present invention. A control panel 212 is provided for a device 210 and includes a control knob of the present invention. In the described embodiment, device 210 is an audio device that controls the output of sound, such as music or speech, from speakers that are connected to the device 210. For example, a common embodiment of device 210 is a stereo system that includes the ability to play sound from one or more media or signals, such as cassette tapes, digital audio transmission (DAT) tapes, compact discs (CD's) or other optical discs, or radio signals transmitted through the air from a broadcasting station.

The device 210 can also include additional or other functionality not related to audio control and output. For example, many vehicles include electronic systems to control the temperature in the vehicle cabin (air conditioning, heat, etc.), as well as systems to provide information on the current operating characteristics of the vehicle, such as current speed, engine temperature, fuel or other fluid levels, whether windows of the vehicle are open, etc. Other systems may include a navigation system that displays a map and the current location of the vehicle with respect to the map, a cellular telephone or other portable telephone control system, and a security/alarm system. Device 210 can include the ability to display information from and/or influence such other systems in a vehicle or other environment, such as a house, office, etc.

Alternatively, device 210 can be a variety of other electronic or computer devices. For example, device 210 can be a home appliance such as a television set, a microwave oven or other kitchen appliances, a washer or dryer, a home stereo component or system, a home computer, a

Control knobs 218 are provided to allow the user a different type of control of functions and settings of device 210 than the buttons 216 allow. Knobs 218, in the described embodiment, are approximately cylindrical objects engageable by the user. The knobs 218 can alternatively be implemented as a variety of different objects, including conical shapes, spherical shapes, dials, cubical shapes, rods, etc., and may have a variety of different textures on their circumferential surfaces, including bumps, lines, or other grips, or even projections or members extending from the circumferential surface. In addition, any of variety of differently-sized knobs can be provided; for example, if high-magnitude forces are output, a larger-diameter cylindrical knob is often easier for a user to interface with device 210. In the described embodiment, each knob 218 rotates in a single rotary degree of freedom about an axis extending out of the knob, such as axis A. The user preferably grips or contacts the circumferential surface 226 of the knob 218 and rotates it a desired amount. Force feedback can be provided in this rotary degree of freedom in some embodiments, as described in greater detail with reference to Figs. 12a and 12b.

Furthermore, the control knobs 218 of the present invention allow additional control functionality for the user. The knobs 218 are preferably able to be moved by the user in one or more directions approximately perpendicular to the axis A of rotation, e.g. parallel to the surface of the front panel 212 as shown in Fig. 10 ("transverse motion" or "transverse direction"). This transverse motion is indicated by arrows 228. For example, the knob 218 can be moved in the four orthogonal directions shown, or may be moveable in less or more directions in other embodiments, e.g. only two of the directions shown, or in eight directions spaced at 45 degree intervals about axis A. In one embodiment, each transverse direction of the knob is spring loaded such that, after being moved in a direction 228 and once the user releases or stops exerting sufficient force on the knob, the knob will move back to its centered rest position. In other embodiments, the knob can be provided without such a spring bias so that the knob 218 stays in any position to which it is moved until the user actively moves it to a new position.

This transverse motion of knob 218 can allow the user to select additional settings or functions of the device 210. In some embodiments, the additional control options provided by knob 218 allow the number of buttons 216 and other controls to be reduced, since the functions normally assigned to these buttons can be assigned to the knob 218. For example, the user can move a cursor 30 or other visual indicator on display 214 (e.g. pointer, selection box, arrow, or highlighting of selected text/image) to a desired selection on the display. Thus, the cursor 230 can be moved from the "radio" selection shown to the "tape" selection by moving the knob 218 in the down direction as shown in Fig. 10. Or, the cursor 230 can be moved to the "CD" selection by moving the knob 218 in the direction to the right. If knob 218 is provided with diagonal directions (e.g. at 45 degree intervals), the user can move the cursor 230 from the "radio" selection directly to the "off" selection. The user can similarly move cursor 230 or a

direction as shown by arrow 236. In the present invention, slider control 232 preferably includes force feedback functionality. Thus, as the user moves the knob 234, force sensations such as a spring force, a damping force, jolts, detents, textures, or other forces can be output and felt by the user. Furthermore, the slider knob 234 can include a button 238 which can be pressed by the user similarly to the push knob embodiment discussed above with reference to knob 218. Alternatively, the knob 234 can be pushed and/or pulled similarly to the knob 218 as described above. Slider control 232 can control any of the various functions, settings, or options of the device 210. For example, the motion left or right of knob 234 can control the radio frequency 222, where force detents are output for each station and/or each preset station previously programmed by the user. Or, the cursor 230 can be moved using the slider knob 234, such that when the cursor reaches a desired setting or selection, the user can push button 238 or push on the knob 234 to select that setting. Other functions such as volume, balance, tone, map functions, temperature functions, or mode selection can also be controlled by the slider control 232. Slider control is described in greater detail with respect to Figure 14.

FIGURE 11 is an example showing images which can be displayed on display 214 to assist the user in selecting options with knobs 218 and/or slider control 232. Display 214 can present icons as shown, in this example for the control of audio output signals from device 210. Icon 246 is selected to control the volume of the audio output using knob 218, where the circular pointer 242 can be moved in accordance with the knob 218. Icon 247 is used to control the frequency of the radio tuner (the current selected frequency can be displayed as well), and the icons 248, 249, and 251 are used to control the balance, treble, and bass of the audio, respectively. For example, the indicator 244 can be moved left or right depending on the current setting. Cursor 245 is used to select one of the icons to allow the control of the functions associated with the selected icon. Cursor 245 indicates which of the icons in display 214 are currently selected. The icon can be moved from each icon to the next by rotating the knob 218. Alternatively, the transverse motion of the knob can move the cursor 245. A function of the device designed by the selected icon can be selected by pushing the knob 218 in the linear direction. The cursor can be a square or other-shaped box, or the currently-selected icon can be highlighted to indicate the cursor's location.

It should be noted that each of the icons can preferably be set to a position control mode or to a rate control mode as desired by the user. For example, the user may select position control for volume 246 and rate control for the functions of icons 247, 248, 249, and 251, or any other combination. In position control mode, force detents are preferably output to indicate particular settings or how far the knob 218 has been rotated. In rate control mode, detents can also be output. For example, the user maintains the knob 218 at a rotary position away from the center position in opposition to a spring return force, and a detent force (e.g., jolt) is output to indicate how much a particular value has been changed. For example, a jolt can be output for

A pusher member 256 is rigidly coupled to shaft 250 next to the switch 252. Since the switch 252 includes an aperture through which the shaft 250 extends, the knob 218, shaft 250 and pusher member 256 are operative to move as a unit along axis A with respect to the front panel (ground) and the switch 252. A switch 258 (see Fig. 12b) is coupled to a grounded member 260 and is provided in the path of the pusher member 256. Thus, when the knob 218 is pushed by the user, the shaft 250 and the pusher member 256 are moved along axis A in a direction indicated by arrow 262 (see Fig. 12b). This causes pusher member 256 to engage the button 264 of the switch 258, causing the button 264 to be pushed inward and close (or open) the switch. The pushing motion of the knob 218 is thus sensed.

In other embodiments, a sensor can be provided to sense a range of positions of the knob 218 or a continuous motion of the knob 218 linearly along axis A. For example, a Hall effect switch can be provided on pusher member 256 which measures the position of the pusher member 256 relative to a grounded magnet on member 260 (or the Hall effect switch can be placed on the member 260 and the magnet can be placed on the member 256). Or, an optical sensor (such as a photodiode) or other type of sensor can detect the position of the member 256 and/or knob 218. In such an embodiment, the position of the knob along axis A can proportionately control a function or setting of the device 210. For example, such movement can control the volume of audio output of the device, motion of a cursor across a display, or the brightness of lights inside a vehicle.

A pull switch can be implemented similarly to the push switch shown in Figs. 12a and 12b. For example, a switch similar to switch 258 can be grounded and provided on the opposite side of pushed member 256 so that when knob 218 is pulled in a direction opposed to direction 262, a button on this switch is engaged by the pusher member to detect the pulled motion. The pull motion of knob 218 can also be sensed in a continuous range similar to the push embodiments described above. In some embodiments, both push and pull motions of the knob 218 may be provided and sensed.

A spring member 264 is rigidly coupled to the pushing member 256 at one end and is rigidly coupled to a rotatable end member 266 at its other end. Spring member 264 is compressed when the knob 218 and pusher member 256 are moved in the direction of arrow 262. Spring member 264 thus provides a spring force that biases the knob 218 in the direction opposite to direction 262. If the knob 218 is not forced in direction 262, the spring bias moves the knob 218 opposite to direction 262 until the knob reaches its rest position. In those embodiments including a pull motion of the knob 218 in the direction opposite to direction 262, a spring member can be included on the opposite side of pusher member 256 to spring member 264, to bias the knob 218 in direction 262 after the user has pulled the knob. In yet other embodiments, no spring member 264 is provided, and the knob 218 remains at any pushed or pulled position until actively moved to a new position by the user.

Also, the magnitude of the force detents can differ based on the value being controlled. For example, a radio frequency having a higher value might be associated with a stronger force detent, while a lower radio frequency might be associated with a weaker force detent when it is displayed, thus informing the user generally of the radio station being displayed without requiring the user to look at the display 214 (which is particularly useful when operating the device 210 while performing another task, such as driving a vehicle). In some embodiments, the user can also change the magnitude of detents associated with particular values, such as radio stations, to preferred values so as to "mark" favorite settings. Programmability of the location of the detents in the rotary degree of freedom is also convenient since preferred radio frequencies are most likely spaced at irregular intervals in the radio frequency range, and the ability to program the detents at any location in the range allows the user to set detents to those preferred stations. In addition, the knob can be moved by the actuator 270 to select the nearest preprogrammed station or preferred setting. Also, different sets of detent force profiles can be stored in a memory device on the device 230 and a particular set can be provided on the knob 218 by a microprocessor or other controller in the device 230.

Another type of force sensation that can be output on knob 218 is a spring force. The spring force can provide resistance to rotational movement of the knob in either direction to simulate a physical spring on the knob. This can be used, for example, to "snap back" the knob to its rest or center position after the user lets go of the knob, e.g. once the knob is rotated past a particular position, a function is selected, and the user releases the knob to let the knob move back to its original position. A damping force sensation can also be provided on knob 218 to slow down the rotation of the knob, allowing more accurate control by the user. Furthermore, any of these force sensations can be combined together for a single knob 218 to provide multiple simultaneous force effects.

The spring return force provided in the rotary degree of freedom of the knob 218 can also be used to implement a rate control paradigm. "Rate control" is the control of a rate of a function, object, or setting based on the displacement of the knob 218 from a designated origin position. The further the knob is moved away from the origin position, the greater the rate of change of controlled input. For example, if a rate control knob 218 with a spring return force is used to control the radio frequency, then the further the knob is moved from the center origin position, the faster the radio frequency will change in the appropriate direction. The frequency stops changing when the knob is returned to the origin position. The spring force is provided so that the further the user moves the knob away from the origin position, the greater the force on the knob in the direction toward the origin position. This feels to the user as if he or she is inputting pressure or force against the spring rather than rotation or displacement, where the magnitude of pressure dictates the magnitude of the rate. However, the amount of rotation of the

Furthermore, in other embodiments, the pull and/or push motion of knob 218 along axis A can be actuated. For example, a jolt force can be output on the knob in the linear degree of freedom along axis A as the user pushes the knob. Also, the spring return force provided by spring member 264 can instead be output using an actuator controlled by a microprocessor.

5 It should be noted that the embodiment of Figs. 12a and 12b is not the only embodiment of the present invention. For example, some embodiments may only include the transverse motion of knob 18 and not the push and/or pull functionality nor the force feedback functionality. Other embodiments may only include the push and/or pull functions. Yet other
10 embodiments may only include force feedback with transverse knob motion, or force feedback with push and/or pull functions.

FIGURE 13a is a perspective view of an alternate embodiment 280 of the control knob 218 of the present invention. In embodiment 280, knob 218 is coupled to shaft 250, which is rigidly coupled to a flex member 282. Flex member 282 includes a base plate 284 and a plurality of bent portions 286 extending from the base plate 284. For example, as shown in
15 FIGURE 13b, the flex member 282 can be formed by cutting out the circular base plate 284 and the portions 286 from a unitary piece 285 of material, such as spring steel or stainless steel. The unitary piece is preferably provided as a thin sheet. Holes 288 or other apertures can be placed near the ends of the portions 286. Referring back to Fig. 13a, the portions 286 are then bent such that the holes 288 substantially align with the other holes 288, where the holes 288 are aligned
20 with axis B that extends approximately perpendicular to the surface of the base plate 284. The base plate 284 is rigidly coupled to the rotating shaft of the actuator 270.

FIGURE 13c is a side elevational view of the embodiment 280 of Fig. 13a. In the described embodiment, knob 218 is coupled to shaft 250, which extends through a switch 290 and is coupled to the bent portions 286 of the flex member 282. The switch 290 is preferably
25 similar to the switch 252 described above with reference to Figs. 12a and 12b. For example, a microswitch can be provided on the inside surface of the housing of switch 290 for each transverse direction of knob 218 that is to be sensed. The base plate 284 of the flex member 282 is rigidly coupled to shaft 292 of actuator 270. The shaft 292 is rigidly coupled to a shaft (not shown) of sensor 276, which has a grounded housing that is coupled to the grounded housing of
30 actuator 270.

Alternatively, a plurality of sensors can be positioned external to the flex member 282 instead of using switch 290. For example, switches 294 can be positioned on two or more sides around the flex member 282, depending on how many directions are to be sensed. Switches 294 can be contact switches that each detect when the portions 286 move to engage the contact
35 switch, thus indicating movement of knob 218 in a particular transverse direction. Alternatively, members can be positioned on shaft 250 which extend to the sides of the shaft and which engage

transmission member moves. Voice coil actuators such as actuator 304 are described in greater detail in U.S. Patent No. 5,805,140, the disclosure of which is incorporated herein by reference. In particular, the operation of the voice coils as actuators and/or sensors is described therein.

Other types of actuators 304 and transmissions can also be used in slider control 232. For example, a capstan drive and cable transmission can provide linear forces on the knob 234. Other types of actuators suitable for use with the slider include active actuators, such as linear current control motors, stepper motors, pneumatic/hydraulic active actuators, a torquer, etc. Passive actuators may also be used, such as magnetic particle brakes, friction brakes, fluid controlled passive actuators, or other actuators which generate a damping resistance or friction in a degree of motion.

Slider knob 234 can also include a button 238 which is used to provide input to the device 210. In yet other embodiments, the slider knob 234 can be pushed and/or pulled in a linear degree of freedom approximately perpendicularly to the surface of front panel 212. In such an embodiment, a moveable contact switch can be provided between the knob 234 and the transmission member 300. A spring member can also be provided similarly to the embodiment of Figs. 12a-12b and 13a-13c to bias the knob 234 to a neutral rest position.

The force sensations and modes described above for the rotary knob in Figs. 12a-12b and 13a-13c may also be used for the slider control 232 in a linear degree of freedom. For example, force detents can be applied in a position control paradigm as the knob 234 is moved in its linear degree of freedom. In a rate control paradigm, a spring return force can bias the knob 234 toward a center origin position, for example the center of the range of motion of the knob. The further the user moves the knob from the origin position, the greater the spring force opposing that motion and the greater the rate of the controlled value changes (increases or decreases). Other force effects include damping forces, texture forces, jolts, obstruction forces, assistive forces, periodic forces such as vibration forces, and end-of-travel forces.

FIGURES 15a and 15b are diagrammatic illustrations illustrating detent force profiles suitable for use with the knobs of device 210. Detent force profiles can be implemented by a microprocessor or other controller based on instructions stored in a computer readable medium, such as a memory circuit, magnetic disk, optical disk, etc. In Fig. 15a, a detent force profile is shown. The vertical axis F represents the magnitude of force output, where a positive F value indicates force in one direction, and a negative F value indicates force in the opposite direction. The horizontal axis d represents the distance or position of the moved user object (knob) in a degree of freedom, where the origin position O indicates the position of the detent, a positive d is a position past the origin of the detent in one direction, and a negative d is a position past the origin of the detent in the opposite direction. The curve 324 represents the force output for a single detent over a position range for the detent. Thus, for example, if the user moves the knob

same distance from origin O2 as P3. Detent curve 328 ends at endpoint 332 on the right side of origin O1 and within the range of forces of detent curve 330. Preferably, the end point 332 of curve 328 is positioned well after the endpoint 334 of curve 330, such that the point 332 has a position in the middle of the range between point 334 and the origin O2. The overlapped zone is between positions P3 and P2. In addition, the end point 332 of the first detent preferably does not extend past the origin O2 of the second detent into the positive side of the second detent. If another detent is positioned further on the d axis after curve 330, the end point 333 of curve 330 preferably is positioned well after the starting endpoint of the next detent curve and not past the origin of the next detent curve. Similar positioning can be provided for curves before curve 328 on axis d.

To solve the problem of unintentionally moving past a successive detent, the range of the second or successive detent is adjusted such that a lesser magnitude is preferably output at the beginning of the successive detent than would normally be output if the entire curve of the successive detent were used. Furthermore, the force detent curve used to output force is preferably different depending on the direction of the knob, similar to a hysteresis effect. As shown in FIGURE 15c, when moving the knob so the knob position changes from left to right, the force at the beginning of the range of detent curve 330 is at point 335 having a magnitude of 0.5M, which is one-half the magnitude M of the force at the other endpoint 333 of the range of curve 330 (ignoring the signs or direction of the forces). Of course, in other embodiments point 335 can have a magnitude of other fractions of M, such as one-third or three-fourths of M. Additional curve 327 can be similarly positioned and provide a similar overlap with curve 330, and additional curves may be added before curve 328 and/or after curve 327.

As shown in FIGURE 15d, when moving the knob in the other direction so the knob position changes from right to left, the endpoints of the curve 330 reverse in magnitude with respect to the endpoints shown in Fig. 15c. In Fig. 15d, starting from origin O2, the force at the beginning of the range of detent curve 328 is at point 336 having a magnitude of 0.5M, which is one-half the magnitude M of the force at the other endpoint 331 of curve 328 (other fractions of M can be provided for endpoint 336 in other embodiments). Any additional curves, such as curve 327, can be provided with a similar overlap. The force output on the knob thus changes depending on the direction of the knob. In a digital sensing system (e.g. using a digital encoder), the direction can be determined from a history of sensed values. For example, one or more sensed position values can be stored and compared to a current sensed position to determine the knob direction.

The use of a lesser magnitude at the beginning of the second detent reduces the tendency of the user to unintentionally skip past a second detent after moving the knob over a first detent closely spaced to the second detent. For example, when moving the knob left to right (e.g., clockwise) from position P1, a first detent (curve 328) ends at point 332 of curve 328, after

the deadband is reached (zero magnitude). Similarly, at point P4 on the other side of the origin O, the force increases from zero to a maximum magnitude M5 at location P5, after which the force drops a short distance to magnitude M6 at location P6. The force then drops to zero for increasing d, until another detent effect is encountered. The small decreases in force magnitude from the maximum magnitude at the end points of the curve 338 are useful in some detent embodiments to provide a less extreme assistive or resistive force to the user when entering or exiting the detent range, e.g., to gradually lead the user into the detent range before outputting the maximum force. This can provide a smoother-feeling and, in some cases, a more easily-selected detent (i.e., it can be easier to position the knob at the detent's origin).

The detent curve 338 can thus be defined using the parameters shown in Fig. 16a. For example, a force command protocol can provide a number of different commands that can cause the output of different force sensations to the user. The commands can each include a command identifier followed by one or more command parameters that define and characterize the desired force sensation. An example of a command defining a detent curve 338 is as follows:

DETENT (TYPE, PERIOD, MAGNITUDE, LOCATION, DEADBAND, FLAG, WIDTH, PHASE, OFFSET, LOCATION, INCREMENT, ARRAY POINTER)

The DETENT identifier indicates the type of force sensation. The TYPE parameter indicates a type of periodic wave from which to base the force detent curve, such as a sine wave, triangle wave, square wave, ramp, etc. The PERIOD and MAGNITUDE parameters define those characteristics of the periodic wave. The LOCATION parameter defines the location of the origin position for the detent in the degree of freedom of the knob. The DEADBAND parameter indicates the size of the deadband around the origin position. The FLAG parameter is a flag that indicates whether the detent is provided on the positive side, the negative side, or both sides around the location (origin position). The WIDTH parameter defines the amount of the wave 339 used for the detent curve, i.e. the extent of the wave used starting from the PHASE position. The PHASE parameter indicates the starting position of the detent curve 338 on the wave 339 (and is described in greater detail below). The OFFSET parameter indicates the amount of magnitude offset that curve 338 includes from the d axis, and is described in greater detail below. The INCREMENT parameter indicates the distance in the degree of freedom of the knob between successive detent locations. The optional LOCATION ARRAY POINTER parameter indicates a location in a separate array that has been previously programmed with the particular positions in the degree of freedom of the knob at which the detents are located and (optionally) the total number of detents; the array can be provided in memory, such as RAM, or other writable storage device. For example, the array can be preprogrammed with three detents, at locations of 45 degrees, 78 degrees, and 131 degrees in the rotation of the knob. The array can be accessed as necessary to retrieve these locations at which detent forces are to be output. This

FIGURE 16c is a graph 344 showing the resulting detent curve 346 obtained from the application of the parameters to the wave 342 described with reference to Fig. 16b. The portion of the wave 342 starting at the phase and positioned above the offset line in Fig. 16b is used in the detent curve 346. Furthermore, a deadband 348 has been added to the curve. The flag in the detent command has caused the positive side of the curve 346 to be mirrored on the negative side of the origin O. This detent curve 346 causes a detent force that is similar to the detent force described with reference to Fig. 16a, only smaller in magnitude and in position range over the degree of freedom of the knob.

FIGURE 16d is a graph 360 showing a periodic wave and parameters to be applied to the wave. Sine wave 362 is provided as described above, having a particular period and magnitude. An offset is specified for the resulting detent curve; in the example of Fig. 16d, the offset is 1, thus causing the detent curve to be shifted upward by its entire magnitude. A phase of 270 degrees is also indicated, so that the detent curve starts at the lowest magnitude of the wave 372 at point P. Furthermore, an increment is also specified as a parameter (not shown). FIGURE 16e is a graph 370 illustrating the detent curves 372 and 374 resulting from the wave 362 and parameters described with reference to Fig. 16d. The portion of the wave 362 past point P and ending at a point defined by a width parameter is provided both on the positive side and the negative side of origin O1 of graph 370 for curve 372 (the positive and negative sides are designated by the flag parameter). A second curve 374 is also shown, where the origin O2 of the second curve is positioned at a distance from the origin O1 as specified by the increment parameter. Additional curves similar to curves 372 and 374 are provided at further distances at same increment from each other. The detent curves 372 and 374 provide a much steeper, less gradual detent force over the detent range than the other detent forces shown in Figs. 16a and 16c. Furthermore, no actual deadband is specified, although the shape of each half of the curve 372 provides a small zone 376 where zero force is output, similar to a deadband.

FIGURE 17 is a block diagram illustrating an electromechanical system 400 for the device 210 of Fig. 10 suitable for use with the present invention. A force feedback system including many of the below components is described in detail in Patent number 5,734,373.

In one embodiment, device 210 includes an electronic portion having a local microprocessor 402, local clock 404, local memory 406, sensor interface 408, and actuator interface 410.

Local microprocessor 402 is considered local to device 210 and is preferably similar in type and function to microprocessor 90, described above. Microprocessor 402 can include one microprocessor chip, or multiple processors and/or co-processor chips, and can include digital signal processor (DSP) functionality. Also, "haptic accelerator" chips can be provided which

such as a lateral effect photo diodes, tachometers, and accelerometers. Furthermore, both absolute and relative sensors may be used.

In those embodiments including force feedback, actuator 270 transmits forces to knob 218 in one or more directions in a rotary degree of freedom in response to signals output by microprocessor 402 or other electronic logic or device, i.e., it is "electronically-controlled." The actuator 270 produces electronically modulated forces which means that microprocessor 402 or other electronic device controls the application of the forces. Typically, an actuator 270 is provided for each knob 218 that includes force feedback functionality. In some embodiments, additional actuators can also be provided for the other degrees of freedom of knob 218, such as the transverse motion of the knob 18 and/or the push or pull motion of the knob. The actuators, such as actuator 270, can include active actuators, such as linear current control motors, stepper motors, pneumatic/hydraulic active actuators, a torquer (motor with limited angular range), voice coil actuators, etc. Passive actuators can also be used, including magnetic particle brakes, friction brakes, or pneumatic/hydraulic passive actuators, and generate a damping resistance or friction in a degree of motion. In some embodiments, all or some of sensors 414 and actuator 270 can be included together as a sensor/actuator pair transducer, as shown in Figs. 12a-12b for actuator 270 and sensor 276.

Mechanism 416 is used to translate motion of knob 218 to a form that can be read by sensors 414, and, in those embodiments including force feedback, to transmit forces from actuator 270 to knob 218. Examples of mechanism 416 are shown with respect to Figs. 12a-12b and 13a-13c. Other types of mechanisms can also be used, as disclosed in U.S. Patent Nos. 5,767,839, 5,721,566, 5,805,140, all incorporated by reference herein. Also, a drive mechanism such as a capstan drive mechanism can be used to provide mechanical advantage to the forces output by actuator 270, as described in patent no. 5,731,804, incorporated by reference herein. Alternatively, a belt drive system, gear system, or other mechanical amplification/transmission system can be used.

Other input devices 420 can be included in interface device 210 and send input signals to microprocessor 402. Such input devices can include buttons, such as buttons 216 on front panel 212 as shown in Fig. 10, used to supplement the input from the knob to the device 210. Also, dials, switches, voice recognition hardware (e.g. a microphone, with software implemented by microprocessor 402), or other input mechanisms can be used. can also be included to send a signal (or cease sending a signal) to microprocessor 402 or to the actuator 270 or actuator interface 410, indicating that the user is not gripping the knob 218, at which point all output forces are ceased for safety purposes. A safety or "deadman" switch 422 can optionally be included for the knob 218 in those implementations providing force feedback on the knob. Such a safety switch can be implemented similarly to safety switch 115 described above with

can be provided with software instructions to wait for commands or requests from the host computer, parse/decode the command or request, and handle/control input and output signals according to the command or request.

5 For example, in one force feedback embodiment, host microprocessor 424 can provide low-level force commands over bus 426, which microprocessor 402 directly transmits to the actuators. In a different force feedback local control embodiment, host microprocessor 424 provides high level supervisory commands to microprocessor 402 over bus 426, and microprocessor 402 manages low level force control loops to sensors and actuators in accordance with the high level commands and independently of the host computer, similar to the
10 embodiments for wheel 16 described above.

In an alternate embodiment, no local microprocessor 402 is included in interface device 210, and a remote microprocessor, such as microprocessor 424, controls and processes all signals to and from the components of interface device 210. Or, hardwired digital logic can perform any input/output functions to the knob 218.

15 While this invention has been described in terms of several preferred embodiments, it is contemplated that alterations, permutations and equivalents thereof will become apparent to those skilled in the art upon a reading of the specification and study of the drawings. For example, many types of actuators, sensors, and mechanisms can be used to sense and apply forces on the wheel or knob. In addition, the wheel or knob itself can be implemented in a variety of ways, as a dial, cylinder, knob, sphere, or other shape. Also, a great variety and types
20 of force sensations can be output on wheel 16. It should also be noted that the embodiments described above can be combined in various ways in a particular implementation. Furthermore, certain terminology has been used for the purposes of descriptive clarity, and not to limit the present invention. It is therefore intended that the following appended claims include all such
25 alterations, permutations, and equivalents as fall within the true spirit and scope of the present invention.

What is claimed is:

8. An interface device as recited in claim 2 wherein said wheel can be depressed into a housing of said user manipulandum.

9. An interface device as recited in claim 2 wherein said wheel is coupled to a first shaft that is coupled to and rotatable about a second shaft, said second shaft being coupled to said wheel actuator.

10. An interface device as recited in claim 1 further comprising a local microprocessor, separate from host computer, coupled to said actuator and controlling said actuator to apply said computer-modulated force on said wheel.

11. An interface device as recited in claim 1 wherein said host computer is running a graphical environment and wherein said force applied to said wheel corresponds with an event or interaction displayed in said graphical environment.

12. An interface device as recited in claim 1 wherein said wheel actuator outputs a set of isotonic forces when said interface device is in an isotonic mode, and wherein said wheel actuator outputs a set of isometric forces when said interface device is in an isometric mode.

13. A handheld force feedback remote control device for providing input to an electronic device located remotely from said remote control device, the remote control device comprising:

a wheel rotatably coupled to a housing of said remote control device and rotatable about an axis, said wheel being manipulated by a user;

an actuator coupled to said wheel for outputting a computer-modulated force detent on said wheel, said force detent felt by said user, wherein said force detent is provided at a predetermined rotational position of said wheel; and

a sensor that senses rotation of said wheel and provides a wheel signal to said electronic device indicating a rotary position of said wheel.

14. A force feedback wheel device as recited in claim 13 wherein said force detent includes an attractive force for biasing said wheel to said predetermined rotational position

15. A force feedback wheel device as recited in claim 13 wherein said remote control device sends signals to said electronic device using wireless transmission of information using an electromagnetic beam.

22. A method for providing a force feedback mouse wheel on a mouse interface device, said mouse interface device coupled to a host computer, the method comprising:

sensing a position of a mouse of said mouse interface device in a planar workspace and sending an indication of said position to a host computer;

5 sensing a rotation of said mouse wheel about an axis of rotation and sending a wheel signal to said host computer indicating a current position of said wheel about said axis; and

applying a force to said mouse wheel about said axis using a wheel actuator coupled to said mouse wheel, wherein said force is coordinated with an event occurring in said graphical environment.

10

23. A method as recited in claim 22 wherein said sensing a rotation of said mouse wheel includes sensing an absolute position of said mouse wheel about said axis.

24. A method as recited in claim 22 wherein said applying a force to said mouse wheel is commanded by a local microprocessor included in said mouse interface device and separate from
15 said host computer.

25. A method as recited in claim 22 wherein said event is a scrolling of a displayed document as controlled by said sensed rotation of said mouse wheel and said wheel signal.

26. A method as recited in claim 22 wherein said event is an interaction of a cursor with a graphical object implemented by said host computer, said cursor having motion influenced by
20 said rotation of said wheel.

27. A method as recited in claim 26 wherein said interaction is a collision of said cursor with said graphical object.

28. A method as recited in claim 22 wherein said force is one of a damping force sensation, an inertial force sensation, and a friction force sensation.

25 29. A method as recited in claim 22 wherein said force is a force detent sensation.

30. A method as recited in claim 22 wherein said force is one of an obstruction force sensation, a texture sensation, a jolt sensation, and a vibration sensation.

31. A method as recited in claim 22 further comprising applying a force to said mouse object in said planar workspace using an actuator different from said wheel actuator.

39. A knob controller device as recited in claim 38 wherein said device is an audio device.

40. A knob controller device as recited in claim 32 further comprising a microprocessor coupled to said rotational sensor and to said transverse sensor, said microprocessor receiving sensor signals from said sensors and controlling a function of a device in response to said sensor signals, said microprocessor sending force feedback signals to said actuator to control forces output by said actuator.

41. A knob controller device as recited in claim 32 further comprising a display, wherein an image on said display is changed in response to manipulation of said knob in said transverse direction.

42. A knob controller device as recited in claim 32 wherein a flexible member is coupled between said knob and said actuator to allow said movement in said transverse direction.

43. A knob controller device as recited in claim 42 wherein said flexible member is a spring member.

43. A knob controller device as recited in claim 42 wherein said flexible member includes a base plate and a plurality of bent flexible portions coupled to said base plate.

44. A knob controller device comprising:

a knob coupled to a grounded surface, said knob rotatable in a rotary degree of freedom about an axis extending through said knob, said knob also moveable in a linear degree of freedom approximately parallel to said axis;

a rotational sensor that detects a position of said knob in said rotary degree of freedom;

a linear sensor that detects a position of said knob in said linear degree of freedom; and

an actuator coupled to said knob and operative to output a force in said rotary degree of freedom about said axis.

45. A knob controller device as recited in claim 44 further comprising a microprocessor coupled to said rotational sensor and to said linear sensor, said microprocessor receiving sensor signals from said sensors and controlling a function of a device in response to said sensor

change of said value based on a position of said knob in said degree of freedom, wherein said rate control mode provides a force on said knob using said actuator, said force being applied in a direction opposing a movement of said knob away from an origin position.

5 53. An interface control device as recited in claim 52 wherein said degree of freedom is a rotary degree of freedom.

54. An interface control device as recited in claim 52 wherein said degree of freedom is a linear degree of freedom.

10 55. An interface control device as recited in claim 52 wherein said force opposing said movement is a spring force.

56. An interface control device as recited in claim 52 wherein said microprocessor controls said actuator to output at least one force detent during movement of said knob in said position control mode.

15 57. An interface control device as recited in claim 52 wherein said rate control mode is used to control the value of a volume, bass, treble, or balance function of said device.

58. An interface control device as recited in claim 52 wherein said position control mode is used to control the value of a volume, bass, treble, or balance function of said device.

59. An interface control device as recited in claim 52 wherein said rate control mode is used to control a position of a physical component in a vehicle.

20 60. A method for providing detent forces for a force feedback control, the method comprising:

25 outputting a first force for a first detent on a user manipulatable object contacted by a user and moveable in a degree of freedom, said first force being output when said user manipulatable object is moved within a range of said first detent, said first force being output by a electronically-controlled actuator, wherein said first force assists movement of said user manipulatable object toward an origin position of said first detent and wherein said first force resists movement of said user manipulatable object away from said origin position of said first detent; and

30 outputting a second force for a second detent on said user manipulatable object when said user manipulatable object is moved within a range of said second detent, said second force being

said user manipulatable object in a degree of freedom, said user manipulatable object being contacted and moveable by a user; and

using said detent force curve to command said force on said user manipulatable object, said force being output by a electronically-controlled actuator.

5

68. A method as recited in claim 67 wherein said defining a periodic wave includes specifying a type, a period and a magnitude for said periodic wave.

69. A method as recited in claim 67 wherein said using at least a portion of said periodic wave to define a detent force curve includes specifying a portion of said periodic wave to define a width of said detent force curve.

10

70. A method as recited in claim 69 wherein said using at least a portion of said periodic wave to define a detent force curve includes specifying a phase and an offset to be applied to said periodic wave to define said detent force curve.

15

71. A method as recited in claim 67 wherein said using at least a portion of said periodic wave to define a detent force curve includes specifying an increment distance, wherein successive detent force curves in said degree of freedom are spaced apart by said increment distance.

72. A method as recited in claim 67 wherein said user manipulatable object is a knob moveable in a rotary degree of freedom.

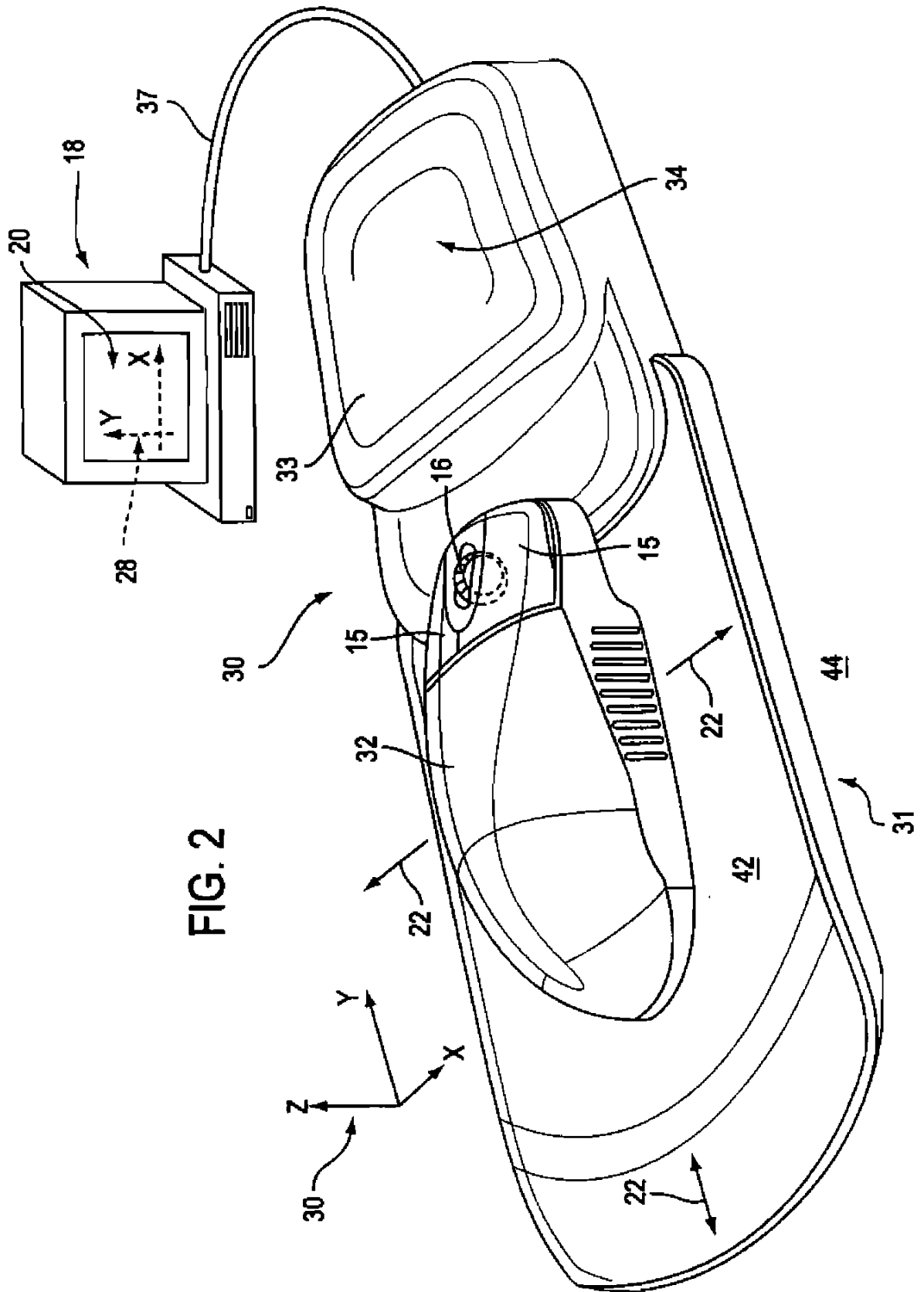


FIG. 2

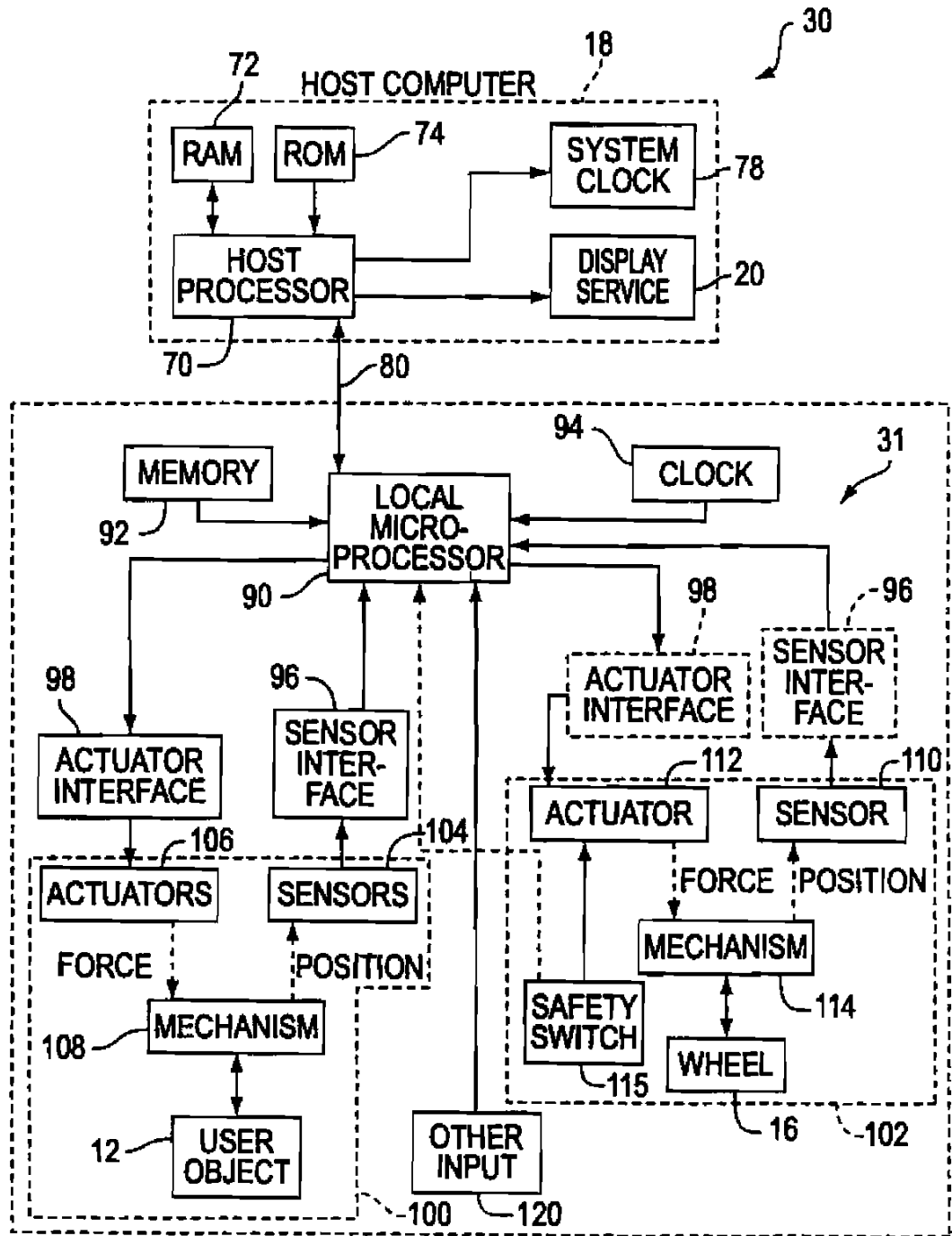


FIG. 4

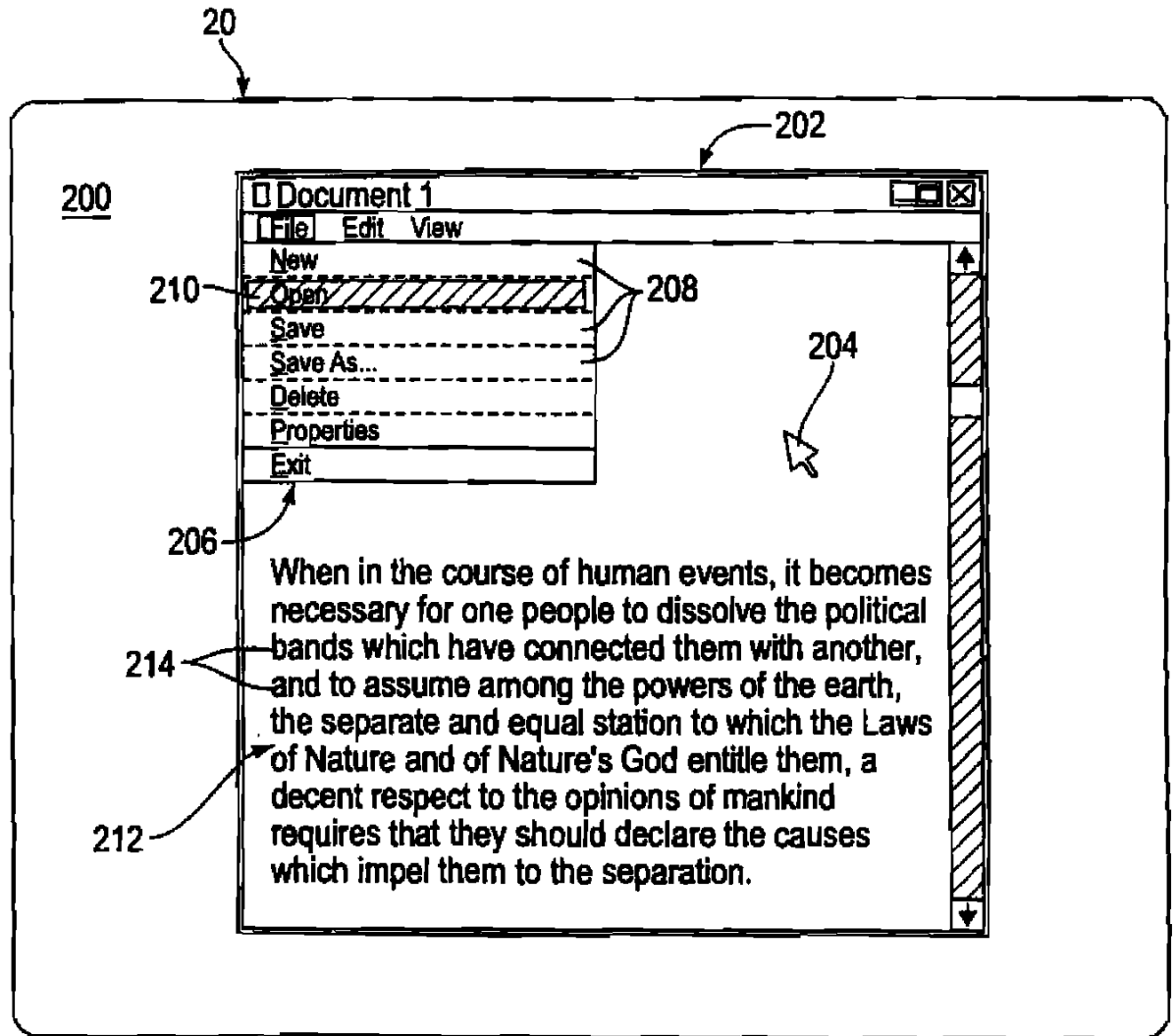


FIG. 9

8/17

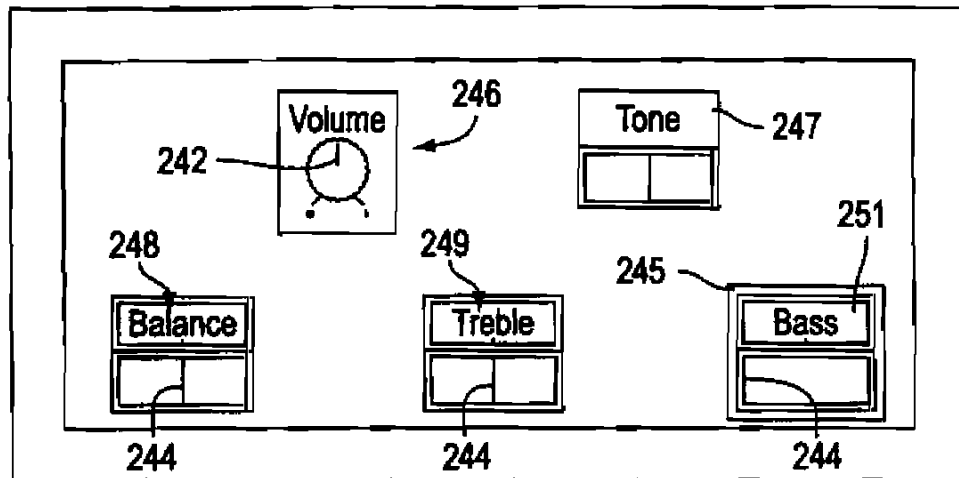


FIG. 11

10/17

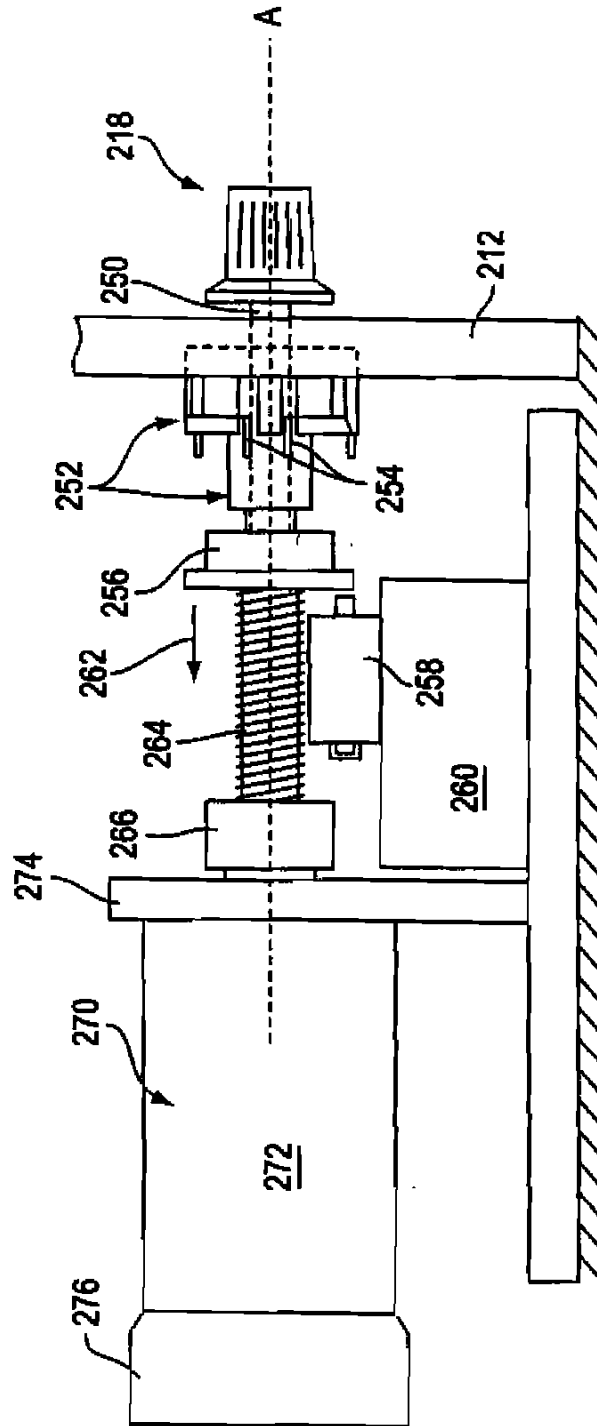


FIG. 12b

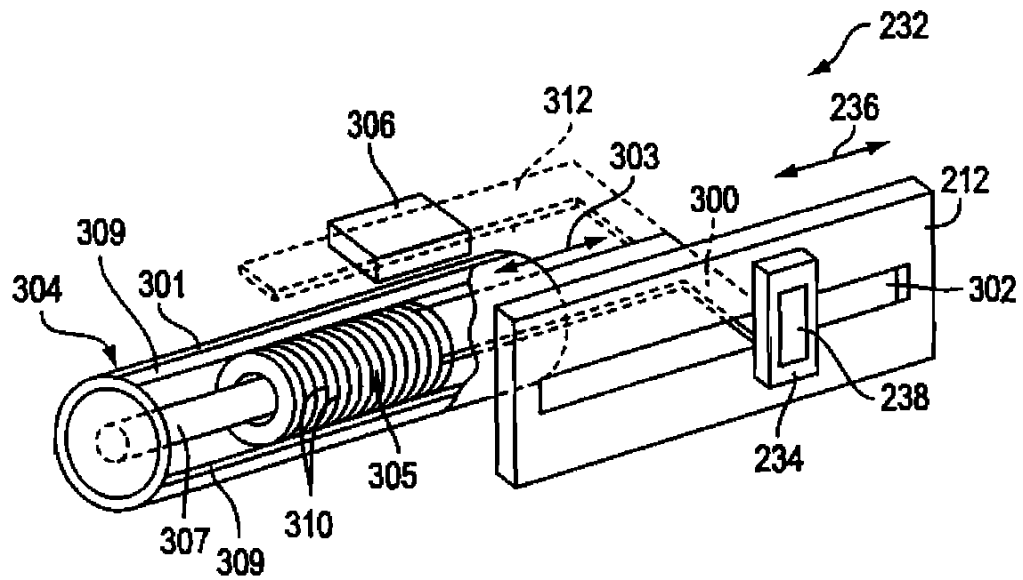


FIG. 14

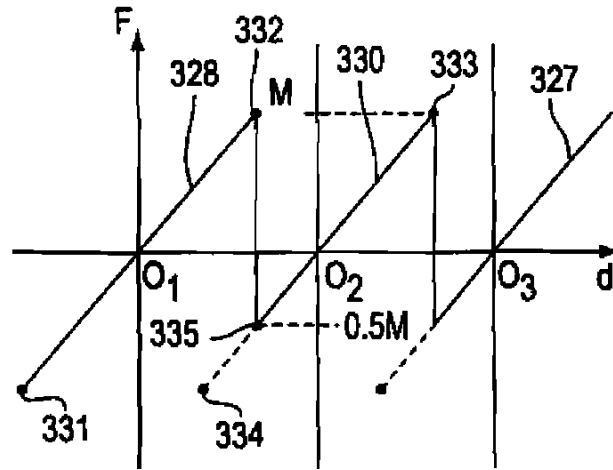


FIG. 15C

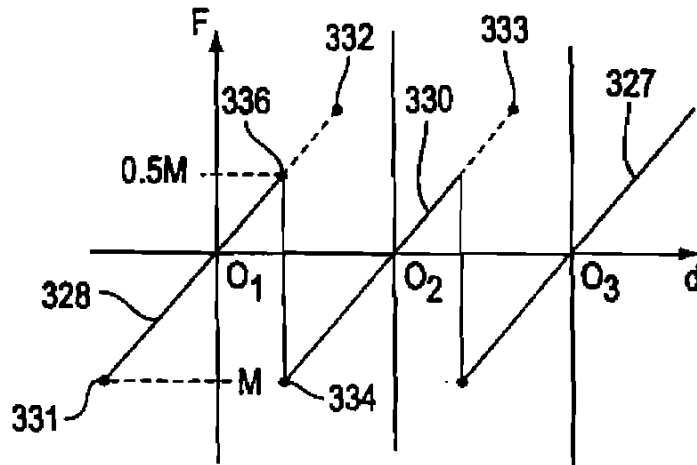


FIG. 15D

16/17

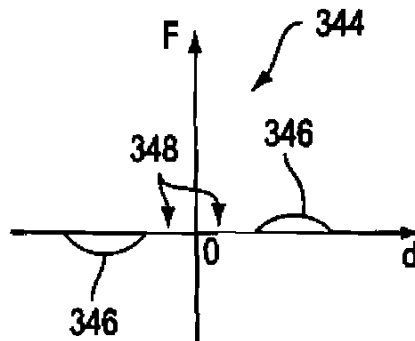


FIG. 16C

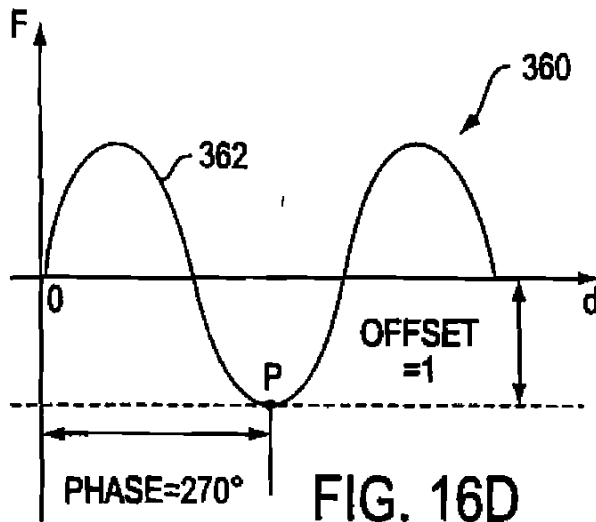


FIG. 16D

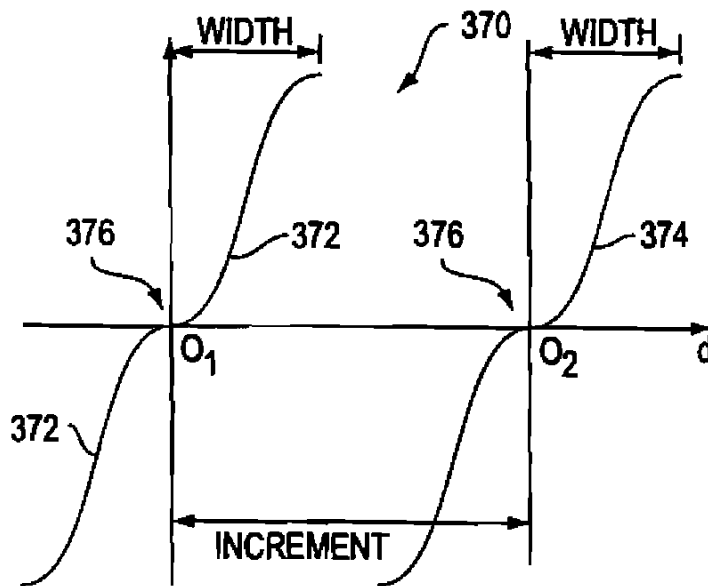


FIG. 16E



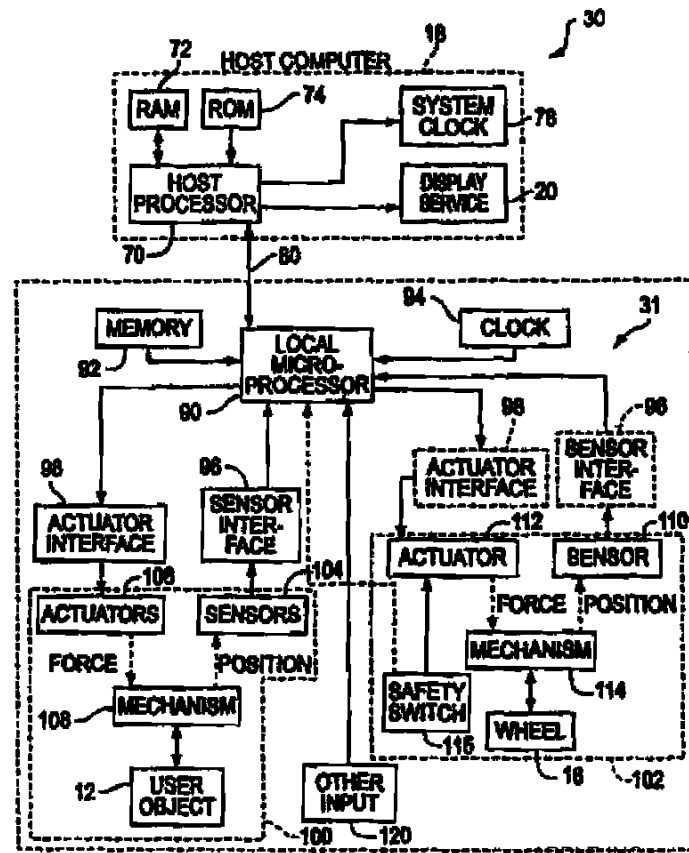
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<p>(21) International Application Number: PCT/US99/06510 (22) International Filing Date: 24 March 1999 (24.03.99) (30) Priority Data: 09/049,155 26 March 1998 (26.03.98) US 09/179,382 26 October 1998 (26.10.98) US (71) Applicant: IMMERSION CORPORATION [US/US]; 2158 Paragon Drive, San Jose, CA 95131 (US). (72) Inventors: ROSENBERG, Louis, B.; 5002 Felter Road, San Jose, CA 95132 (US). SCHENA, Bruce, M.; 414 Pope Street, Menlo Park, CA 94025 (US). (74) Agent: HICKMAN, Paul, L.; Hickman Stephens & Coleman, LLP, P.O. Box 52037, Palo Alto, CA 94303-0746 (US).</p>		<p>(81) Designated States: AU, CA, CN, JP. European patent (AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE). Published Without international search report and to be republished upon receipt of that report.</p>

(54) Title: FORCE FEEDBACK CONTROL WHEELS AND KNOBS

(57) Abstract

A force feedback wheel or knob is provided on a mouse or other device to be manipulated by a user. In one embodiment, a rotatable wheel is mounted upon a manipulandum, such as a mouse, and rotates about a wheel axis, where a wheel sensor provides a wheel signal to a host computer indicating a rotary position of the wheel, and a wheel actuator coupled to the rotatable wheel applies a computer-modulated force to the wheel about the wheel axis. The force applied to the wheel can correspond with an event or interaction displayed in a host graphical environment. In other embodiments, a knob on a device allows a user to control functions of the device. The knob is rotatable in a rotary degree of freedom and can be moved in a transverse direction perpendicular to the axis of rotation and/or moved in a linear degree of freedom, allowing the knob to be pushed or pulled by the user. Force feedback is preferably provided using an actuator coupled to the knob. The device controlled by the knob can be, for example, an audio device, a video device, etc. Detent forces can be provided for the knob by overlapping and adjusting ranges of closely-spaced detents in the rotary degree of freedom of the knob.



APPLE INC.

FORCE FEEDBACK CONTROL WHEELS AND KNOBS

BACKGROUND OF THE INVENTION

5 The present invention relates generally to interface devices for allowing humans to interface with electronic and computer devices, and more particularly to mechanical computer interface devices that allow the user to provide input to electronic systems and provide force feedback to the user.

10 Electronic and computer devices are used in a wide variety of applications. For many devices, a user desires to provide input to a device using a simple, intuitive mechanical control. Control wheels and knobs provide such an intuitive input device for many applications.

15 In one application, control wheels and knobs are useful to provide input to computer systems. For example, users can interact with a visual environment displayed by a computer on a display device to perform functions on the computer, play a game, experience a simulation or “virtual reality” environment, use a computer aided design (CAD) system, browse the World Wide Web, or otherwise influence events or images depicted on the screen. One visual environment that is particularly common is a graphical user interface (GUI). GUI's present visual images which describe various graphical metaphors of a program or operating system implemented on the computer. Common GUI's include the Windows® operating system from
20 Microsoft Corporation, the MacOS® operating system from Apple Computer, Inc., and the X- Windows GUI for Unix operating systems. The user typically moves a user-controlled graphical object, such as a cursor or pointer, across a computer screen and onto other displayed graphical objects or screen regions, and then inputs a command to execute a given selection or operation. Other programs or environments also may provide user-controlled graphical objects such as a
25 cursor and include browsers and other programs displaying graphical “web pages” or other environments offered on the World Wide Web of the Internet, CAD programs, video games, virtual reality simulations, etc.

30 A common interface device for providing user input to a GUI is a mouse or trackball. A mouse is moved by a user in a planar workspace to move a graphical object such as a cursor on the 2-dimensional display screen in a direct mapping between the position of the user manipulandum and the position of the cursor. This is typically known as “position control”, where the motion of the graphical object directly correlates to motion of the user manipulandum. One drawback to traditional mice is that functions such as scrolling a document in a window and zooming a view displayed on the screen in or out are typically awkward to perform, since the
35 user must use the cursor to drag a displayed scroll bar or click on displayed zoom controls.

Some control knobs have been provided with "force feedback." Force feedback devices can provide physical sensations to the user manipulating the knob. Typically, a motor is coupled to the knob and is connected to a controller such as a microprocessor. The microprocessor receives sensor signals from the knob and sends appropriate force feedback control signals to the motor so that the motor provides forces on the knob. In this manner, a variety of programmable feel sensations can be output on the knob, such as detents, spring forces, or the like.

One problem occurring in control knobs of the prior art is that the knobs are limited to basic rotary motion. This limits the control options of the user to a simple, one-degree-of-freedom device that does not allow a variety of selection options. In addition, if force feedback is provided on the knob, the limited force feedback and control functionality of the knob limits the user from fully taking advantage of the force feedback to provide more control over desired functions.

provided at a predetermined user-preferred rotational position of the wheel, and a sensor that senses rotation of the wheel and provides a wheel signal to the electronic device indicating a rotary position of the wheel. The wheel can be included on a remote control device for remotely sending signals to the electronic device, or on the housing of the electronic device itself. The electronic device can be any of a variety of devices or appliances; for example, a radio can include the force wheel for providing user-preferred detents at radio station frequencies spaced irregularly about the rotational range of the wheel.

In an embodiment of a knob controller device of the present invention, a knob is coupled to a grounded surface. The knob is rotatable in a rotary degree of freedom about an axis extending through the knob, and the knob also moveable in a transverse direction approximately perpendicular to the axis. A rotational sensor detects a position of the knob in the rotary degree of freedom, and a transverse sensor detects a position of the knob in the transverse direction. An actuator is coupled to the knob to output a force in the rotary degree of freedom about the axis, thus providing force feedback. In a preferred embodiment, the knob is moveable in multiple transverse directions. For example, the transverse sensor includes a switch that detects when the knob is moved in a transverse direction; the switch can be a hat switch having multiple individual switches, for example. In one embodiment, the knob is moveable in four transverse directions spaced approximately orthogonal to each other.

Furthermore, a local microprocessor can be included to control the force feedback on the knob. The microprocessor receives sensor signals from the rotary and transverse sensors and controls a function of a device in response to the sensor signals. The device can also include a display, wherein an image on said display is changed in response to manipulation of the knob in the transverse direction. A method of the present invention for controlling functions of a device from input provided by a knob similarly uses sensor signals from a rotary sensor and a transverse sensor to control at least one function of a device, such as adjusting a frequency of a radio tuner or updating a displayed image based on at least one of the sensor signals.

In another aspect of the present invention, a knob is coupled to a grounded surface, where the knob is rotatable in a rotary degree of freedom about an axis extending through the knob. The knob is also moveable in a linear degree of freedom approximately parallel to the axis. A rotational sensor and a linear sensor detect positions of the knob in the respective degrees of freedom. An actuator is also coupled to the knob and operative to output a force in the rotary degree of freedom about the axis, thereby providing force feedback to the knob. The linear degree of freedom of the knob allows it to be pushed and/or pulled by the user, where the push or pull motion is detected by the linear sensor. A transverse degree of freedom and a local microprocessor can also be included.

These and other advantages of the present invention will become apparent to those skilled in the art upon a reading of the following specification of the invention and a study of the several figures of the drawing.

Figure 13c is a side elevational view of the embodiment of Fig. 13a;

Figure 14 is a perspective view of a linear slider control of the present invention;

Figures 15a-15d illustrate nonoverlapping, overlapping, and hysteresis features of force detent profiles;

5 Figures 16a-16e are graphs illustrating the creation of detent force profiles from periodic waves according to the present invention; and

Figure 17 is a block diagram of a control system for the control knob of the present invention.

approximately spherical object) provided in a socket in mouse 12, and which can be moved in both X- and Y- directions and have forces applied thereto.

Furthermore, in some embodiments, wheel 16 may be depressed by the user as indicated by arrow 19. The wheel, when pressed, causes contacts to be electrically connected and provides a signal to host computer 18. Wheel 16 thus can also operate as an additional mouse button 15. A mechanical/electrical interface (not shown) is preferably included to sense manipulations of the wheel 16 and transmit force to the wheel. In the preferred embodiment, power is provided to actuators over bus 17 (e.g. when bus 17 includes a USB interface). The structure and operation of wheel 16 and the interface is described in greater detail with respect to Figures 5-9.

Host computer 18 is preferably a personal computer or workstation, such as an IBM-PC compatible computer or Macintosh personal computer, or a SUN or Silieon Graphics workstation. For example, the computer 18 can operate under the Windows™ or MS-DOS operating system in conformance with an IBM PC AT standard. Alternatively, host computer system 18 can be one of a variety of home video game systems commonly connected to a television set, such as systems available from Nintendo, Sega, or Sony. In other embodiments, host computer system 18 can be a "set top box" which can be used, for example, to provide interactive television functions to users, or a "network-" or "internet-computer" which allows users to interact with a local or global network using standard connections and protocols such as used for the Internet and World Wide Web. Host computer preferably includes a host microprocessor, random access memory (RAM), read only memory (ROM), input/output (I/O) circuitry, and other components of computers well-known to those skilled in the art.

Host computer 18 preferably implements a host application program with which a user is interacting via mouse 12 and other peripherals, if appropriate. The application program includes force feedback functionality to provide appropriate force signals to mouse 12. For example, the host application program can be a GUI, simulation, video game, Web page or browser that implements HTML or VRML instructions, scientific analysis program, virtual reality training program or application, or other application program that utilizes input of mouse 12 and outputs force feedback commands to the mouse 12. Herein, for simplicity, operating systems such as Windows™, MS-DOS, MacOS, Unix, etc. are also referred to as "application programs." In one preferred embodiment, an application program utilizes a graphical user interface (GUI) to present options to a user and receive input from the user. Herein, computer 18 may be referred as displaying "graphical objects" or "computer objects." These objects are not physical objects, but are logical software unit collections of data and/or procedures that may be displayed as images by computer 18 on display screen 20, as is well known to those skilled in the art. A displayed cursor, a view displayed by a GUI window, a portion of a document displayed in the window, or a simulated cockpit of an aircraft can all be considered graphical objects. The host application program checks for input signals received from the mouse 12, displays updated

position control paradigm, the position (or change in position) of a user-controlled graphical object, such as a cursor, in host frame 30 corresponds to a position (or change in position) of the mouse 12 in the local frame 28.

5 Rate control is also used as a control paradigm. This refers to a mapping in which the displacement of a user manipulandum along one or more provided degrees of freedom is abstractly mapped to motion or rate of a computer-simulated object under control. There is not a direct physical mapping between physical object (mouse) motion and computer object motion.

10 The mouse 12 is useful for both position control ("isotonic") tasks and rate control ("isometric") tasks. For example, as a traditional mouse, the position of mouse 12 in its local frame 30 workspace can be directly mapped to a position of a cursor in host frame 28 on display screen 20 in a position control paradigm. Also, the mouse wheel 16 can be rotated in its degree of freedom against an opposing output force to command rate control tasks in an isometric mode. Wheel 16 can also be used for position control tasks, as described in greater detail below.

15 FIGURE 2 is a perspective view of a second embodiment 30 of a mouse device using the force feedback mouse wheel 16 of the present invention. Force feedback mouse interface system 30 is capable of providing input to a host computer based on the user's manipulation of the mouse and capable of providing force feedback to the system based on events occurring in a program implemented by the host computer. Mouse device 30 includes added force feedback functionality over the embodiment 12 of Figure 1 in that the planar degrees of freedom of mouse
20 32 are provided with force feedback in addition to the wheel 16 being provided with force feedback. Mouse system 30 includes an interface device 31 including a mouse 32 and an interface 34; and a host computer 18.

25 Mouse 32, similar to mouse 12 of Figure 1, is an object that is preferably grasped or gripped and manipulated by a user. In the described embodiment, mouse 32 is shaped so that a user's fingers or hand may comfortably grasp the object and move it in the provided degrees of freedom in physical space. One or more buttons 15 allow the user to provide additional commands to the computer system. A thumb button (not shown) can also be provided on mouse 32. One or more of the buttons 15 may command specific force feedback features of the system 30, as described below. Mouse 32 is preferably supported upon a grounded pad 42, which is
30 supported by grounded surface 44.

It will be appreciated that a great number of other types of user manipulandums ("user manipulatable objects" or "physical objects") can be used with the method and apparatus of the present invention in place of or in addition to mouse 32. For example, such objects may include a sphere, a puck, a joystick, cubical- or other-shaped hand grips, a receptacle for receiving a
35 finger or a stylus, a flat planar surface like a plastic card having a rubberized, contoured, and/or

Host computer 18 is described above with reference to Figure 1. The host application program checks for input signals received from the mouse 32, and outputs force values and/or commands to be converted into forces on mouse 32 and on wheel 16. Suitable software drivers which interface force feedback application software with computer input/output (I/O) devices are available from Immersion Human Interface Corporation of San Jose, California.

Mouse system 30 can be used for both position control and rate control. Under a position control mapping, the positions of mouse 32 and a graphical object such as a cursor are directly mapped, as in normal mouse operation. "Ballistics", as described above, can also be provided, and these adjustments can be used in mouse system 30 if desired. Mouse system 30 can also provide a rate control mode in which the displacement of mouse 32 in a particular direction against an opposing output force can command rate control tasks in an isometric mode, as described in U.S. Patent no. 5,825,308, incorporated by reference herein. Furthermore, mouse wheel 16 can also control position and/or rate control tasks independently of the position of the mouse 32 in its workspace, as described in greater detail below.

The mouse system 10 can also include an indexing function or "indexing mode" which allows the user to redefine the offset between the positions of the mouse 32 in the local frame 30 and a user-controlled graphical object, such as a cursor, in the host frame 28. A hand weight safety switch can also be provided as described in greater detail in patent 5,825,308. Other features of the present invention are also provided using force feedback functionality. For example, a thumb button (not shown) or other button 15 can toggle a force functionality mode in which designated graphical objects or regions displayed on screen 20 have other functions enabled by force feedback to wheel 16. This is described in greater detail with respect to Figure 9.

FIGURES 3a and 3b illustrate other embodiments of an interface device and user manipulandum which can incorporate the features of the present invention. In Figure 3a, a handheld remote control device 50 can be used to access the functions of an electronic device or appliance remotely by a user. For example, remote control 50 can be used to select functions of a television, video cassette recorder, sound stereo system, home computer, kitchen appliance, etc. Such control devices typically provide wireless operation by transmitting input signals using an electromagnetic beam that is detected by a detector on the electronic device. Or, remote control 50 can select functions of an internet or network computer connected to a television. For example, one popular device is Web-TV™, which is connected to a television and displays internet information such as web pages on the television screen. Remote control 50 may include buttons 52 for selecting options of the device or appliance, of the application program running on the device, of web pages, etc. Herein, the term "electronic device" is intended to include all such devices as well as a host computer 18 as described above.

same knob, such as volume, tone, balance, etc. Alternatively, different sets of detent force profiles can be stored in a memory device on the radio and a particular set can be provided on the knob 54 by a microprocessor in the radio.

5 Figure 3b shows another embodiment in which a gamepad controller 60 is provided with a force feedback wheel. Controller 60 is intended to be held by both hands of a user. The controller 60 can include the standard input devices of game controllers, such as buttons 62, a directional game pad 64, and a fingertip joystick 66. The joystick 66 can in some embodiments be provided with force feedback. A finger wheel 68 can also be provided on controller 60 at any of various locations on the controller. Wheel 68 can operate similarly to the mouse wheel 16
10 described with reference to Figures 1 and 2, or to the knob 54 described with reference to Figure 3a. For example, wheel 68 can operate as a throttle or thrust control in a game for a simulated vehicle and include force feedback in an isometric mode or isotonic mode, or the wheel can be used to guide a pointer or other object on the screen.

FIGURE 4 is a block diagram illustrating an interface of the mouse system 30 of Figure 2
15 suitable for use with the present invention. Mouse system 30 includes a host computer 18 and interface device 31. A similar force feedback system including many of the below components is described in detail in U.S. patent nos. 5,734,373 and 5,825,308, which are incorporated by reference herein in their entirety.

Host computer 18 is preferably a personal computer, workstation, video game console, or
20 other computing or display device, as explained with reference to Figure 1. Host computer system 18 commonly includes a host microprocessor 70, random access memory (RAM) 72, read-only memory (ROM) 74, a clock 78, and a display device 20. Host microprocessor 70 can include a variety of available microprocessors from Intel, AMD, Motorola, or other manufacturers. Microprocessor 108 can be single microprocessor chip, or can include multiple
25 primary and/or co-processors. Microprocessor 108 preferably retrieves and stores instructions and other necessary data from RAM 72 and ROM 74 as is well known to those skilled in the art. In the described embodiment, host computer system 18 can receive sensor data or a sensor signal via a bus 80 from sensors of system 10 and other information. Microprocessor 70 can receive data from bus 120 using I/O electronics, and can use the I/O electronics to control other
30 peripheral devices. Host computer system 18 can also output commands to interface device 31 via bus 120 to cause force feedback.

Clock 78 is a standard clock crystal or equivalent component which can be used by host computer 18 to provide timing to electrical signals used by host microprocessor 70 and other components of the computer system 18. Display device 20 is described with reference to Figure
35 1. Other types of peripherals can also be coupled to host processor 70, such as storage devices

embodiment, the microprocessor 90 can independently process sensor signals to determine appropriate output actuator signals by following the instructions of a "force process" that may be stored in local memory and includes calculation instructions, formulas, force magnitudes, and/or other data. The force process can command distinct force sensations, such as vibrations, textures, jolts, or even simulated interactions between displayed objects. The host can send the local processor a spatial layout of objects in the graphical environment so that the microprocessor has a mapping of locations of graphical objects like enclosures and can determine interactions with the cursor locally. Such operation of local microprocessor in force feedback applications is described in greater detail in patent nos. 5,734,373 and 5,825,308. In an alternate embodiment, no local microprocessor 90 is included in interface device 31, and host computer 18 directly controls and processes all signals to and from the interface device 31.

A local clock 92 can be coupled to the microprocessor 90 to provide timing data, similar to system clock 78 of host computer 18 to, for example, compute forces to be output by actuators 106 and 112. In alternate embodiments using the USB communication interface, timing data for microprocessor 90 can be retrieved from the USB interface. Local memory 94, such as RAM and/or ROM, is preferably coupled to microprocessor 90 in interface device 31 to store instructions for microprocessor 90, temporary and other data, calibration parameters, adjustments to compensate for sensor variations can be included, and/or the state of the force feedback device.

Sensor interface 96 may optionally be included in device 31 to convert sensor signals to signals that can be interpreted by the microprocessor 90 and/or host computer system 18. For example, sensor interface 96 can receive signals from a digital sensor such as an encoder and convert the signals into a digital binary number. An analog to digital converter (ADC) can also be used. Such circuits, or equivalent circuits, are well known to those skilled in the art. Alternately, microprocessor 90 or host computer 18 can perform these interface functions. Actuator interface 98 can be optionally connected between the actuators 106 and 112 and microprocessor 90 to convert signals from microprocessor 90 into signals appropriate to drive the actuators. Interface 98 can include power amplifiers, switches, digital to analog controllers (DACs), and other components, as well known to those skilled in the art. In alternate embodiments, interface 98 circuitry can be provided within microprocessor 90 or in the actuators.

In a preferred embodiment, power is supplied to the actuators 106 and 112 and any other components (as required) by the USB. Alternatively, power from the USB can be stored and regulated by device 31 and thus used when needed to drive actuators 106 and 112. Or, a power supply can optionally be coupled to actuator interface 98 and/or actuators 106 and 112 to provide electrical power.

mouse but can alternatively be a joystick, remote control, or other device or article, as described above.

Mechanical portion 102 interfaces the wheel 16 with the host computer 18. Portion 102 includes a sensor 110, an actuator 112, a mechanism 114, and wheel 16. Sensor 110 can be any suitable sensor for detecting the rotary motion of wheel 16, such as an optical encoder, potentiometer, or other varieties as described above for sensors 104. Alternatively, sensor 110 can be a linear sensor that senses linear motion of mechanism 114 converted from the rotary motion of wheel 16. Sensor 110 can be an absolute sensor, where absolute positions of the wheel in the range of motion are reported to host computer 18; or a relative sensor, in which changes in position from a previous position are reported to the host computer. Sensor 110 can be directly coupled to the user object 12 or 32, be coupled through a drive mechanism, or can be decoupled from the user object (e.g. by sensing motion using electromagnetic beam detectors and emitters).

Actuator 112 is any suitable actuator for providing rotary forces on wheel 16 and produces "computer-modulated" forces as referred to above similarly to actuators 106. In the preferred embodiment, actuator 112 is a DC current control motor that has a small enough size to fit into a small manipulandum such as a mouse and a small enough weight as to not interfere with mouse planar movement. Thus, the forces provided on wheel 16 may be small, but since the finger of a user is typically quite sensitive, small magnitude forces are sufficient to convey a variety of force sensations. In other embodiments, different types of active or passive actuators can be used as described above with reference to actuators 106. For example, passive actuators such as a magnetic particle brake, a friction brake, an electrorheological fluid actuator, or a magnetorheological fluid actuator, are quite suitable for use as actuator 112 due to their smaller size and weight and reduced power requirements. If such passive actuators are used, then a desired amount of play can be provided between actuator and wheel 16 to allow sensing of the wheel when the actuator is activated, as described in greater detail in patent nos. 5,721,566 and 5,767,839.

Also, a drive mechanism such as a capstan drive mechanism can be used to provide mechanical advantage to the forces output by actuator 112. Some examples of capstan drive mechanisms are described in patents 5,731,804 and 5,767,839. Alternatively, a belt drive system can be used as described below with reference to Figure 8.

In the described embodiment, the sensor 110 can input signals to a single sensor interface 96 used also for sensors 104 as described above. Actuator 112 can similarly use the actuator interface 98 also used by actuators 106. Alternatively, sensor 110 and/or actuator 112 can be provided with their own dedicated interfaces separate from interfaces 96 and 98.

coupled to actuator 112 by a shaft 128; thus, when the actuator applies rotary force to shaft 128 about axis A, the user's finger 130 on wheel 16 will feel the rotary force about axis A. It should be noted that if the user is applying sufficient force in the opposite direction of the rotary force, the actuator operates in a stalled condition where the wheel 16 will not physically rotate, but the user will feel the rotational force.

Sensor 110 is coupled to the shaft 128 (or a portion of actuator 112 coupled to shaft 128) to measure the rotation of the shaft about axis A and thus the rotation of the wheel 16. Sensor 110 senses the rotation of wheel 16 even when no forces are applied to the wheel by actuator 112. In the embodiment of Figure 5, the actuator 112 is provided between the sensor 110 and the wheel 16. FIGURE 6 is a perspective view of a second embodiment 102' of mechanical portion 102, where the wheel 16 is positioned between the sensor 110 and actuator 112. Embodiment 102' is more appropriate than embodiment 102 when a desired play is introduced between actuator and wheel 16, since the sensor is desired to be rigidly coupled to wheel 16 without play in such an embodiment. In other respects, the embodiment 102' functions similarly to the mechanical portion 102.

FIGURE 7 is a perspective view of a third embodiment 102'' of mechanical portion 102 for force feedback mouse wheel 16. Wheel 16 is coupled to a pulley 132 by a rotatable shaft 134, where pulley 132, shaft 134, and wheel 16 rotate about axis B. In this embodiment, the pulley 132, shaft 134, and wheel 16 are preferably fixed at their rotation location, i.e., axis B is fixed with respect to mouse 12 or 32. Pulley 132 is coupled to a pulley 136 by a belt 138. Pulley 136 is rigidly coupled to a shaft 140, which is coupled to actuator 112 and to sensor 110, where pulley 136, actuator 112, and sensor 110 rotate about axis C. Mechanical portion 102'' thus operates similarly to the embodiment 102, except that the belt transmission system 142 that includes pulley 132, belt 138, and pulley 134 is used to scale the motion of wheel 16 and forces applied to wheel 16. For example, pulley 136 preferably has a smaller diameter than pulley 132 to allow the rotational motion of wheel 16 to be converted to a greater number of rotations of shaft 140, thus increasing the sensing resolution. Furthermore, a smaller rotation of shaft 140 translates to a greater amount of rotation of shaft 134, thus providing mechanical advantage to forces output by actuator 112 and allowing a smaller actuator to be used in mouse 12 or 32. In other embodiments, belt 138 can be a cable, or belt transmission system 142 can be a capstan drive system. Other mechanical transmission systems may also be used.

FIGURE 8 is a perspective view of a fourth embodiment 102''' of mechanical portion 102 for force feedback mouse wheel 16. Embodiment 102''' is similar to embodiment 102'' except that axis B is floating, i.e., may be rotated about axis C. Thus, the assembly including pulley 132, shaft 134, and wheel 16 may be rotated about axis C. This motion allows the wheel 16 to move approximately vertically with reference to the horizontal planar orientation of the

wheel from a reference position (when viewing wheel coincident with axis of rotation), at a force magnitude of 10% of maximum force output (magnitude can also be expressed in other terms). Additional angle parameters can define additional detents located at different angles around the wheel in a range of 360 degrees, irregularly or regularly spaced as desired. Alternatively, "N pulses per revolution" can be a parameter to command N regularly-spaced force detents per revolution of the wheel. If a local microprocessor 90 is used, the microprocessor can implement the detents independently of control of the host based on the received host command.

For example, one standard GUI feature is a pull-down menu 206. Individual menu items 208 in the pull down menu 206 may be selected by the user using cursor 204. Once the pull-down menu has been displayed, the selection of a menu item 208 can be controlled by wheel 16 moving cursor 204 (and, optionally, vertical motion of mouse 12 or 32 can be disabled while the menu is displayed). For example, a menu item selection bar 209 (or highlighter) can be moved up or down menu 206 by rotating the wheel 16. The force detents can be output on wheel 16 to correspond with the spacing of menu items 208. Thus, the selection of a menu item is made easier from the use of detent forces, which substantially reduces the tendency of the user to overshoot a menu item when moving a cursor down the list of menu items. Furthermore, since the force detents are programmable, the user or software developer can set a rotational distance between detents to a particular preference, and can also set the magnitude of detent forces, e.g. for the "depth" of the detent which controls how easily the user may move the wheel past or out of a detent.

Detent forces can similarly be used for other GUI or application program features. For example, the spacing of objects on a document can be synchronized with force detents. As the document is scrolled using wheel 15, each time a particular object is scrolled past a predetermined location in a window, a force detent can be output. For example the spacing of lines 214 of text in a text document 212 can be synchronized with force detents so that if these text lines are scrolled by the cursor or other location in the window using the wheel 16, a force detent is output on the wheel 16. Similarly, the grid spacing on a spreadsheet or the links on a web page can be associated with force detents. The force detents can be spaced to correspond with the spacing of the text or other features to provide the user with greater feedback concerning the graphical features. Thus, a text document having single-spaced lines would cause force detents to be output in quick succession as the document is scrolled, while a text document having double-spaced lines would cause force detents to be output twice the rotational distance apart as the single spaced document. In other embodiments in which the wheel 16 is used to position the cursor 204 (described below), force detents can be output on wheel 16 when the cursor is moved over a particular graphical object, such as a text word, an icon, or a menu item 208. The flexibility of characterizing the computer-controlled actuator force detents makes

screen. For example, each time a page break in a text document scrolls by the cursor 204 or scrolls past the bottom of the displayed window, a jolt can be output on wheel 16. Other objects such as web page links, images, etc. can also be associated with jolts. A jolt differs from a detent in that a jolt is time-based rather than spatially based; the jolt is output irrespective of the position of the wheel 16, and does not attract or repel the wheel from a particular rotational position.

A different force sensation that can be output on wheel 16 is a vibration. Like the jolt force, this type of force "effect" is time based, not based on the rotational position of the wheel. The vibration force can be commanded with a command such as WHEEL_VIBRATION (Frequency, Waveform, Magnitude) to characterize the vibration force, where "Waveform" can be a sinc wave, square wave, triangle wave, or other-shaped wave. The vibration can be associated with particular graphical objects displayed on the screen, or be output based on events that occur in a host application. For example, a vibration can be output on wheel 16 when a warning or alert message is given, such as when the user receives new mail or when an error in a program occurs.

Other force sensations that can be output on wheel 16 are inertia, friction, and/or damping force. An inertia force is based on a simulated mass of an object, where the larger the mass, the greater the force resisting motion of the object. For example, a document can be assigned a simulated mass based on a characteristic of the document, such as the file size of the document, the font used in the document, etc. A document having a larger mass has a greater inertia force associated with it, so that the wheel 16 is more difficult to rotate when scrolling a large document as compared to scrolling a smaller document. The user can perceive the force on the wheel 16 and readily discern the size of the scrolled document. A friction force depends on a predefined coefficient of friction which causes a drag force on the user manipulandum. A damping force sensation is based on the velocity of an object, where the greater the velocity, the greater the damping force. This force feels like resistance to motion through a viscous liquid. The faster wheel 16 is rotated, the greater the damping force on the wheel. This can be used, for example, to provide areas of a document where scrolling is desired to be slower or controlled to a more fine degree, or to alert the user of a particular portion of the document as it scrolls by.

Another use for wheel 16 is for "coupled control." Coupled control refers to the position of cursor 204 on screen 20 being controlled both by the position of mouse 12 or 32 in its planar workspace as well as by the rotational position of wheel 16 about its axis. In one embodiment, the Y (vertical) screen coordinate of the cursor 204 is determined by the Y position of the mouse added to the Y position of the wheel 16, as summarized by the following:

$$Y_{\text{CURSOR}} = Y_{\text{MOUSE}} + Y_{\text{WHEEL}}$$

associated with the motion of the cursor and/or the interaction of the cursor with other graphical objects in GUI 200. Also, one or more of these forces can be combined with one or more other forces to create compound force sensations on wheel 16.

5 Furthermore, force profiles may be used to control the forces on wheel 16. Force profiles are sequences of individual force magnitudes that have been stored in a storage device such as local memory 92, host RAM 74, a hard disk drive, floppy disk, CD-R or CD Rewritable, DVD, or other storage device. The force magnitudes can be output by microprocessor 90 to the actuator 112 in sequence to apply a particular force sensation characterized by the force profile. The microprocessor can output the force profile magnitudes (or a subset thereof) at different
10 rates or with different offsets from the stored magnitudes as commanded by host computer 18 and/or as a function of characteristics, such as wheel velocity/acceleration/current position, time, etc.

The force feedback functionality of wheel 16 described above can also be provided in different modes of the interface device 12 or 31, where the user, microprocessor 90, and/or host
15 computer 18 can control which mode is currently active. Examples of two preferred modes are isotonic mode and isometric mode. Example of similar isometric and isotonic modes for mouse 12 or 32 are also described in U.S. Patent No. 5,825,308.

Isotonic mode is a position control mode for wheel 16, where the forces output on the wheel are synchronized or associated with the position of the wheel, and where the position of
20 the wheel, when changed, incrementally changes the position or state of a graphical object provided by the host computer. For example, when a position control scrolling is provided by wheel 16, a document is scrolled by an amount corresponding to the amount the wheel is rotated. Similarly, the coupled control described above is a position control function, since a cursor is incrementally moved based on incremental rotations of the wheel 16.

25 Force sensations that are appropriate for such a position control wheel mode include force detents. For example, as explained above, force detents are output on the wheel depending on when text lines or spread sheet cells are scrolled by, where each detent is incrementally output as a document is scrolled, zoomed, panned, etc. Damping, friction, and inertia forces are also position control mode forces, where the force depends on the velocity (which is position
30 based) or the position of the wheel and the cursor, document, or other object which is directly controlled by the wheel. Obstruction forces which represent hard stops to the wheel can be used in position control mode to represent the end of travel of the wheel; for example, when the end of a document is reached during a scrolling function, a hard stop force can be output to indicate this condition and resist further scrolling. Alternatively, a wall obstruction force on wheel 16
35 indicates that a wheel-controlled cursor has hit a wall. Texture forces are also appropriate in the position control mode, where the texture force is dependent on the position of the wheel; for

is active. For example, when the mode is not active, the cursor can be moved normally through the border or edge of a window, with no force sensations associated with the movement over the window. However, when the force mode is active (such as by pressing or holding a particular button 15), a spring force will be output on mouse 32 and/or on wheel 16 opposing the movement of the cursor through the window border, i.e. the window border becomes an "isometric surface." This force is used as for "pressure scrolling" or as a "scroll surface", where the amount of penetration of the mouse against the spring force controls the speed of scrolling, zooming, etc. of a document displayed in that window (similar to isometric mode described above). In a "pressure clicking" or "click surface" embodiment, if the cursor is moved against the border of an icon or other object and the force functionality mode is active, a force will be output resisting motion of the cursor into the icon; when the mouse 32 and/or wheel 16 moves against the force a threshold distance, the icon is selected as if the cursor had clicked or double-clicked on the icon. These types of features are especially applicable to wheel 16 when in the coupled cursor control embodiment described above. In other embodiments, other input devices besides or in addition to buttons 15 can control the force functionality mode. Or, different input devices can control different modes.

FIGURE 10 illustrates an application for a control knob embodiment of the present invention. A control panel 212 is provided for a device 210 and includes a control knob of the present invention. In the described embodiment, device 210 is an audio device that controls the output of sound, such as music or speech, from speakers that are connected to the device 210. For example, a common embodiment of device 210 is a stereo system that includes the ability to play sound from one or more media or signals, such as cassette tapes, digital audio transmission (DAT) tapes, compact discs (CD's) or other optical discs, or radio signals transmitted through the air from a broadcasting station.

The device 210 can also include additional or other functionality not related to audio control and output. For example, many vehicles include electronic systems to control the temperature in the vehicle cabin (air conditioning, heat, etc.), as well as systems to provide information on the current operating characteristics of the vehicle, such as current speed, engine temperature, fuel or other fluid levels, whether windows of the vehicle are open, etc. Other systems may include a navigation system that displays a map and the current location of the vehicle with respect to the map, a cellular telephone or other portable telephone control system, and a security/alarm system. Device 210 can include the ability to display information from and/or influence such other systems in a vehicle or other environment, such as a house, office, etc.

Alternatively, device 210 can be a variety of other electronic or computer devices. For example, device 210 can be a home appliance such as a television set, a microwave oven or other kitchen appliances, a washer or dryer, a home stereo component or system, a home computer, a

Control knobs 218 are provided to allow the user a different type of control of functions and settings of device 210 than the buttons 216 allow. Knobs 218, in the described embodiment, are approximately cylindrical objects engageable by the user. The knobs 218 can alternatively be implemented as a variety of different objects, including conical shapes, spherical shapes, 5 dials, cubical shapes, rods, etc., and may have a variety of different textures on their circumferential surfaces, including bumps, lines, or other grips, or even projections or members extending from the circumferential surface. In addition, any of variety of differently-sized knobs can be provided; for example, if high-magnitude forces are output, a larger-diameter cylindrical knob is often easier for a user to interface with device 210. In the described embodiment, each 10 knob 218 rotates in a single rotary degree of freedom about an axis extending out of the knob, such as axis A. The user preferably grips or contacts the circumferential surface 226 of the knob 218 and rotates it a desired amount. Force feedback can be provided in this rotary degree of freedom in some embodiments, as described in greater detail with reference to Figs. 12a and 12b.

Furthermore, the control knobs 218 of the present invention allow additional control 15 functionality for the user. The knobs 218 are preferably able to be moved by the user in one or more directions approximately perpendicular to the axis A of rotation, e.g. parallel to the surface of the front panel 212 as shown in Fig. 10 ("transverse motion" or "transverse direction"). This transverse motion is indicated by arrows 228. For example, the knob 218 can be moved in the four orthogonal directions shown, or may be moveable in less or more directions in other 20 embodiments, e.g. only two of the directions shown, or in eight directions spaced at 45 degree intervals about axis A. In one embodiment, each transverse direction of the knob is spring loaded such that, after being moved in a direction 228 and once the user releases or stops exerting sufficient force on the knob, the knob will move back to its centered rest position. In other embodiments, the knob can be provided without such a spring bias so that the knob 218 25 stays in any position to which it is moved until the user actively moves it to a new position.

This transverse motion of knob 218 can allow the user to select additional settings or functions of the device 210. In some embodiments, the additional control options provided by knob 218 allow the number of buttons 216 and other controls to be reduced, since the functions normally assigned to these buttons can be assigned to the knob 218. For example, the user can 30 move a cursor 30 or other visual indicator on display 214 (e.g. pointer, selection box, arrow, or highlighting of selected text/image) to a desired selection on the display. Thus, the cursor 230 can be moved from the "radio" selection shown to the "tape" selection by moving the knob 218 in the down direction as shown in Fig. 10. Or, the cursor 230 can be moved to the "CD" selection by moving the knob 218 in the direction to the right. If knob 218 is provided with 35 diagonal directions (e.g. at 45 degree intervals), the user can move the cursor 230 from the "radio" selection directly to the "off" selection. The user can similarly move cursor 230 or a

direction as shown by arrow 236. In the present invention, slider control 232 preferably includes force feedback functionality. Thus, as the user moves the knob 234, force sensations such as a spring force, a damping force, jolts, detents, textures, or other forces can be output and felt by the user. Furthermore, the slider knob 234 can include a button 238 which can be pressed by the user similarly to the push knob embodiment discussed above with reference to knob 218. Alternatively, the knob 234 can be pushed and/or pulled similarly to the knob 218 as described above. Slider control 232 can control any of the various functions, settings, or options of the device 210. For example, the motion left or right of knob 234 can control the radio frequency 222, where force detents are output for each station and/or each preset station previously programmed by the user. Or, the cursor 230 can be moved using the slider knob 234, such that when the cursor reaches a desired setting or selection, the user can push button 238 or push on the knob 234 to select that setting. Other functions such as volume, balance, tone, map functions, temperature functions, or mode selection can also be controlled by the slider control 232. Slider control is described in greater detail with respect to Figure 14.

FIGURE 11 is an example showing images which can be displayed on display 214 to assist the user in selecting options with knobs 218 and/or slider control 232. Display 214 can present icons as shown, in this example for the control of audio output signals from device 210. Icon 246 is selected to control the volume of the audio output using knob 218, where the circular pointer 242 can be moved in accordance with the knob 218. Icon 247 is used to control the frequency of the radio tuner (the current selected frequency can be displayed as well), and the icons 248, 249, and 251 are used to control the balance, treble, and bass of the audio, respectively. For example, the indicator 244 can be moved left or right depending on the current setting. Cursor 245 is used to select one of the icons to allow the control of the functions associated with the selected icon. Cursor 245 indicates which of the icons in display 214 are currently selected. The icon can be moved from each icon to the next by rotating the knob 218. Alternatively, the transverse motion of the knob can move the cursor 245. A function of the device designed by the selected icon can be selected by pushing the knob 218 in the linear direction. The cursor can be a square or other-shaped box, or the currently-selected icon can be highlighted to indicate the cursor's location.

It should be noted that each of the icons can preferably be set to a position control mode or to a rate control mode as desired by the user. For example, the user may select position control for volume 246 and rate control for the functions of icons 247, 248, 249, and 251, or any other combination. In position control mode, force detents are preferably output to indicate particular settings or how far the knob 218 has been rotated. In rate control mode, detents can also be output. For example, the user maintains the knob 218 at a rotary position away from the center position in opposition to a spring return force, and a detent force (e.g., jolt) is output to indicate how much a particular value has been changed. For example, a jolt can be output for

A pusher member 256 is rigidly coupled to shaft 250 next to the switch 252. Since the switch 252 includes an aperture through which the shaft 250 extends, the knob 218, shaft 250 and pusher member 256 are operative to move as a unit along axis A with respect to the front panel (ground) and the switch 252. A switch 258 (see Fig. 12b) is coupled to a grounded member 260 and is provided in the path of the pusher member 256. Thus, when the knob 218 is pushed by the user, the shaft 250 and the pusher member 256 are moved along axis A in a direction indicated by arrow 262 (see Fig. 12b). This causes pusher member 256 to engage the button 264 of the switch 258, causing the button 264 to be pushed inward and close (or open) the switch. The pushing motion of the knob 218 is thus sensed.

In other embodiments, a sensor can be provided to sense a range of positions of the knob 218 or a continuous motion of the knob 218 linearly along axis A. For example, a Hall effect switch can be provided on pusher member 256 which measures the position of the pusher member 256 relative to a grounded magnet on member 260 (or the Hall effect switch can be placed on the member 260 and the magnet can be placed on the member 256). Or, an optical sensor (such as a photodiode) or other type of sensor can detect the position of the member 256 and/or knob 218. In such an embodiment, the position of the knob along axis A can proportionately control a function or setting of the device 210. For example, such movement can control the volume of audio output of the device, motion of a cursor across a display, or the brightness of lights inside a vehicle.

A pull switch can be implemented similarly to the push switch shown in Figs. 12a and 12b. For example, a switch similar to switch 258 can be grounded and provided on the opposite side of pushed member 256 so that when knob 218 is pulled in a direction opposed to direction 262, a button on this switch is engaged by the pusher member to detect the pulled motion. The pull motion of knob 218 can also be sensed in a continuous range similar to the push embodiments described above. In some embodiments, both push and pull motions of the knob 218 may be provided and sensed.

A spring member 264 is rigidly coupled to the pushing member 256 at one end and is rigidly coupled to a rotatable end member 266 at its other end. Spring member 264 is compressed when the knob 218 and pusher member 256 are moved in the direction of arrow 262. Spring member 264 thus provides a spring force that biases the knob 218 in the direction opposite to direction 262. If the knob 218 is not forced in direction 262, the spring bias moves the knob 218 opposite to direction 262 until the knob reaches its rest position. In those embodiments including a pull motion of the knob 218 in the direction opposite to direction 262, a spring member can be included on the opposite side of pusher member 256 to spring member 264, to bias the knob 218 in direction 262 after the user has pulled the knob. In yet other embodiments, no spring member 264 is provided, and the knob 218 remains at any pushed or pulled position until actively moved to a new position by the user.

Also, the magnitude of the force detents can differ based on the value being controlled. For example, a radio frequency having a higher value might be associated with a stronger force detent, while a lower radio frequency might be associated with a weaker force detent when it is displayed, thus informing the user generally of the radio station being displayed without requiring the user to look at the display 214 (which is particularly useful when operating the device 210 while performing another task, such as driving a vehicle). In some embodiments, the user can also change the magnitude of detents associated with particular values, such as radio stations, to preferred values so as to "mark" favorite settings. Programmability of the location of the detents in the rotary degree of freedom is also convenient since preferred radio frequencies are most likely spaced at irregular intervals in the radio frequency range, and the ability to program the detents at any location in the range allows the user to set detents to those preferred stations. In addition, the knob can be moved by the actuator 270 to select the nearest preprogrammed station or preferred setting. Also, different sets of detent force profiles can be stored in a memory device on the device 230 and a particular set can be provided on the knob 218 by a microprocessor or other controller in the device 230.

Another type of force sensation that can be output on knob 218 is a spring force. The spring force can provide resistance to rotational movement of the knob in either direction to simulate a physical spring on the knob. This can be used, for example, to "snap back" the knob to its rest or center position after the user lets go of the knob, e.g. once the knob is rotated past a particular position, a function is selected, and the user releases the knob to let the knob move back to its original position. A damping force sensation can also be provided on knob 218 to slow down the rotation of the knob, allowing more accurate control by the user. Furthermore, any of these force sensations can be combined together for a single knob 218 to provide multiple simultaneous force effects.

The spring return force provided in the rotary degree of freedom of the knob 218 can also be used to implement a rate control paradigm. "Rate control" is the control of a rate of a function, object, or setting based on the displacement of the knob 218 from a designated origin position. The further the knob is moved away from the origin position, the greater the rate of change of controlled input. For example, if a rate control knob 218 with a spring return force is used to control the radio frequency, then the further the knob is moved from the center origin position, the faster the radio frequency will change in the appropriate direction. The frequency stops changing when the knob is returned to the origin position. The spring force is provided so that the further the user moves the knob away from the origin position, the greater the force on the knob in the direction toward the origin position. This feels to the user as if he or she is inputting pressure or force against the spring rather than rotation or displacement, where the magnitude of pressure dictates the magnitude of the rate. However, the amount of rotation of the

Furthermore, in other embodiments, the pull and/or push motion of knob 218 along axis A can be actuated. For example, a jolt force can be output on the knob in the linear degree of freedom along axis A as the user pushes the knob. Also, the spring return force provided by spring member 264 can instead be output using an actuator controlled by a microprocessor.

5 It should be noted that the embodiment of Figs. 12a and 12b is not the only embodiment of the present invention. For example, some embodiments may only include the transverse motion of knob 18 and not the push and/or pull functionality nor the force feedback functionality. Other embodiments may only include the push and/or pull functions. Yet other
10 embodiments may only include force feedback with transverse knob motion, or force feedback with push and/or pull functions.

FIGURE 13a is a perspective view of an alternate embodiment 280 of the control knob 218 of the present invention. In embodiment 280, knob 218 is coupled to shaft 250, which is rigidly coupled to a flex member 282. Flex member 282 includes a base plate 284 and a plurality of bent portions 286 extending from the base plate 284. For example, as shown in
15 FIGURE 13b, the flex member 282 can be formed by cutting out the circular base plate 284 and the portions 286 from a unitary piece 285 of material, such as spring steel or stainless steel. The unitary piece is preferably provided as a thin sheet. Holes 288 or other apertures can be placed near the ends of the portions 286. Referring back to Fig. 13a, the portions 286 are then bent such that the holes 288 substantially align with the other holes 288, where the holes 288 are aligned
20 with axis B that extends approximately perpendicular to the surface of the base plate 284. The base plate 284 is rigidly coupled to the rotating shaft of the actuator 270.

FIGURE 13c is a side elevational view of the embodiment 280 of Fig. 13a. In the described embodiment, knob 218 is coupled to shaft 250, which extends through a switch 290 and is coupled to the bent portions 286 of the flex member 282. The switch 290 is preferably
25 similar to the switch 252 described above with reference to Figs. 12a and 12b. For example, a microswitch can be provided on the inside surface of the housing of switch 290 for each transverse direction of knob 218 that is to be sensed. The base plate 284 of the flex member 282 is rigidly coupled to shaft 292 of actuator 270. The shaft 292 is rigidly coupled to a shaft (not shown) of sensor 276, which has a grounded housing that is coupled to the grounded housing of
30 actuator 270.

Alternatively, a plurality of sensors can be positioned external to the flex member 282 instead of using switch 290. For example, switches 294 can be positioned on two or more sides around the flex member 282, depending on how many directions are to be sensed. Switches 294 can be contact switches that each detect when the portions 286 move to engage the contact
35 switch, thus indicating movement of knob 218 in a particular transverse direction. Alternatively, members can be positioned on shaft 250 which extend to the sides of the shaft and which engage

transmission member moves. Voice coil actuators such as actuator 304 are described in greater detail in U.S. Patent No. 5,805,140, the disclosure of which is incorporated herein by reference. In particular, the operation of the voice coils as actuators and/or sensors is described therein.

Other types of actuators 304 and transmissions can also be used in slider control 232. For example, a capstan drive and cable transmission can provide linear forces on the knob 234. Other types of actuators suitable for use with the slider include active actuators, such as linear current control motors, stepper motors, pneumatic/hydraulic active actuators, a torquer, etc. Passive actuators may also be used, such as magnetic particle brakes, friction brakes, fluid controlled passive actuators, or other actuators which generate a damping resistance or friction in a degree of motion.

Slider knob 234 can also include a button 238 which is used to provide input to the device 210. In yet other embodiments, the slider knob 234 can be pushed and/or pulled in a linear degree of freedom approximately perpendicularly to the surface of front panel 212. In such an embodiment, a moveable contact switch can be provided between the knob 234 and the transmission member 300. A spring member can also be provided similarly to the embodiment of Figs. 12a-12b and 13a-13c to bias the knob 234 to a neutral rest position.

The force sensations and modes described above for the rotary knob in Figs. 12a-12b and 13a-13c may also be used for the slider control 232 in a linear degree of freedom. For example, force detents can be applied in a position control paradigm as the knob 234 is moved in its linear degree of freedom. In a rate control paradigm, a spring return force can bias the knob 234 toward a center origin position, for example the center of the range of motion of the knob. The further the user moves the knob from the origin position, the greater the spring force opposing that motion and the greater the rate of the controlled value changes (increases or decreases). Other force effects include damping forces, texture forces, jolts, obstruction forces, assistive forces, periodic forces such as vibration forces, and end-of-travel forces.

FIGURES 15a and 15b are diagrammatic illustrations illustrating detent force profiles suitable for use with the knobs of device 210. Detent force profiles can be implemented by a microprocessor or other controller based on instructions stored in a computer readable medium, such as a memory circuit, magnetic disk, optical disk, etc. In Fig. 15a, a detent force profile is shown. The vertical axis F represents the magnitude of force output, where a positive F value indicates force in one direction, and a negative F value indicates force in the opposite direction. The horizontal axis d represents the distance or position of the moved user object (knob) in a degree of freedom, where the origin position O indicates the position of the detent, a positive d is a position past the origin of the detent in one direction, and a negative d is a position past the origin of the detent in the opposite direction. The curve 324 represents the force output for a single detent over a position range for the detent. Thus, for example, if the user moves the knob

same distance from origin O2 as P3. Detent curve 328 ends at endpoint 332 on the right side of origin O1 and within the range of forces of detent curve 330. Preferably, the end point 332 of curve 328 is positioned well after the endpoint 334 of curve 330, such that the point 332 has a position in the middle of the range between point 334 and the origin O2. The overlapped zone is between positions P3 and P2. In addition, the end point 332 of the first detent preferably does not extend past the origin O2 of the second detent into the positive side of the second detent. If another detent is positioned further on the d axis after curve 330, the end point 333 of curve 330 preferably is positioned well after the starting endpoint of the next detent curve and not past the origin of the next detent curve. Similar positioning can be provided for curves before curve 328 on axis d.

To solve the problem of unintentionally moving past a successive detent, the range of the second or successive detent is adjusted such that a lesser magnitude is preferably output at the beginning of the successive detent than would normally be output if the entire curve of the successive detent were used. Furthermore, the force detent curve used to output force is preferably different depending on the direction of the knob, similar to a hysteresis effect. As shown in FIGURE 15c, when moving the knob so the knob position changes from left to right, the force at the beginning of the range of detent curve 330 is at point 335 having a magnitude of 0.5M, which is one-half the magnitude M of the force at the other endpoint 333 of the range of curve 330 (ignoring the signs or direction of the forces). Of course, in other embodiments point 335 can have a magnitude of other fractions of M, such as one-third or three-fourths of M. Additional curve 327 can be similarly positioned and provide a similar overlap with curve 330, and additional curves may be added before curve 328 and/or after curve 327.

As shown in FIGURE 15d, when moving the knob in the other direction so the knob position changes from right to left, the endpoints of the curve 330 reverse in magnitude with respect to the endpoints shown in Fig. 15c. In Fig. 15d, starting from origin O2, the force at the beginning of the range of detent curve 328 is at point 336 having a magnitude of 0.5M, which is one-half the magnitude M of the force at the other endpoint 331 of curve 328 (other fractions of M can be provided for endpoint 336 in other embodiments). Any additional curves, such as curve 327, can be provided with a similar overlap. The force output on the knob thus changes depending on the direction of the knob. In a digital sensing system (e.g. using a digital encoder), the direction can be determined from a history of sensed values. For example, one or more sensed position values can be stored and compared to a current sensed position to determine the knob direction.

The use of a lesser magnitude at the beginning of the second detent reduces the tendency of the user to unintentionally skip past a second detent after moving the knob over a first detent closely spaced to the second detent. For example, when moving the knob left to right (e.g., clockwise) from position P1, a first detent (curve 328) ends at point 332 of curve 328, after

the deadband is reached (zero magnitude). Similarly, at point P4 on the other side of the origin O, the force increases from zero to a maximum magnitude M5 at location P5, after which the force drops a short distance to magnitude M6 at location P6. The force then drops to zero for increasing d, until another detent effect is encountered. The small decreases in force magnitude from the maximum magnitude at the end points of the curve 338 are useful in some detent embodiments to provide a less extreme assistive or resistive force to the user when entering or exiting the detent range, e.g., to gradually lead the user into the detent range before outputting the maximum force. This can provide a smoother-feeling and, in some cases, a more easily-selected detent (i.e., it can be easier to position the knob at the detent's origin).

The detent curve 338 can thus be defined using the parameters shown in Fig. 16a. For example, a force command protocol can provide a number of different commands that can cause the output of different force sensations to the user. The commands can each include a command identifier followed by one or more command parameters that define and characterize the desired force sensation. An example of a command defining a detent curve 338 is as follows:

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DETENT (TYPE, PERIOD, MAGNITUDE, LOCATION, DEADBAND, FLAG,
WIDTH, PHASE, OFFSET, LOCATION, INCREMENT, ARRAY POINTER)
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The DETENT identifier indicates the type of force sensation. The TYPE parameter indicates a type of periodic wave from which to base the force detent curve, such as a sine wave, triangle wave, square wave, ramp, etc. The PERIOD and MAGNITUDE parameters define those characteristics of the periodic wave. The LOCATION parameter defines the location of the origin position for the detent in the degree of freedom of the knob. The DEADBAND parameter indicates the size of the deadband around the origin position. The FLAG parameter is a flag that indicates whether the detent is provided on the positive side, the negative side, or both sides around the location (origin position). The WIDTH parameter defines the amount of the wave 339 used for the detent curve, i.e. the extent of the wave used starting from the PHASE position. The PHASE parameter indicates the starting position of the detent curve 338 on the wave 339 (and is described in greater detail below). The OFFSET parameter indicates the amount of magnitude offset that curve 338 includes from the d axis, and is described in greater detail below. The INCREMENT parameter indicates the distance in the degree of freedom of the knob between successive detent locations. The optional LOCATION ARRAY POINTER parameter indicates a location in a separate array that has been previously programmed with the particular positions in the degree of freedom of the knob at which the detents are located and (optionally) the total number of detents; the array can be provided in memory, such as RAM, or other writable storage device. For example, the array can be preprogrammed with three detents, at locations of 45 degrees, 78 degrees, and 131 degrees in the rotation of the knob. The array can be accessed as necessary to retrieve these locations at which detent forces are to be output. This

FIGURE 16c is a graph 344 showing the resulting detent curve 346 obtained from the application of the parameters to the wave 342 described with reference to Fig. 16b. The portion of the wave 342 starting at the phase and positioned above the offset line in Fig. 16b is used in the detent curve 346. Furthermore, a deadband 348 has been added to the curve. The flag in the detent command has caused the positive side of the curve 346 to be mirrored on the negative side of the origin O. This detent curve 346 causes a detent force that is similar to the detent force described with reference to Fig. 16a, only smaller in magnitude and in position range over the degree of freedom of the knob.

FIGURE 16d is a graph 360 showing a periodic wave and parameters to be applied to the wave. Sine wave 362 is provided as described above, having a particular period and magnitude. An offset is specified for the resulting detent curve; in the example of Fig. 16d, the offset is 1, thus causing the detent curve to be shifted upward by its entire magnitude. A phase of 270 degrees is also indicated, so that the detent curve starts at the lowest magnitude of the wave 372 at point P. Furthermore, an increment is also specified as a parameter (not shown). FIGURE 16e is a graph 370 illustrating the detent curves 372 and 374 resulting from the wave 362 and parameters described with reference to Fig. 16d. The portion of the wave 362 past point P and ending at a point defined by a width parameter is provided both on the positive side and the negative side of origin O1 of graph 370 for curve 372 (the positive and negative sides are designated by the flag parameter). A second curve 374 is also shown, where the origin O2 of the second curve is positioned at a distance from the origin O1 as specified by the increment parameter. Additional curves similar to curves 372 and 374 are provided at further distances at same increment from each other. The detent curves 372 and 374 provide a much steeper, less gradual detent force over the detent range than the other detent forces shown in Figs. 16a and 16c. Furthermore, no actual deadband is specified, although the shape of each half of the curve 372 provides a small zone 376 where zero force is output, similar to a deadband.

FIGURE 17 is a block diagram illustrating an electromechanical system 400 for the device 210 of Fig. 10 suitable for use with the present invention. A force feedback system including many of the below components is described in detail in Patent number 5,734,373.

In one embodiment, device 210 includes an electronic portion having a local microprocessor 402, local clock 404, local memory 406, sensor interface 408, and actuator interface 410.

Local microprocessor 402 is considered local to device 210 and is preferably similar in type and function to microprocessor 90, described above. Microprocessor 402 can include one microprocessor chip, or multiple processors and/or co-processor chips, and can include digital signal processor (DSP) functionality. Also, "haptic accelerator" chips can be provided which

such as a lateral effect photo diodes, tachometers, and accelerometers. Furthermore, both absolute and relative sensors may be used.

In those embodiments including force feedback, actuator 270 transmits forces to knob 218 in one or more directions in a rotary degree of freedom in response to signals output by microprocessor 402 or other electronic logic or device, i.e., it is "electronically-controlled." The actuator 270 produces electronically modulated forces which means that microprocessor 402 or other electronic device controls the application of the forces. Typically, an actuator 270 is provided for each knob 218 that includes force feedback functionality. In some embodiments, additional actuators can also be provided for the other degrees of freedom of knob 218, such as the transverse motion of the knob 218 and/or the push or pull motion of the knob. The actuators, such as actuator 270, can include active actuators, such as linear current control motors, stepper motors, pneumatic/hydraulic active actuators, a torquer (motor with limited angular range), voice coil actuators, etc. Passive actuators can also be used, including magnetic particle brakes, friction brakes, or pneumatic/hydraulic passive actuators, and generate a damping resistance or friction in a degree of motion. In some embodiments, all or some of sensors 414 and actuator 270 can be included together as a sensor/actuator pair transducer, as shown in Figs. 12a-12b for actuator 270 and sensor 276.

Mechanism 416 is used to translate motion of knob 218 to a form that can be read by sensors 414, and, in those embodiments including force feedback, to transmit forces from actuator 270 to knob 218. Examples of mechanism 416 are shown with respect to Figs. 12a-12b and 13a-13c. Other types of mechanisms can also be used, as disclosed in U.S. Patent Nos. 5,767,839, 5,721,566, 5,805,140, all incorporated by reference herein. Also, a drive mechanism such as a capstan drive mechanism can be used to provide mechanical advantage to the forces output by actuator 270, as described in patent no. 5,731,804, incorporated by reference herein. Alternatively, a belt drive system, gear system, or other mechanical amplification/transmission system can be used.

Other input devices 420 can be included in interface device 210 and send input signals to microprocessor 402. Such input devices can include buttons, such as buttons 216 on front panel 212 as shown in Fig. 10, used to supplement the input from the knob to the device 210. Also, dials, switches, voice recognition hardware (e.g. a microphone, with software implemented by microprocessor 402), or other input mechanisms can be used. can also be included to send a signal (or cease sending a signal) to microprocessor 402 or to the actuator 270 or actuator interface 410, indicating that the user is not gripping the knob 218, at which point all output forces are ceased for safety purposes. A safety or "deadman" switch 422 can optionally be included for the knob 218 in those implementations providing force feedback on the knob. Such a safety switch can be implemented similarly to safety switch 115 described above with

can be provided with software instructions to wait for commands or requests from the host computer, parse/decode the command or request, and handle/control input and output signals according to the command or request.

5 For example, in one force feedback embodiment, host microprocessor 424 can provide low-level force commands over bus 426, which microprocessor 402 directly transmits to the actuators. In a different force feedback local control embodiment, host microprocessor 424 provides high level supervisory commands to microprocessor 402 over bus 426, and microprocessor 402 manages low level force control loops to sensors and actuators in accordance with the high level commands and independently of the host computer, similar to the
10 embodiments for wheel 16 described above.

In an alternate embodiment, no local microprocessor 402 is included in interface device 210, and a remote microprocessor, such as microprocessor 424, controls and processes all signals to and from the components of interface device 210. Or, hardwired digital logic can perform any input/output functions to the knob 218.

15 While this invention has been described in terms of several preferred embodiments, it is contemplated that alterations, permutations and equivalents thereof will become apparent to those skilled in the art upon a reading of the specification and study of the drawings. For example, many types of actuators, sensors, and mechanisms can be used to sense and apply forces on the wheel or knob. In addition, the wheel or knob itself can be implemented in a
20 variety of ways, as a dial, cylinder, knob, sphere, or other shape. Also, a great variety and types of force sensations can be output on wheel 16. It should also be noted that the embodiments described above can be combined in various ways in a particular implementation. Furthermore, certain terminology has been used for the purposes of descriptive clarity, and not to limit the present invention. It is therefore intended that the following appended claims include all such
25 alterations, permutations, and equivalents as fall within the true spirit and scope of the present invention.

What is claimed is:

8. An interface device as recited in claim 2 wherein said wheel can be depressed into a housing of said user manipulandum.

9. An interface device as recited in claim 2 wherein said wheel is coupled to a first shaft that is coupled to and rotatable about a second shaft, said second shaft being coupled to said wheel actuator.

10. An interface device as recited in claim 1 further comprising a local microprocessor, separate from host computer, coupled to said actuator and controlling said actuator to apply said computer-modulated force on said wheel.

11. An interface device as recited in claim 1 wherein said host computer is running a graphical environment and wherein said force applied to said wheel corresponds with an event or interaction displayed in said graphical environment.

12. An interface device as recited in claim 1 wherein said wheel actuator outputs a set of isotonic forces when said interface device is in an isotonic mode, and wherein said wheel actuator outputs a set of isometric forces when said interface device is in an isometric mode.

13. A handheld force feedback remote control device for providing input to an electronic device located remotely from said remote control device, the remote control device comprising:

a wheel rotatably coupled to a housing of said remote control device and rotatable about an axis, said wheel being manipulated by a user;

an actuator coupled to said wheel for outputting a computer-modulated force detent on said wheel, said force detent felt by said user, wherein said force detent is provided at a predetermined rotational position of said wheel; and

a sensor that senses rotation of said wheel and provides a wheel signal to said electronic device indicating a rotary position of said wheel.

14. A force feedback wheel device as recited in claim 13 wherein said force detent includes an attractive force for biasing said wheel to said predetermined rotational position

15. A force feedback wheel device as recited in claim 13 wherein said remote control device sends signals to said electronic device using wireless transmission of information using an electromagnetic beam.

22. A method for providing a force feedback mouse wheel on a mouse interface device, said mouse interface device coupled to a host computer, the method comprising:

sensing a position of a mouse of said mouse interface device in a planar workspace and sending an indication of said position to a host computer:

5 sensing a rotation of said mouse wheel about an axis of rotation and sending a wheel signal to said host computer indicating a current position of said wheel about said axis; and

applying a force to said mouse wheel about said axis using a wheel actuator coupled to said mouse wheel, wherein said force is coordinated with an event occurring in said graphical environment.

10

23. A method as recited in claim 22 wherein said sensing a rotation of said mouse wheel includes sensing an absolute position of said mouse wheel about said axis.

24. A method as recited in claim 22 wherein said applying a force to said mouse wheel is commanded by a local microprocessor included in said mouse interface device and separate from
15 said host computer.

25. A method as recited in claim 22 wherein said event is a scrolling of a displayed document as controlled by said sensed rotation of said mouse wheel and said wheel signal.

26. A method as recited in claim 22 wherein said event is an interaction of a cursor with a graphical object implemented by said host computer, said cursor having motion influenced by
20 said rotation of said wheel.

27. A method as recited in claim 26 wherein said interaction is a collision of said cursor with said graphical object.

28. A method as recited in claim 22 wherein said force is one of a damping force sensation, an inertial force sensation, and a friction force sensation.

25 29. A method as recited in claim 22 wherein said force is a force detent sensation.

30. A method as recited in claim 22 wherein said force is one of an obstruction force sensation, a texture sensation, a jolt sensation, and a vibration sensation.

31. A method as recited in claim 22 further comprising applying a force to said mouse object in said planar workspace using an actuator different from said wheel actuator.

39. A knob controller device as recited in claim 38 wherein said device is an audio device.

5 40. A knob controller device as recited in claim 32 further comprising a microprocessor coupled to said rotational sensor and to said transverse sensor, said microprocessor receiving sensor signals from said sensors and controlling a function of a device in response to said sensor signals, said microprocessor sending force feedback signals to said actuator to control force output by said actuator.

10 41. A knob controller device as recited in claim 32 further comprising a display, wherein an image on said display is changed in response to manipulation of said knob in said transverse direction.

42. A knob controller device as recited in claim 32 wherein a flexible member is coupled between said knob and said actuator to allow said movement in said transverse direction.

43. A knob controller device as recited in claim 42 wherein said flexible member is a spring member.

15 43. A knob controller device as recited in claim 42 wherein said flexible member includes a base plate and a plurality of bent flexible portions coupled to said base plate.

44. A knob controller device comprising:

20 a knob coupled to a grounded surface, said knob rotatable in a rotary degree of freedom about an axis extending through said knob, said knob also moveable in a linear degree of freedom approximately parallel to said axis;

a rotational sensor that detects a position of said knob in said rotary degree of freedom;

a linear sensor that detects a position of said knob in said linear degree of freedom; and

25 an actuator coupled to said knob and operative to output a force in said rotary degree of freedom about said axis.

45. A knob controller device as recited in claim 44 further comprising a microprocessor coupled to said rotational sensor and to said linear sensor, said microprocessor receiving sensor signals from said sensors and controlling a function of a device in response to said sensor

change of said value based on a position of said knob in said degree of freedom, wherein said rate control mode provides a force on said knob using said actuator, said force being applied in a direction opposing a movement of said knob away from an origin position.

5 53. An interface control device as recited in claim 52 wherein said degree of freedom is a rotary degree of freedom.

 54. An interface control device as recited in claim 52 wherein said degree of freedom is a linear degree of freedom.

10 55. An interface control device as recited in claim 52 wherein said force opposing said movement is a spring force.

 56. An interface control device as recited in claim 52 wherein said microprocessor controls said actuator to output at least one force detent during movement of said knob in said position control mode.

15 57. An interface control device as recited in claim 52 wherein said rate control mode is used to control the value of a volume, bass, treble, or balance function of said device.

 58. An interface control device as recited in claim 52 wherein said position control mode is used to control the value of a volume, bass, treble, or balance function of said device.

 59. An interface control device as recited in claim 52 wherein said rate control mode is used to control a position of a physical component in a vehicle.

20

 60. A method for providing detent forces for a force feedback control, the method comprising:

25 outputting a first force for a first detent on a user manipulatable object contacted by a user and moveable in a degree of freedom, said first force being output when said user manipulatable object is moved within a range of said first detent, said first force being output by a electronically-controlled actuator, wherein said first force assists movement of said user manipulatable object toward an origin position of said first detent and wherein said first force resists movement of said user manipulatable object away from said origin position of said first detent; and

30 outputting a second force for a second detent on said user manipulatable object when said user manipulatable object is moved within a range of said second detent, said second force being

said user manipulatable object in a degree of freedom, said user manipulatable object being contacted and moveable by a user; and

using said detent force curve to command said force on said user manipulatable object, said force being output by a electronically-controlled actuator.

5

68. A method as recited in claim 67 wherein said defining a periodic wave includes specifying a type, a period and a magnitude for said periodic wave.

69. A method as recited in claim 67 wherein said using at least a portion of said periodic wave to define a detent force curve includes specifying a portion of said periodic wave to define a width of said detent force curve.

10

70. A method as recited in claim 69 wherein said using at least a portion of said periodic wave to define a detent force curve includes specifying a phase and an offset to be applied to said periodic wave to define said detent force curve.

71. A method as recited in claim 67 wherein said using at least a portion of said periodic wave to define a detent force curve includes specifying an increment distance, wherein successive detent force curves in said degree of freedom are spaced apart by said increment distance.

15

72. A method as recited in claim 67 wherein said user manipulatable object is a knob moveable in a rotary degree of freedom.

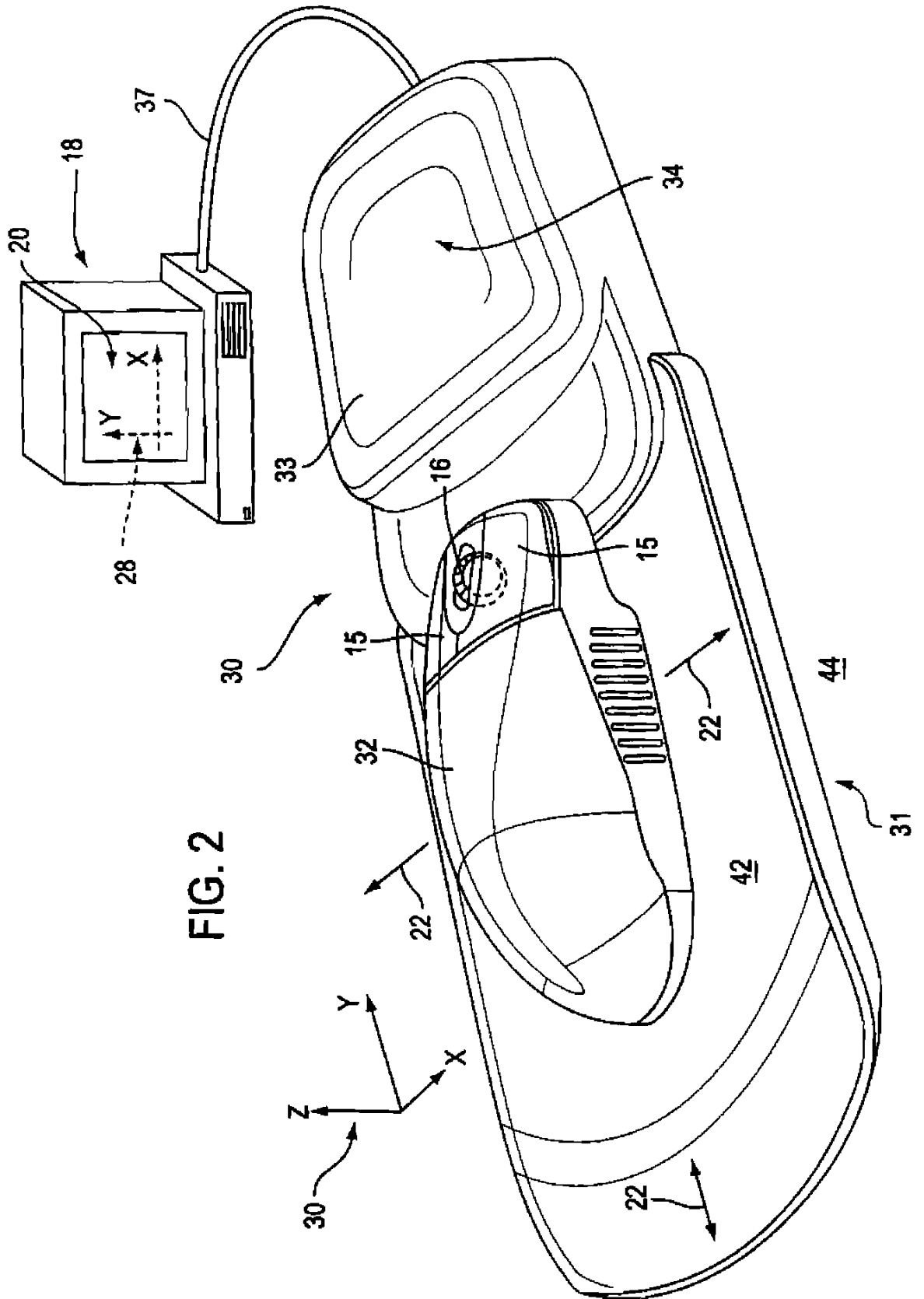


FIG. 2

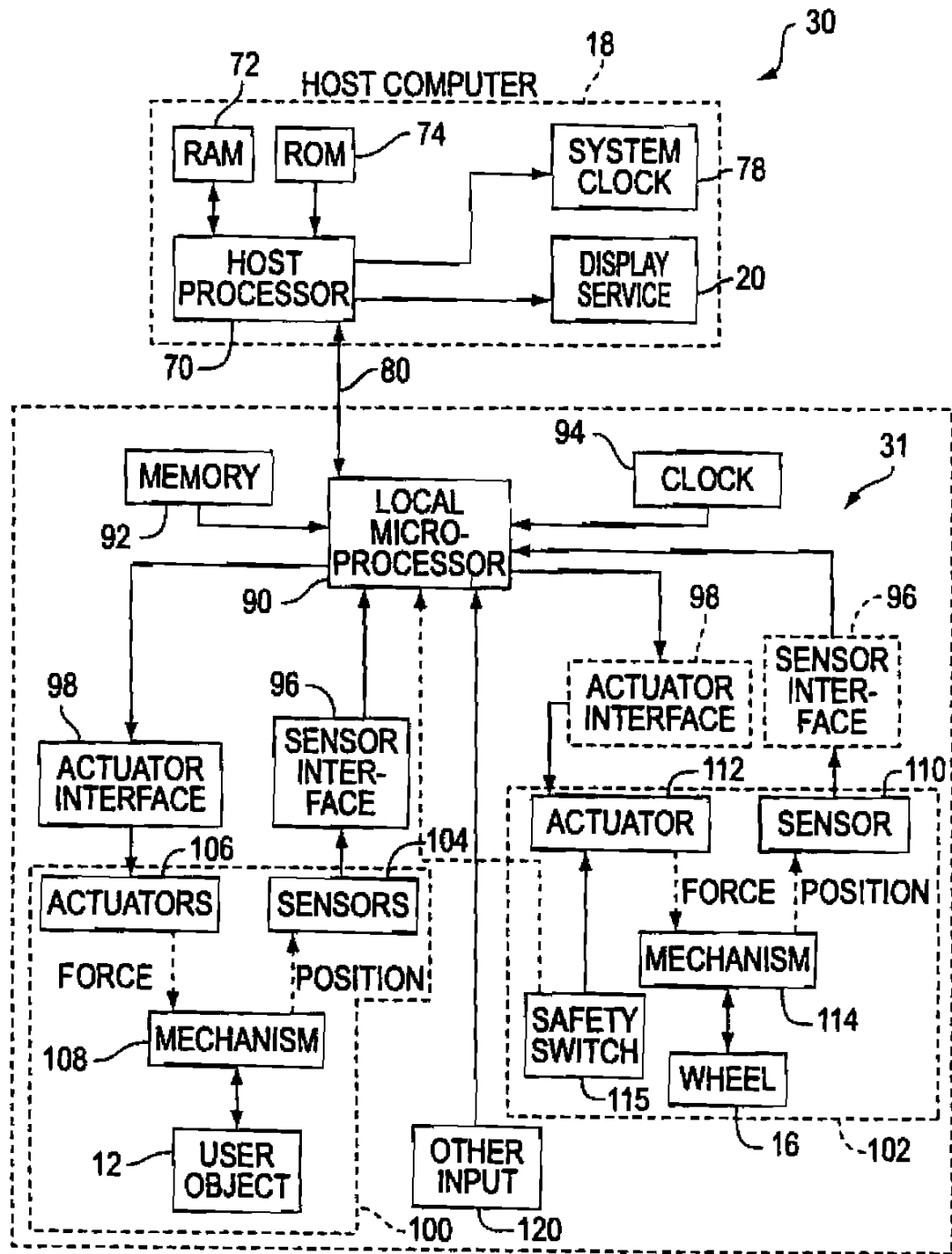


FIG. 4

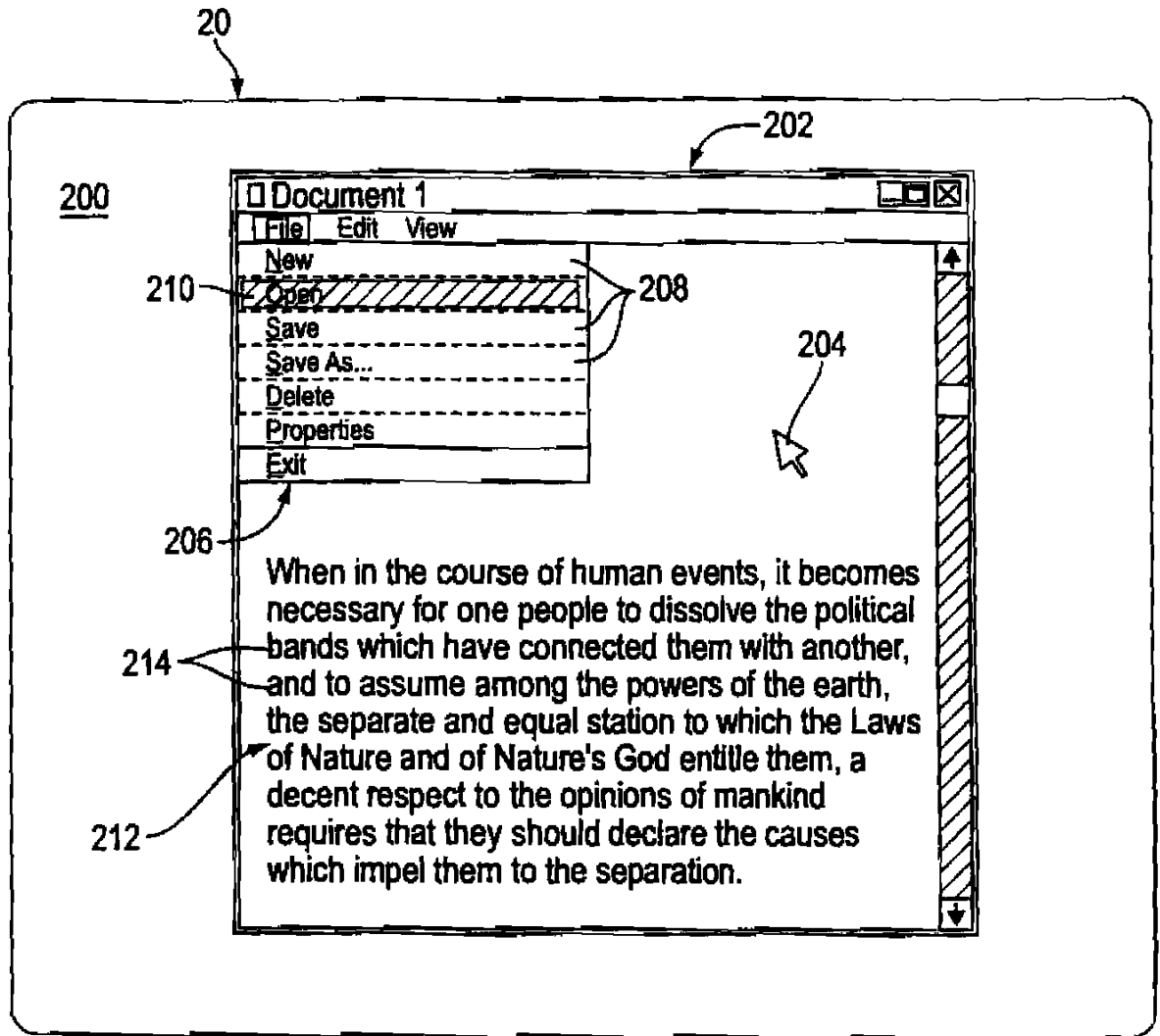


FIG. 9

8/17

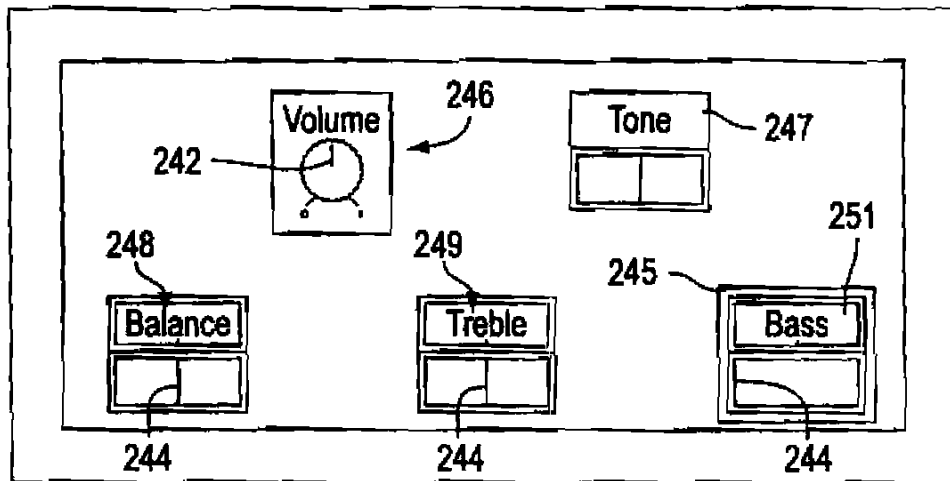


FIG. 11

10/17

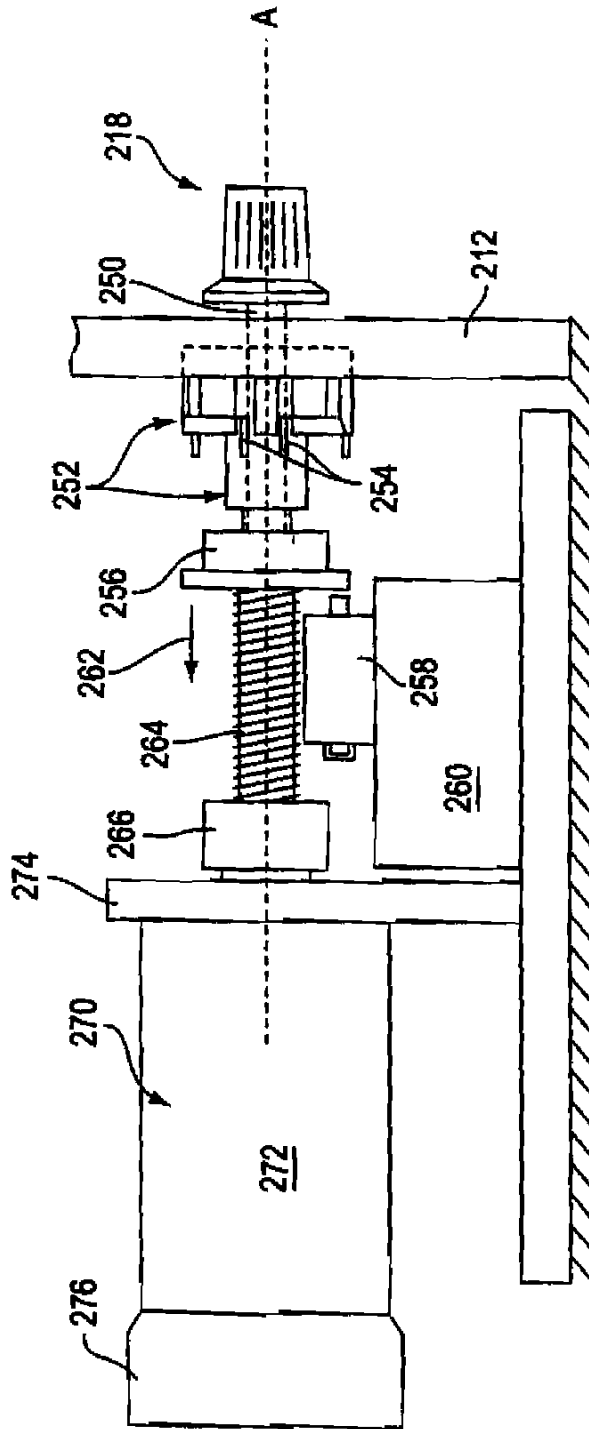


FIG. 12b

12/17

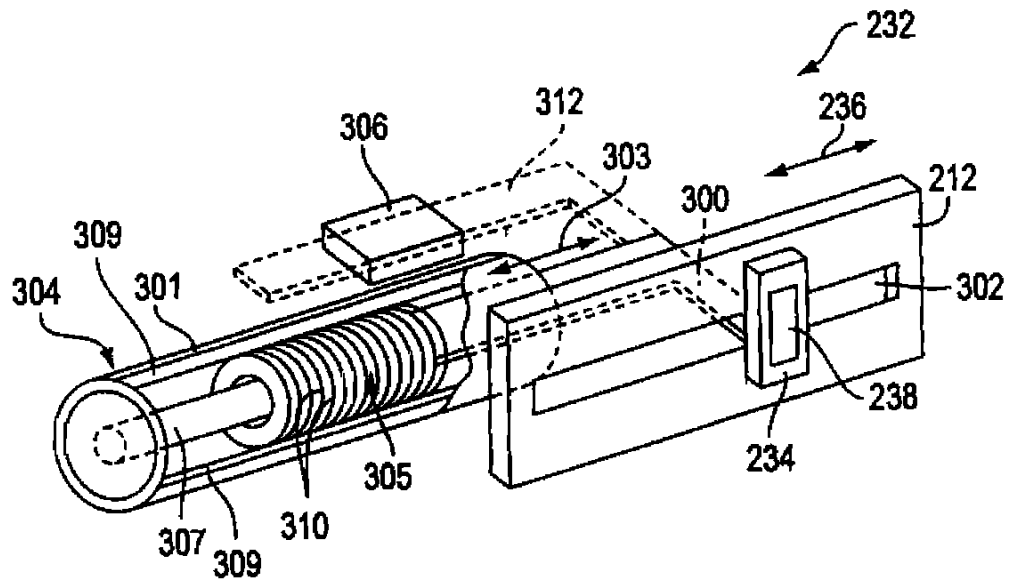


FIG. 14

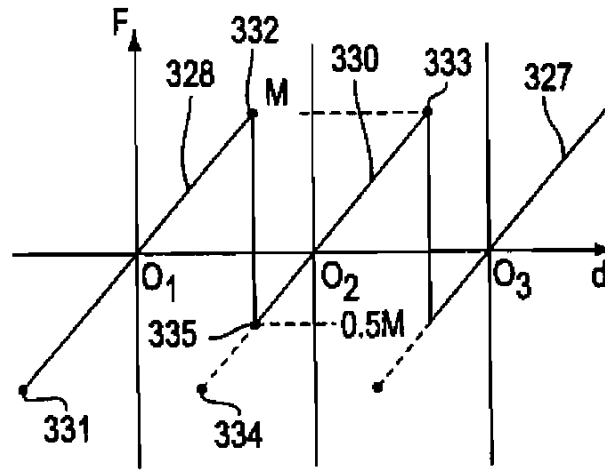


FIG. 15C

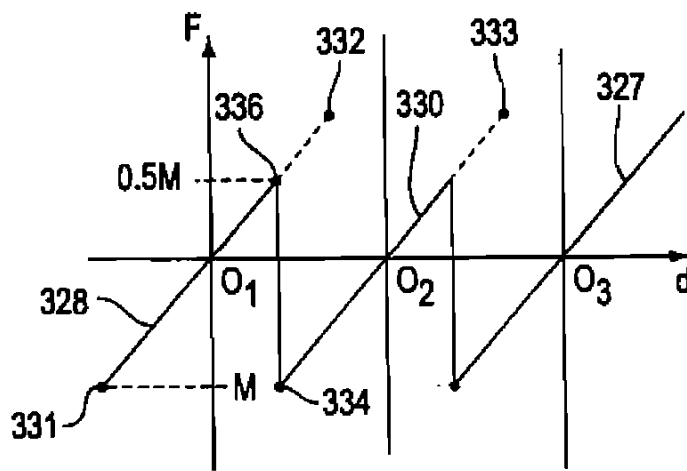


FIG. 15D

16/17

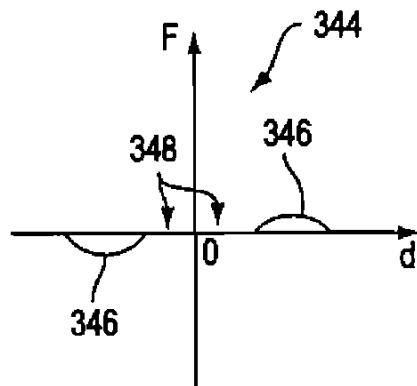


FIG. 16C

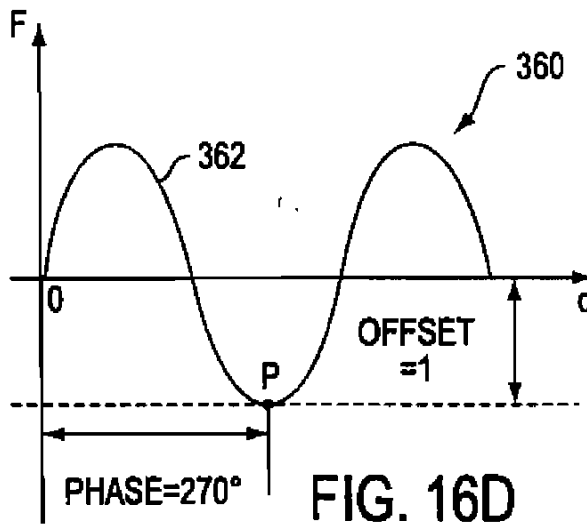


FIG. 16D

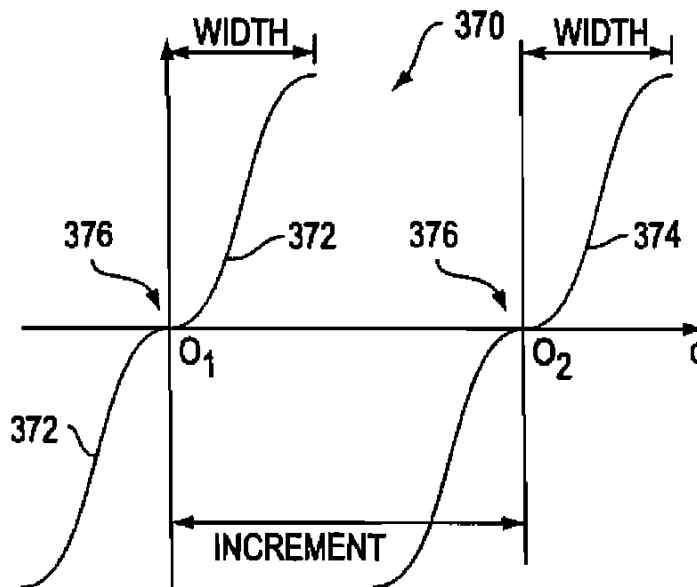


FIG. 16E



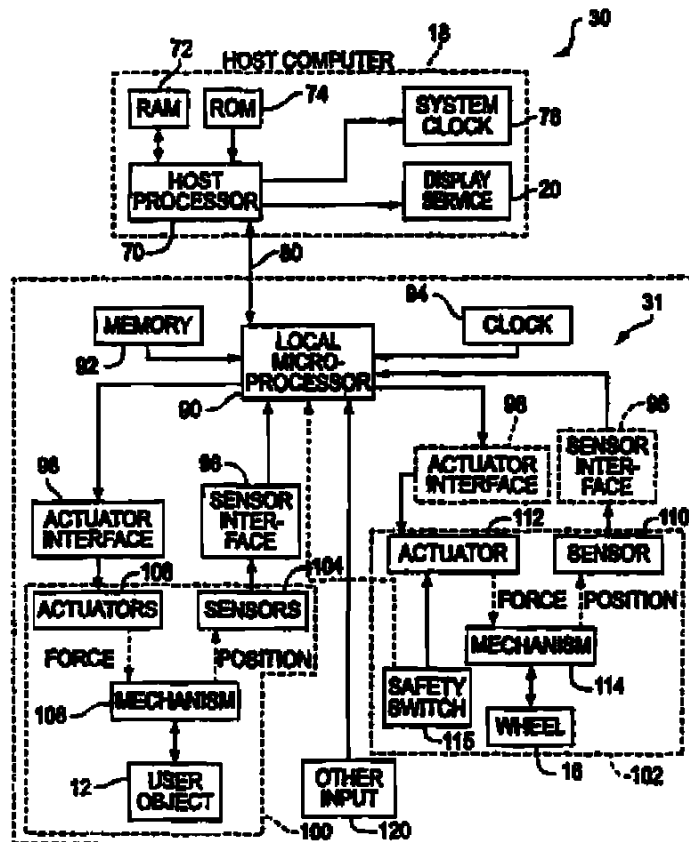
INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

<p>(51) International Patent Classification ⁶ : G09G 5/08</p>	<p>A3</p>	<p>(11) International Publication Number: WO 99/49443 (43) International Publication Date: 30 September 1999 (30.09.99)</p>
<p>(21) International Application Number: PCT/US99/06510 (22) International Filing Date: 24 March 1999 (24.03.99) (30) Priority Data: 09/049,155 26 March 1998 (26.03.98) US 09/179,382 26 October 1998 (26.10.98) US (71) Applicant: IMMERSION CORPORATION [US/US]; 2158 Paragon Drive, San Jose, CA 95131 (US). (72) Inventors: ROSENBERG, Louis, B.; 5002 Felter Road, San Jose, CA 95132 (US). SCHENA, Bruce, M.; 414 Pope Street, Menlo Park, CA 94025 (US). (74) Agent: HICKMAN, Paul, L.; Hickman Stephens & Coleman, LLP, P.O. Box 52037, Palo Alto, CA 94303-0746 (US).</p>		<p>(81) Designated States: AU, CA, CN, JP, European patent (AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE). Published <i>With international search report.</i> (88) Date of publication of the international search report: 26 October 2000 (26.10.00)</p>

(54) Title: FORCE FEEDBACK CONTROL WHEELS AND KNOBS

(57) Abstract

A force feedback wheel (16) or knob (226) is provided on a mouse (12) or other device to be manipulated by a user. The force applied to the wheel (16) can correspond with an event or interaction displayed in a host graphical environment. Force feedback is preferably provided using an actuator (112) coupled to the knob (226). The device controlled by the knob (226) can be, for example, an audio device, a video device, etc. Detent forces can be provided for the knob (226) by overlapping and adjusting ranges of closely-spaced detents in the rotary degree of freedom of the knob (226).



* (Referred to in PCT Gazette No. 47/1999, Section II)

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US99/06510

A. CLASSIFICATION OF SUBJECT MATTER

IPC(6) :G09G 5/08
US CL :345/163, 161

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)

U.S. : 345/163, 161, 156, 157, 184, 970, 974; 74/471XY, 485; 463/38, 37, 30; 364/705.05; 200/23-25, 28, 29, 179, 564

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 practicable, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	US 5,473,344 A (BACON et al) 05 December 1995, col. 3, line 34-col. 5, line 24.	1-5, 7, 10-12, 22-31
Y	US 4,868,549 A (AFFINITO et al) 19 September 1989, col. 3, lines 30-63, col. 4, lines 59-65, col. 5, line 1-51, col. 6, lines 5-32, col. 6, line 39-col. 7, line 18.	1-5, 7, 10-31
Y	US 5,724,106 A (AUTRY et al) 03 March 1998, col. 5, line 20-33, col. 6, lines 2-14, col. 11, lines 24-51, col. 13, lines 14-21, col. 14, lines 10-21.	13-21
A,P	US 5,745,057 A (SASAKI et al) 28 April 1998, col. 3, lines 49-54 col. 4, lines 31-39, col. 4, lines 56-67, col. 5, lines 7-44.	32-35, 38-42, 43-53, 55-58,

Further documents are listed in the continuation of Box C. See patent family annex.

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Date of the actual completion of the international search

18 JULY 1999

Date of mailing of the international search report

29 OCT 1999

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Joni Hill
APPLICANT
EXHIBIT 1010 - PAGE 594

Electronic Acknowledgement Receipt

EFS ID:	3665362
Application Number:	11693117
International Application Number:	
Confirmation Number:	8743
Title of Invention:	Method and Apparatus for Providing Tactile Sensations
First Named Inventor/Applicant Name:	Kenneth M. Martin
Customer Number:	34300
Filer:	Carl E. Sanders/Amber Johnson
Filer Authorized By:	Carl E. Sanders
Attorney Docket Number:	IMM147.C1
Receipt Date:	23-JUL-2008
Filing Date:	29-MAR-2007
Time Stamp:	16:30:11
Application Type:	Utility under 35 USC 111(a)

Payment information:

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4	NPL Documents	CNOA090507.pdf	405069 5d48a52653823019d4595e3aef2b68ac1bcca174	no	12
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23	Foreign Reference	WO9949443.pdf	945368	no	84
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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.

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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.

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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

Application of : Martin et al.
Application No. : 11/693,117
Filed : March 29, 2007
For : **Method and Apparatus for Providing Tactile Sensations**
Examiner : Unassigned
Art Unit : 2817
Confirmation No. : 8743

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

TRANSMITTAL

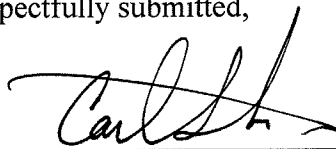
Sir:

Transmitted herewith are copies of the following documents for filing in the above-identified application:

Information Disclosure Statement Letter
Form PTO/SB/08a
Non-Patent Literature Documents

The Commissioner is hereby authorized to charge any deficiency to Deposit Account Number 16-1435.

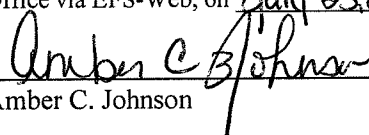
Respectfully submitted,

By: 
Carl Sanders (Reg. No. 57,203)

Date: 7/23/2008
KILPATRICK STOCKTON LLP
1001 West Fourth Street
Winston-Salem, NC 27101-2400
(336) 607-7300

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I hereby certify that this correspondence is being electronically filed with The United States Patent Office via EFS-Web, on July 23, 2008.


Amber C. Johnson



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Table with 5 columns: APPLICATION NO., FILING DATE, FIRST NAMED INVENTOR, ATTORNEY DOCKET NO., CONFIRMATION NO.

11/693,117 03/29/2007 Kenneth M. Martin IMM147.C1 8743

34300 7590 03/05/2009
PATENT DEPARTMENT (51851)
KILPATRICK STOCKTON LLP
1001 WEST FOURTH STREET
WINSTON-SALEM, NC 27101

EXAMINER

OSORIO, RICARDO

ART UNIT PAPER NUMBER

2629

MAIL DATE DELIVERY MODE

03/05/2009 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. 11/693,117	Applicant(s) MARTIN ET AL.	
Examiner RICARDO L. OSORIO	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 29 March 2007.
- 2a) This action is **FINAL**.
- 2b) This action is non-final.
- 3) 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

- 4) Claim(s) 1-43 is/are pending in the application.
4a) Of the above claim(s) _____ is/are withdrawn from consideration.
- 5) Claim(s) _____ is/are allowed.
- 6) Claim(s) 1-43 is/are rejected.
- 7) Claim(s) _____ is/are objected to.
- 8) Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

- 9) The specification is objected to by the Examiner.
- 10) 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).
- 11) 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

- 12) 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 7/23/2008; 10/17/2007; 10/17/2007.
- 4) Interview Summary (PTO-413)
Paper No(s)/Mail Date. _____
- 5) Notice of Informal Patent Application
- 6) Other: _____

Art Unit: 2629

DETAILED ACTION

1. The nonstatutory double patenting rejection is based on a judicially created doctrine grounded in public policy (a policy reflected in the statute) so as to prevent the unjustified or improper timewise extension of the "right to exclude" granted by a patent and to prevent possible harassment by multiple assignees. A nonstatutory obviousness-type double patenting rejection is appropriate where the conflicting claims are not identical, but at least one examined application claim is not patentably distinct from the reference claim(s) because the examined application claim is either anticipated by, or would have been obvious over, the reference claim(s). See, e.g., *In re Berg*, 140 F.3d 1428, 46 USPQ2d 1226 (Fed. Cir. 1998); *In re Goodman*, 11 F.3d 1046, 29 USPQ2d 2010 (Fed. Cir. 1993); *In re Longi*, 759 F.2d 887, 225 USPQ 645 (Fed. Cir. 1985); *In re Van Ornum*, 686 F.2d 937, 214 USPQ 761 (CCPA 1982); *In re Vogel*, 422 F.2d 438, 164 USPQ 619 (CCPA 1970); and *In re Thorington*, 418 F.2d 528, 163 USPQ 644 (CCPA 1969).

A timely filed terminal disclaimer in compliance with 37 CFR 1.321(c) or 1.321(d) may be used to overcome an actual or provisional rejection based on a nonstatutory double patenting ground provided the conflicting application or patent either is shown to be commonly owned with this application, or claims an invention made as a result of activities undertaken within the scope of a joint research agreement.

Effective January 1, 1994, a registered attorney or agent of record may sign a terminal disclaimer. A terminal disclaimer signed by the assignee must fully comply with 37 CFR 3.73(b).

2. Claims 1-43 are rejected on the ground of nonstatutory double patenting over claims 1-9 of U. S. Patent No. 7,336,260 since the claims, if allowed, would improperly extend the "right to exclude" already granted in the patent.

The subject matter claimed in the instant application is fully disclosed in the patent and is covered by the patent since the patent and the application are claiming common subject matter, as follows: "a touch sensitive input device", "an actuator", "a processor", etc.

Furthermore, there is no apparent reason why applicant was prevented from presenting claims corresponding to those of the instant application during prosecution of the application which matured into a patent. See *In re Schneller*, 397 F.2d 350, 158 USPQ 210 (CCPA 1968).

See also MPEP § 804.


Art Unit: 2629

3. Any inquiry concerning this communication or earlier communications from the examiner should be directed to RICARDO L. OSORIO whose telephone number is (571) 272-7676. The examiner can normally be reached on MONDAY-THURSDAY 7:00 am-5:30 PM.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, AMARE MENGISTU can be reached on (571) 272-7674. 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.

/RICARDO L OSORIO/
Primary Examiner, Art Unit 2629

Search Notes 	Application/Control No. 11693117	Applicant(s)/Patent Under Reexamination MARTIN ET AL.
	Examiner RICARDO L OSORIO	Art Unit 2629

SEARCHED			
Class	Subclass	Date	Examiner
345	156, 161, 163, 173, 167-169	3/1/09	RLO

SEARCH NOTES		
Search Notes	Date	Examiner
EAST	3/1/09	RLO

INTERFERENCE SEARCH			
Class	Subclass	Date	Examiner

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U.S. Patent and Trademark Office: U.S. DEPARTMENT OF COMMERCE
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Substitute for form 1449A/PTO Information Disclosure Statement by Applicant (use as many sheets as necessary)				Complete if Known	
		Application Number		11/693,117	
		Filing Date		March 29, 2007	
		First Named Inventor		Martin et al.	
		Group Art Unit		2817	
		Examiner Name		Unknown	
		Attorney Docket Number		IMM147C1 (51851-342043)	
Sheet	1	of	9		

U.S. PATENT DOCUMENTS					
Examiner	Cite No. ¹	Document Number	Publication Date MM-DD-YYYY	Name of Patentee or Applicant of Cited Document	Pages, Columns, Lines, Where Relevant Passages or Relevant Figures Appear
		Number Kind Code ² (if known)			
	1	2,972,140	2/14/1961	Hirsch	
	2	3,157,853	11/17/1964	Hirsch	
	3	3,220,121	11/30/1965	Cutler	
	4	3,497,668	2/24/1970	Hirsch	
	5	3,517,446	6/30/1970	Corlyon et al.	
	6	3,623,064	11/23/1970	Kagen	
	7	3,902,687	9/2/1975	Hightower	
	8	3,903,614	9/9/1975	Diamond et al.	
	9	3,911,416	10/7/1995	Feder	
	10	4,127,752	11/28/1978	Lowthorp	
	11	4,160,508	7/10/1979	Salsbury	
	12	4,236,325	12/2/1980	Hall et al.	
	13	4,262,549	4/21/1981	Schwollenbach	
	14	4,311,980	1/19/1982	Fabrica Italiana Magneti Marelli, S. p. A.	
	15	4,333,070	6/1/1982	Barnes	
	16	4,362,408	12/7/1982	Cordes et al.	
	17	4,464,117	8/7/1984	Forest	
	18	4,484,191	11/20/1984	Vavra	
	19	4,513,235	4/23/1985	Acklam et al.	
	20	4,581,491	4/8/1986	Boothroyd	
	21	4,581,972	4/15/1986	Hoshino Gakki Co., Ltd.	
	22	4,599,070	7/8/1986	Hladky et al.	
	23	4,692,756	9/8/1987	U. S. Phillips Corporation	
	24	4,708,656	11/24/1987	De Vries et al.	
	25	4,713,007	12/15/1987	Alban	
	26	4,725,817	2/16/1988	Tecator AB	
	27	4,795,296	1/3/1989	California Institute of Technology	
	28	4,791,416	12/13/1988	Zenith Electronics Corpration	
	29	4,794,392	12/27/1988	Selinko	
	30	4,798,919	1/17/1989	IBM Corporation	
	31	4,821,030	4/11/1989	Tektronix, Inc.	
	32	4,823,106	4/16/1989	Tapeswitch Corporation of America	
	33	4,840,634	6/20/1989	Clayton Foundation for Research	
	34	4,885,565	12/8/1989	General Motors Corporation	

Examiner Signature	/Ricardo Osorio/	Date Considered	03/01/2009
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² Applicant's unique citation designation number (optional). ³ Kinds of U.S. Patent Documents at www.uspto.gov or MPEP 901.04. ⁴ Enter Office that issued the document, by the two-letter code (WIPO Standard ST.3). ⁵ For Japanese patent documents, the indication of the year of the reign of the Emperor must precede the serial number of the patent document. ⁶ Kind of document by the appropriate symbols as indicated on the document under WIPO Standard ST. 16 if possible. ⁷ Applicant is to place a check mark here if English language Translation is attached.

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Substitute for form 1449A/PTO				Complete if Known	
				Application Number	11/693,117
Information Disclosure Statement by Applicant <i>(use as many sheets as necessary)</i>				Filing Date	March 29, 2007
				First Named Inventor	Martin et al.
				Group Art Unit	2817
				Examiner Name	Unknown
				Attorney Docket Number	IMM147C1 (51851-342043)
Sheet	2	of	9		

U.S. PATENT DOCUMENTS						
Examiner	Cite No. ¹	Document Number		Publication Date MM-DD-YYYY	Name of Patentee or Applicant of Cited Document	Pages, Columns, Lines, Where Relevant Passages or Relevant Figures Appear
		Number Kind Code ² (if known)				
	35	4,891,764		1/2/1990	McIntosh	
	36	4,930,770		6/5/1990	Baker	
	37	4,934,694		6/19/1990	McIntosh	
	38	4,982,918		1/8/1991	British Aerospace Public Limited Company	
	39	4,983,786		1/8/1991	The University of British Columbia	
	40	5,019,761		5/28/1991	Kraft	
	41	5,022,384		6/11/1991	Freels	
	42	5,022,407		6/11/1991	Horch et al.	
	43	5,035,242		7/30/1991	Franklin, et al.	
	44	5,038,089		8/6/1991	Szakaly	
	45	5,053,585		10/1/1991	Interlink Electronics, Inc.	
	46	5,078,152		1/7/1992	Bond	
	47	5,116,051		5/26/1992	Atari Games Corp.	
	48	5,165,897		11/24/1992	Johnson	
	49	5,175,459		12/29/1992	Danial et al.	
	50	5,182,557		1/26/1993	Semborg Recrob. Corp.	
	51	5,186,685		2/16/1993	Mangseth et al.	
	52	5,212,473		5/18/1993	Louis	
	53	5,223,658		6/29/1993	Yamaha Corporation	
	54	5,237,327		8/17/1993	Sony Corporation	
	55	5,283,970		2/8/1994	Aigner	
	56	5,240,417		8/31/1993	Smithson et al.	
	57	5,241,308		8/31/1993	Paragon Systems, Inc.	
	58	5,246,316		9/21/1993	Excellon Automotion	
	59	5,271,290		12/21/1993	Fischer	
	60	5,275,174		1/4/1994	Cook	
	61	5,289,273		2/22/1994	Societe Nationale d'Etude et de Construction de Moteurs d'Aviation, "S.N.E.C.M.A."	
	62	5,299,810		4/5/1994	Pierce, et al.	
	63	5,309,140		5/3/1994	Everett	
	64	5,334,027		8/2/1994	Wherlock	
	65	5,355,148		10/11/1994	AST Research, Inc	
	66	5,390,128		2/14/1995	Cargill Detroit Corporation	
	67	5,390,296		2/14/1995	Comshare Incorporated	

Examiner Signature	/Ricardo Osorio/	Date Considered	03/01/2009
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ALL REFERENCES CONSIDERED EXCEPT WHERE LINED THROUGH. /R.O./

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Substitute for form 1449A/PTO				Complete if Known	
				Application Number	11/693,117
Information Disclosure Statement by Applicant <i>(use as many sheets as necessary)</i>				Filing Date	March 29, 2007
				First Named Inventor	Martin et al.
				Group Art Unit	2817
				Examiner Name	Unknown
				Attorney Docket Number	IMM147C1 (51851-342043)
Sheet	3	of	9		

U.S. PATENT DOCUMENTS						
Examiner	Cite No. ¹	Document Number		Publication Date MM-DD-YYYY	Name of Patentee or Applicant of Cited Document	Pages, Columns, Lines, Where Relevant Passages or Relevant Figures Appear
		Number Kind Code ² (if known)				
	68	5,402,499		3/28/1995	LSI Logic Corporation	
	69	5,402,680		4/4/1995	Canon Kabushiki Kaisha	
	70	5,436,622		7/25/1995	Gutman et al.	
	71	5,437,607		8/1/1995	Taylor	
	72	5,451,924		9/19/1995	Massachusetts Inst. Of Tech.	
	73	5,461,711		10/24/1995	Interval Research Corporation	
	74	5,466,213		11/14/1995	Hogan, et al.	
	75	5,489,812		2/6/1996	IBM Corporation	
	76	5,496,174		3/5/1996	The United States of America as represented by the Administrator of the National	
	77	5,514,150		5/7/1996	LSI Logic Corporation	
	78	5,521,336		5/28/1996	IBM Corporation	
	79	5,547,382		8/20/1996	Yamasaki, et al.	
	80	5,575,761		11/19/1996	Hajianpour	
	81	5,631,861		5/20/1997	Virtual Technologies, Inc.	
	82	5,684,722		11/4/1997		
	83	5,691,747		11/25/1997	Seiko Epson Corporation	
	84	5,709,219		1/20/1998	Microsoft Corporation	
	85	5,729,249		3/17/1998	ITU Research, Inc.	
	86	5,766,016		6/16/1998	Sinclair, et al.	
	87	5,767,457		6/16/1998	Cirque Corporation	
	88	5,785,630		7/28/1998	Bobick et al.	
	89	5,791,992		8/11/1998	IBM Corp.	
	90	5,844,392		12/1/1998	Cybernet Systems Corporation	
	91	5,857,986		1/12/1999		
	92	5,887,995		3/30/1999	Compaq Computer Corporation	
	93	5,889,670		3/30/1999	Immersion Corporation	
	94	5,889,672		3/30/1999	Immersion Corporation	
	95	5,917,906		6/29/99	Thornton	
	96	5,943,044		8/24/1999	Interlink Electronics, Inc.	
	97	5,945,772		8/31/1999	Motorola, Inc.	
	98	5,977,867		11/2/1999	Bouin	
	99	5,988,902		11/23/1999	Compaq Computer Corporation	
	100	6,078,126		6/20/2000	Motorola, Inc.	

Examiner Signature	/Ricardo Osorio/	Date Considered	03/01/2009
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				First Named Inventor	Martin et al.
				Group Art Unit	2817
				Examiner Name	Unknown
				Attorney Docket Number	IMM147C1 (51851-342043)
Sheet	4	of	9		

101	6,097,964	8/1/2000	Nokia Mobile Phones Ltd.
102	6,059,506	5/9/2000	Virtual Techonologies, Inc.
103	6,160,489	12/12/2000	Perry et al.
104	6,111,577	8/29/2000	Zilles et al.
105	6,118,435	9/12/2000	Fujita et al.
106	6,198,206	3/6/2001	Active Control Experts, Inc.
107	6,131,097	10/10/2000	Immersion Corporation
108	6,195,592	2/27/2001	Immersion Corporation
109	6,160,489	12/12/2000	Motorola, Inc.
110	6,198,206	3/6/2001	Active Control eXperts, Inc.
111	6,218,966	4/17/2001	IBM Corporation
112	6,219,034	4/17/2001	Elbing, et al.
113	6,225,976	5/1/2001	Interlink Electronics, Inc.
114	6,292,173	9/18/2001	Rambaldi et al.
115	6,307,465	10/23/2001	Kayma et al.
116	6,344,791	2/5/2002	Armstrong
117	6,369,803	4/9/2002	Brisebois et al.
118	6,373,463	4/16/2002	Beeks
119	6,374,255	4/16/2002	Immersion Corporation
120	6,388,655	5/14/2002	Leung
121	6,422,941	7/23/02	Thomer, et al.
122	6,429,846	8/6/2002	Immersion Corporation
123	6,543,487	5/13/2003	Immersion Corporation
124	6,597,347	7/22/2003	Yasutake
125	6,657,617	12/2/2003	Paolini et al.
126	6,781,569	8/24/2004	Gregorio et al.
127	6,801,191	10/5/2004	Mukai et al.
128	6,976,562	12/20/2005	Perret, Jr. et al.
129	2002/0033795	3/21/2002	Immersion Corporation
130	2002/0171621	11/21/2002	Johnson
131	2002/177471A1	11/28/2002	Nokia Mobile Phones Limited
132	2002/0128048A1	9/12/2002	Nokia Mobile Phones Limited
133	2002/0149561A1	10/17/2002	Fukumoto et al.
134	2005/0099393	5/12/2005	Johnson

Examiner Signature	/Ricardo Osorio/	Date Considered	03/01/2009
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		Application Number	11/693,117
		Filing Date	March 29, 2007
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		Country Code ²	Number ⁴	Kind Code ⁵ (if known)			
	135.	EP	0349086		1/3/1990	Stork Kwant B.V.	
	136.	JP	01-003664		7/19/1990	Taito Corporation	
	137.	JP	02-109714		1/13/1992	Epoch Co. and Key-Planning Co.	
	138.	JP	04-007371		8/3/1993	Taito Corporation	
	139.	JP	05-193862		1/27/1995	Sega Corporation	
	140.	JP	H2-185278		7/19/1990	Yamada	
	141.	JP	H4-8381		1/13/1992	Endo	
	142.	JP	H5-192449		8/3/1993	Koma et al.	
	143.	JP	H7-24147		1/27/1995	Yokoyama	
	144.	WO	0231807A1		4/18/2002	Motorola, Inc.	
	145.	WO	019110A1A1		11/29/2002	Immersion Corporation	
	146.	WO	02/27645		4/4/2002	Franzen	
	147.	JP	2002-259059A		9/13/2002	Motoyama et al.	
	148.	JP	2001-350592A		12/21/2001	Ryo et al.	

Examiner Signature	/Ricardo Osorio/	Date Considered	03/01/2009
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				Application Number	11/693,117	
Sheet		6	of	9	Examiner Name	Unknown
					Attorney Docket Number	IMM147C1 (51851-342043)

OTHER PRIOR ART -- NON PATENT LITERATURE DOCUMENTS			
Examiner Initials *	Cite No. ¹	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, page(s), volume-issue number(s), publisher, city and/or country where published.	
	149.	ADELSTEIN, "A Virtual Environment System For The Study of Human Arm Tremor," Ph.D. Dissertation, Dept. of Mechanical Engineering, MIT, June 1989.	
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Substitute for form 1449A/PTO INFORMATION DISCLOSURE STATEMENT BY APPLICANT (use as many sheets as necessary)		Complete if Known	
		Application Number	11/693,117
		Filing Date	March 29, 2007
		First Named Inventor	Martin et al.
		Group Art Unit	2817
		Examiner Name	Unknown
Sheet	7	of	9
		Attorney Docket Number	IMM147C1 (51851-342043)

OTHER PRIOR ART -- NON PATENT LITERATURE DOCUMENTS			
Examiner Initials *	Cite No. ¹	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, page(s), volume-issue number(s), publisher, city and/or country where published.	
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EAST Search History

Ref #	Hits	Search Query	DBs	Default Operator	Plurals	Time Stamp
L1	1246	osorio	US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2009/03/01 16:57
L2	263093	input adj device	US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2009/03/01 16:57
L3	82	L2 and (detect\$4 or sens\$4) adj first adj pressure	US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2009/03/01 16:57
L4	33	L3 and (detect\$4 or sens\$4) adj second adj pressure	US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2009/03/01 16:57
L5	7	L3 and (detect\$4 or sens\$4) adj third adj pressure	US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2009/03/01 16:57
L6	5	L3 and (detect\$4 or sens\$4) adj fourth adj pressure	US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2009/03/01 16:57
L7	2	L5 not L6	US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2009/03/01 16:57

L8	3	L4 and tactile	US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2009/03/01 16:57
L9	6	L3 and tactile	US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2009/03/01 16:57
L10	376	osorio and pressure	US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2009/03/01 16:57
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L16	15	L15 and "345"/\$. ccls.	US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2009/03/01 16:57
L17	4	L16 and tactile	US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2009/03/01 16:57
L18	3	L17 and (mobile or cell)	US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2009/03/01 16:57
L19	16	L15 and (touchpad or input adj device) and computer and display	US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2009/03/01 16:57
L20	4	L19 and tactile	US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2009/03/01 16:57
L21	19	L1 and calculator	US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2009/03/01 16:57
L22	0	L20 and calculator	US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2009/03/01 16:57
L23	3	L20 and measur \$4	US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2009/03/01 16:57

L24	2	(US-6657617-\$ or US-6292173-\$ or US-6801191-\$ or US-6597347-\$). did.	USPAT	OR	OFF	2009/03/01 16:57
L25	1	L24 and tactile	US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2009/03/01 16:57
L26	376	L1 and pressure	US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2009/03/01 16:57
L27	1	L25 and pressure	US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2009/03/01 16:57
L28	33722	first adj pressure and second adj pressure	US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2009/03/01 16:57
L29	8	L28 and first adj ((tactile or force) adj (feedback or sensation))	US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2009/03/01 16:57
L30	6	L29 and second adj ((tactile or force) adj (feedback or sensation))	US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2009/03/01 16:57
L31	488	L28 and input adj device	US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2009/03/01 16:57

L32	23	L31 and detect \$4 near3 first adj pressure	US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2009/03/01 16:57
L33	55	L31 and (detect \$4 or sens\$4) near3 first adj pressure	US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2009/03/01 16:57
L34	34	L33 and (detect \$4 or sens\$4) near3 second adj pressure	US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2009/03/01 16:57
L35	55	L31 and (detect \$4 or sens\$4) near3 first adj (press\$4 or push \$4)	US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2009/03/01 16:57
L36	34	L35 and (detect \$4 or sens\$4) near3 second adj (press\$4 or puxh \$4)	US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2009/03/01 16:57
L37	3	L36 and (tactile or force) adj (feedback or sensation)	US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2009/03/01 16:57

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			<i>First Named Inventor</i>	Martin et al.	
			<i>Art Unit</i>	2817	
			<i>Examiner Name</i>	Unknown	
Sheet	1	of		<i>Attorney Docket Number</i>	IMM147C1

U.S. PATENT DOCUMENTS					
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		Number - Kind Code ² (if known)			
	1.	US- 4,362,408	12/7/1982	Cordes et al.	
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		Country Code ³ - Number ⁴ - Kind Code ⁵ (if known)				
	12.	JP 11-085400	3/30/1999	Sony Corp		
	13.	JP 8221173	8/30/1996	Taima Shinobu		
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	20.	JP 2002-528831	9/3/2002	unknown		
	21.	WO 99/49443	09-30-1999	Immersion Corp.		
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	23.	EP 0 817 110	01-07-1998	Nokia Mobile Phones Ltd.		
	24.	GB 2 180 342	03-25-1987	Alcom Limited		

Examiner Signature	/Ricardo Osorio/	Date Considered	03/01/2009
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*EXAMINER: Initial if reference considered, whether or not citation is in conformance with MPEP 609. Draw line through citation if not in conformance and not considered. Include copy of this form with next communication to applicant. ¹ Applicant's unique citation designation number (optional). ² See Kinds Codes of USPTO Patent Documents at www.uspto.gov or MPEP 901.04. ³ Enter Office that issued the document, by the two-letter code (WIPO Standard ST.3). ⁴ For Japanese patent documents, the indication of the year of the reign of the Emperor must precede the serial number of the patent document. ⁵ Kind of document by the appropriate symbols as indicated on the document under WIPO Standard ST. 16 if possible. ⁶ Applicant is to place a check mark here if English language Translation is attached.

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 2 hours 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.

If you need assistance in completing the form, call 1-800-PTO-9199 and select option 2.

ALL REFERENCES CONSIDERED EXCEPT WHERE LINED THROUGH. /R.O./

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Substitute for form 1449B/PTO <h2 style="text-align: center;">INFORMATION DISCLOSURE STATEMENT BY APPLICANT</h2> <p style="text-align: center;">(Use as many sheets as necessary)</p>		Complete if Known	
		Application Number	11/693,117
		Filing Date	March 29, 2007
		First Named Inventor	Martin et al.
		Art Unit	2817
		Examiner Name	Unknown
Sheet	2	of	2
		Attorney Docket Number	IMM147C1

NON PATENT LITERATURE DOCUMENTS			
Examiner Initials *	Cite No. ¹	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, page(s), volume-issue number(s), publisher, city and/or country where published.	T ²
	25.	U.S. Office of China Sinda Intellectual Property Ltd., Notification of First Office Action, Chinese Application No. 02821854.X, mailed September 5, 2007.	
	26.	Japanese Patent Office, Response to Notice of Reasons for Rejection for January 29, 2008, Japanese Patent Application No. 2003-540973, mailed February 20, 2008.	
	27.	Japanese Patent Office, Notice of Reasons for Rejection of September 11, 2007, Japanese Patent Application No. 2003-540973, mailed September 26, 2007.	
	28.	United States Patent and Trademark Office, Office Action, Application No. 10/285,450, mailed December 23, 2005.	
	29.	United States Patent and Trademark Office, Office Action, Application No. 10/285,450, mailed May 18, 2006.	
	30.	United States Patent and Trademark Office, Office Action, Application No. 10/285,450, mailed November 15, 2006.	
	31.	United States Patent and Trademark Office, Office Action, Application No. 10/285,450, mailed June 1, 2007.	
	32.	European Patent Office, Supplemental Search Report, European Application No. 02773960.6, mailed July 1, 2008.	

Examiner Signature	/Ricardo Osorio/	Date Considered	03/01/2009
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*EXAMINER: Initial if reference considered, whether or not citation is in conformance with MPEP 609. Draw line through citation if not in conformance and not considered. Include copy of this form with next communication to applicant.

¹ Applicant's unique citation designation number (optional). ² Applicant is to place a check mark here if English language Translation is attached. This collection of information is required by 37 CFR 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 2 hours 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.**

If you need assistance in completing the form, call 1-800-PTO-9199 and select option 2.

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.

Substitute for form 1449A/PTO				Complete if Known	
INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Use as many sheets as necessary)				Application Number	11/693,117
				Filing Date	March 29, 2007
				First Named Inventor	Martin et al.
				Art Unit	2817
				Examiner Name	Unknown
Sheet	1	of	1	Attorney Docket Number	IMM147C1 (51851-342043)

U.S. PATENT DOCUMENTS					
Examiner Initials *	Cite No. ¹	Document Number	Publication Date MM-DD-YYYY	Name of Patentee or Applicant of Cited Document	Pages, Columns, Lines, Where Relevant Passages or Relevant Figures Appear
		Number - Kind Code ² (if known)			
		US-			
		US-			
		US-			
		US-			
		US-			
		US-			
		US-			
		US-			

FOREIGN PATENT DOCUMENTS						
Examiner Initials*	Cite No. ¹	Foreign Patent Document	Publication Date MM-DD-YYYY	Name of Patentee or Applicant of Cited Document	Pages, Columns, Lines, Where Relevant Passages or Relevant Figures Appear	T ⁶
		Country Code ³ - Number ⁴ - Kind Code ⁵ (if known)				
	1.	WO 9520787	8/3/1995	Exos, Inc.		
	2.	WO 97/18546A1	5/22/1997	Cirque Corp.		

NON PATENT LITERATURE DOCUMENTS			
Examiner Initials *	Cite No. ¹	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, page(s), volume-issue number(s), publisher, city and/or country where published.	T ²

Examiner Signature	/Ricardo Osorio/	Date Considered	03/01/2009
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*EXAMINER: Initial if reference considered, whether or not citation is in conformance with MPEP 609. Draw line through citation if not in conformance and not considered. Include copy of this form with next communication to applicant. ¹ Applicant's unique citation designation number (optional). ² See Kinds Codes of USPTO Patent Documents at www.uspto.gov or MPEP 901.04. ³ Enter Office that issued the document, by the two-letter code (WIPO Standard ST.3). ⁴ For Japanese patent documents, the indication of the year of the reign of the Emperor must precede the serial number of the patent document. ⁵ Kind of document by the appropriate symbols as indicated on the document under WIPO Standard ST. 16 if possible. ⁶ Applicant is to place a check mark here if English language Translation is attached.

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ALL REFERENCES CONSIDERED EXCEPT WHERE LINED THROUGH. /R.O./


UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
 Address: COMMISSIONER FOR PATENTS
 P.O. Box 1450
 Alexandria, Virginia 22313-1450
 www.uspto.gov

BIB DATA SHEET
CONFIRMATION NO. 8743

SERIAL NUMBER	FILING or 371(c) DATE RULE	CLASS	GROUP ART UNIT	ATTORNEY DOCKET NO. IMM147.C1		
11/693,117	03/29/2007	330	2629			
APPLICANTS Kenneth M. Martin, Los Gatos, CA; Steven P. Vassallo, Redwood City, CA; Alex S. Goldenberg, Portola Valley, CA; Alexander Jasso, Los Altos, CA; Kollin Tierling, Milpitas, CA;						
** CONTINUING DATA ***** This application is a CON of 10/285,450 11/01/2002 PAT 7,336,260 which claims benefit of 60/335,493 11/01/2001 and claims benefit of 60/399,883 07/31/2002						
** FOREIGN APPLICATIONS *****						
** IF REQUIRED, FOREIGN FILING LICENSE GRANTED ** 04/16/2007						
Foreign Priority claimed 35 USC 119(a-d) conditions met Verified and Acknowledged	<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No /RICARDO OSORIO/ Examiner's Signature	<input type="checkbox"/> Met after Allowance Initials	STATE OR COUNTRY CA	SHEETS DRAWINGS 11	TOTAL CLAIMS 25	INDEPENDENT CLAIMS 3
ADDRESS PATENT DEPARTMENT (51851) KILPATRICK STOCKTON LLP 1001 WEST FOURTH STREET WINSTON-SALEM, NC 27101 UNITED STATES						
TITLE Method and Apparatus for Providing Tactile Sensations						
FILING FEE RECEIVED 2570	FEES: Authority has been given in Paper No. _____ to charge/credit DEPOSIT ACCOUNT No. _____ for following:		<input type="checkbox"/> All Fees <input type="checkbox"/> 1.16 Fees (Filing) <input type="checkbox"/> 1.17 Fees (Processing Ext. of time) <input type="checkbox"/> 1.18 Fees (Issue) <input type="checkbox"/> Other _____ <input type="checkbox"/> Credit			

Index of Claims 	Application/Control No. 11693117	Applicant(s)/Patent Under Reexamination MARTIN ET AL.
	Examiner RICARDO L OSORIO	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	03/01/2009							
	1	✓							
	2	✓							
	3	✓							
	4	✓							
	5	✓							
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	31	✓							
	32	✓							
	33	✓							
	34	✓							
	35	✓							
	36	✓							

Index of Claims 	Application/Control No. 11693117	Applicant(s)/Patent Under Reexamination MARTIN ET AL.
	Examiner RICARDO L OSORIO	Art Unit 2629

✓	Rejected
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-	Cancelled
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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	03/01/2009							
	37	✓							
	38	✓							
	39	✓							
	40	✓							
	41	✓							
	42	✓							
	43	✓							

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Application of : Kenneth M. Martin et al
Application No. : 11/693,117
For : **Method and Apparatus for Providing Tactile Sensations**
Filed : March 29, 2007
Examiner : Ricardo Osorio
Art Unit : 2629

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

RESPONSE TO NON-FINAL OFFICE ACTION

Sir:

The following Remarks are submitted in response to the Office Action mailed March 5, 2009.

Remarks begin on page 2 of this paper.

REMARKS

This paper is filed in response to the Office Action mailed March 5, 2009.

Claims 1-43 are pending in this application. Claims 1-43 were rejected under the judicially-created doctrine of obviousness-type double patenting over U.S. Patent No. 7,336,260 to Martin et al ("Martin").

Applicant submits herewith a Terminal Disclaimer over Martin together with the fee due under 37 C.F.R. § 1.20(d). In view of the Terminal Disclaimer, Applicant respectfully requests the Examiner withdraw the rejection of claims 1-43.

CONCLUSION


Applicant respectfully asserts that in view of the remarks above, all pending claims are allowable and Applicant respectfully requests the allowance of all claims.

Should the Examiner have any comments, questions, or suggestions of a nature necessary to expedite the prosecution of the application, or to place the case in condition for allowance, the Examiner is courteously requested to telephone the undersigned at the number listed below.

Date: 3/25/2009

KILPATRICK STOCKTON LLP
1001 West Fourth Street
Winston-Salem, NC 27101
(336) 607-7474 (voice)
(336) 734-2629 (fax)

Respectfully submitted,


Carl Sanders
Reg. No. 57,203

**TERMINAL DISCLAIMER TO OBVIATE A DOUBLE PATENTING
REJECTION OVER A "PRIOR" PATENT**Docket Number (Optional)
IMM147.C1

In re Application of: Kenneth M. Martin

Application No.: 11/693,117

Filed: March 29, 2007

For: Method and Apparatus for Providing Tactile Sensations

The owner*, Immersion Corporation, of 100 percent interest in the instant application hereby disclaims, except as provided below, the terminal part of the statutory term of any patent granted on the instant application which would extend beyond the expiration date of the full statutory term **prior patent** No. 7,336,260 as the term of said prior patent is defined in 35 U.S.C. 154 and 173, and as the term of said **prior patent** is presently shortened by any terminal disclaimer. The owner hereby agrees that any patent so granted on the instant application shall be enforceable only for and during such period that it and the **prior patent** are commonly owned. This agreement runs with any patent granted on the instant application and is binding upon the grantee, its successors or assigns.

In making the above disclaimer, the owner does not disclaim the terminal part of the term of any patent granted on the instant application that would extend to the expiration date of the full statutory term as defined in 35 U.S.C. 154 and 173 of the **prior patent**, "as the term of said **prior patent** is presently shortened by any terminal disclaimer," in the event that said **prior patent** later:

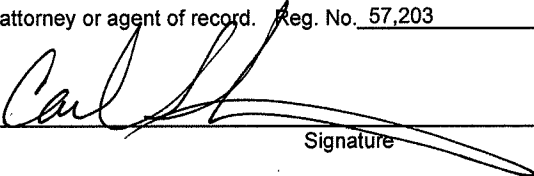
- expires for failure to pay a maintenance fee;
- is held unenforceable;
- is found invalid by a court of competent jurisdiction;
- is statutorily disclaimed in whole or terminally disclaimed under 37 CFR 1.321;
- has all claims canceled by a reexamination certificate;
- is reissued; or
- is in any manner terminated prior to the expiration of its full statutory term as presently shortened by any terminal disclaimer.

Check either box 1 or 2 below, if appropriate.

1. For submissions on behalf of a business/organization (e.g., corporation, partnership, university, government agency, etc.), the undersigned is empowered to act on behalf of the business/organization.

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.

2. The undersigned is an attorney or agent of record. Reg. No. 57,203



Signature

3/25/2009

Date

Carl Sanders

Typed or printed name

(336) 607-7300

Telephone Number

- Terminal disclaimer fee under 37 CFR 1.20(d) included.

WARNING: Information on this form may become public. Credit card information should not be included on this form. Provide credit card information and authorization on PTO-2038.

*Statement under 37 CFR 3.73(b) is required if terminal disclaimer is signed by the assignee (owner).
Form PTO/SB/96 may be used for making this certification. See MPEP § 324.

This collection of information is required by 37 CFR 1.321. 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. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. SEND TO: Commissioner for Patents, 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.

Electronic Patent Application Fee Transmittal

Application Number:	11693117
Filing Date:	29-Mar-2007
Title of Invention:	Method and Apparatus for Providing Tactile Sensations
First Named Inventor/Applicant Name:	Kenneth M. Martin
Filer:	Carl E. Sanders/Laura Smith
Attorney Docket Number:	IMM147.C1

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:				
Statutory disclaimer	1814	1	140	140
Total in USD (\$)				140

Electronic Acknowledgement Receipt

EFS ID:	5030086
Application Number:	11693117
International Application Number:	
Confirmation Number:	8743
Title of Invention:	Method and Apparatus for Providing Tactile Sensations
First Named Inventor/Applicant Name:	Kenneth M. Martin
Customer Number:	34300
Filer:	Carl E. Sanders/Laura Smith
Filer Authorized By:	Carl E. Sanders
Attorney Docket Number:	IMM147.C1
Receipt Date:	25-MAR-2009
Filing Date:	29-MAR-2007
Time Stamp:	11:11:29
Application Type:	Utility under 35 USC 111(a)

Payment information:

Submitted with Payment	yes
Payment Type	Credit Card
Payment was successfully received in RAM	\$140
RAM confirmation Number	6178
Deposit Account	
Authorized User	

File Listing:

Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part / zip (if appl.)	Pages (if appl.)
				APPLE INC.	

1	Miscellaneous Incoming Letter	Transmittal342043.pdf	35729 5c5669a50f3b11b1b45461e42aee4f3e7c1f65c6	no	1
Warnings:					
Information:					
2	Amendment Copy Claims/Response to Suggested Claims	Response342043.pdf	54642 223723f0817baa4dcb99c2f109d23c465f2a885e	no	2
Warnings:					
Information:					
3	Terminal Disclaimer Filed	TerminalDisclaimer342043.pdf	87217 423d0a407e55a30b6f2a00d7f4577ba6c10c15c	no	1
Warnings:					
Information:					
4	Fee Worksheet (PTO-06)	fee-info.pdf	29659 2f095297f3736a8be7fbd8ae8455f3f10fc477f7	no	2
Warnings:					
Information:					
Total Files Size (in bytes):			207247		

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.

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Application of : Kenneth M. Martin et al.
Application No. : 11/693,117
Filed : March 29, 2007
For : METHOD AND APPARATUS FOR PROVIDING
TACTILE SENSATIONS
Examiner : Ricardo Osorio
Art Unit : 2629

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

TRANSMITTAL

Sir:

Transmitted herewith is a copy of the following document for filing in the above-identified application:

Transmittal;
Terminal Disclaimer;
Response to Non-Final Office Action; and
EFS Web Payment in the amount of \$140.00

The Commissioner is hereby authorized to charge any deficiency to Deposit Account Number 16-1435.

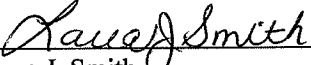
Respectfully submitted,

Date: 3/25/2009
KILPATRICK STOCKTON LLP
1001 West Fourth Street
Winston-Salem, NC 27101-2400
Telephone: (336) 607-7474
Fax: (336) 734-2629


By: 
Carl Sanders (Reg. No. 57,203)

Certificate of Electronic Filing

I hereby certify that this correspondence is being electronically filed with The United States Patent Office via EFS-Web, on March 25, 2009.



Laura J. Smith

Application Number 	Application/Control No. 11/693,117	Applicant(s)/Patent under Reexamination MARTIN ET AL.	

Document Code - DISQ	Internal Document – DO NOT MAIL
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TERMINAL DISCLAIMER	<input checked="" type="checkbox"/> APPROVED	<input type="checkbox"/> DISAPPROVED
Date Filed : 3/25/09	This patent is subject to a Terminal Disclaimer	

Approved/Disapproved by:
BRIAN

U.S. Patent and Trademark Office



UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
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Alexandria, Virginia 22313-1450
www.uspto.gov

Table with 5 columns: APPLICATION NO., FILING DATE, FIRST NAMED INVENTOR, ATTORNEY DOCKET NO., CONFIRMATION NO.
11/693,117 03/29/2007 Kenneth M. Martin IMM147.C1 8743

34300 7590 06/24/2009
PATENT DEPARTMENT (51851)
KILPATRICK STOCKTON LLP
1001 WEST FOURTH STREET
WINSTON-SALEM, NC 27101

EXAMINER

OSORIO, RICARDO

ART UNIT PAPER NUMBER

2629

MAIL DATE DELIVERY MODE

06/24/2009

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. 11/693,117	Applicant(s) MARTIN ET AL.	
Examiner RICARDO L. OSORIO	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 1 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 25 March 2009.
- 2a) This action is **FINAL**.
- 2b) This action is non-final.
- 3) 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

- 4) Claim(s) 1-43 is/are pending in the application.
4a) Of the above claim(s) _____ is/are withdrawn from consideration.
- 5) Claim(s) _____ is/are allowed.
- 6) Claim(s) _____ is/are rejected.
- 7) Claim(s) _____ is/are objected to.
- 8) Claim(s) 1-43 are subject to restriction and/or election requirement.

Application Papers

- 9) The specification is objected to by the Examiner.
- 10) 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).
- 11) 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

- 12) 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 _____.
- 4) Interview Summary (PTO-413)
Paper No(s)/Mail Date. _____.
- 5) Notice of Informal Patent Application
- 6) Other: _____.

DETAILED ACTION

Election/Restrictions

1. This application contains claims directed to the following patentably distinct species Fig. 1 is directed to species 1; Fig. 2 is directed to species 2; Figs. 3 and 4 are directed to species 3; Figs. 5 and 6 are directed to species 4; and Fig. 11 is directed to species 5. The species are independent or distinct because claims to the different species recite the mutually exclusive characteristics of such species. In addition, these species are not obvious variants of each other based on the current record.

Applicant is required under 35 U.S.C. 121 to elect a single disclosed species for prosecution on the merits to which the claims shall be restricted if no generic claim is finally held to be allowable. Currently, independent claims 1, 10, 18, 26 and 35 are generic of their respective dependent claims.

There is an examination and search burden for these patentably distinct species due to their mutually exclusive characteristics. The species require a different field of search (e.g., searching different classes/subclasses or electronic resources, or employing different search queries); and/or the prior art applicable to one species would not likely be applicable to another species; and/or the species are likely to raise different non-prior art issues under 35 U.S.C. 101 and/or 35 U.S.C. 112, first paragraph.

Applicant is advised that the reply to this requirement to be complete must include (i) an election of a species to be examined even though the requirement may be traversed (37 CFR 1.143) and (ii) identification of the claims encompassing the elected species, including

Art Unit: 2629

any claims subsequently added. An argument that a claim is allowable or that all claims are generic is considered nonresponsive unless accompanied by an election.

The election of the species may be made with or without traverse. To preserve a right to petition, the election must be made with traverse. If the reply does not distinctly and specifically point out supposed errors in the election of species requirement, the election shall be treated as an election without traverse. Traversal must be presented at the time of election in order to be considered timely. Failure to timely traverse the requirement will result in the loss of right to petition under 37 CFR 1.144. If claims are added after the election, applicant must indicate which of these claims are readable on the elected species.

Should applicant traverse on the ground that the species are not patentably distinct, applicant should submit evidence or identify such evidence now of record showing the species to be obvious variants or clearly admit on the record that this is the case. In either instance, if the examiner finds one of the species unpatentable over the prior art, the evidence or admission may be used in a rejection under 35 U.S.C. 103(a) of the other species.

Upon the allowance of a generic claim, applicant will be entitled to consideration of claims to additional species which depend from or otherwise require all the limitations of an allowable generic claim as provided by 37 CFR 1.141.

2. Applicant is reminded that upon the cancellation of claims to a non-elected invention, the inventorship must be amended in compliance with 37 CFR 1.48(b) if one or more of the currently named inventors is no longer an inventor of at least one claim remaining in the application. Any amendment of inventorship must be accompanied by a request under 37 CFR 1.48(b) and by the fee required under 37 CFR 1.17(i).

Art Unit: 2629

3. Any inquiry concerning this communication or earlier communications from the examiner should be directed to RICARDO L. OSORIO whose telephone number is (571) 272-7676. The examiner can normally be reached on MONDAY-THURSDAY 7:00 am-5:30 PM.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, AMARE MENGISTU can be reached on (571) 272-7674. 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.

/RICARDO L OSORIO/
Primary Examiner, Art Unit 2629

Index of Claims 	Application/Control No. 11693117	Applicant(s)/Patent Under Reexamination MARTIN ET AL.
	Examiner RICARDO L OSORIO	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	03/01/2009	06/21/2009						
	1	✓	÷						
	2	✓	÷						
	3	✓	÷						
	4	✓	÷						
	5	✓	÷						
	6	✓	÷						
	7	✓	÷						
	8	✓	÷						
	9	✓	÷						
	10	✓	÷						
	11	✓	÷						
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	32	✓	÷						
	33	✓	÷						
	34	✓	÷						
	35	✓	÷						
	36	✓	÷						

Index of Claims 	Application/Control No. 11693117	Applicant(s)/Patent Under Reexamination MARTIN ET AL.
	Examiner RICARDO L OSORIO	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	03/01/2009	06/21/2009						
	37	✓	÷						
	38	✓	÷						
	39	✓	÷						
	40	✓	÷						
	41	✓	÷						
	42	✓	÷						
	43	✓	÷						

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.

Substitute for form 1449A/PTO

**INFORMATION DISCLOSURE
STATEMENT BY APPLICANT**

(Use as many sheets as necessary)

Sheet 1 of 1

Complete if Known

Application Number	11/693,117
Filing Date	March 29, 2007
First Named Inventor	Martin
Art Unit	2629
Examiner Name	Ricardo Osorio
Attorney Docket Number	IMM147C

U.S. PATENT DOCUMENTS

Examiner Initials *	Cite No. ¹	Document Number	Publication Date MM-DD-YYYY	Name of Patentee or Applicant of Cited Document	Pages, Columns, Lines, Where Relevant Passages or Relevant Figures Appear
		Number - Kind Code ² (if known)			
		US-			
		US-			
		US-			
		US-			
		US-			
		US-			
		US-			
		US-			

FOREIGN PATENT DOCUMENTS

Examiner Initials *	Cite No. ¹	Foreign Patent Document	Publication Date MM-DD-YYYY	Name of Patentee or Applicant of Cited Document	Pages, Columns, Lines, Where Relevant Passages or Relevant Figures Appear	T ⁶
		Country Code ³ - Number ⁴ - Kind Code ⁵ (if known)				
	1.	KR 2001-0028369	04-06-2001	Sim Jae Boong		

NON PATENT LITERATURE DOCUMENTS

Examiner Initials *	Cite No. ¹	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, page(s), volume-issue number(s), publisher, city and/or country where published.	T ²
	2.	KIPO Notice of Preliminary Rejection, Korean Patent Application No. 10-2004-7006627, mailed April 16, 2009.	

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 citation if not in conformance and not considered. Include copy of this form with next communication to applicant. ¹ Applicant's unique citation designation number (optional). ² See Kinds Codes of USPTO Patent Documents at www.uspto.gov or MPEP 901.04. ³ Enter Office that issued the document, by the two-letter code (WIPO Standard ST.3). ⁴ For Japanese patent documents, the indication of the year of the reign of the Emperor must precede the serial number of the patent document. ⁵ Kind of document by the appropriate symbols as indicated on the document under WIPO Standard ST. 16 if possible. ⁶ Applicant is to place a check mark here if English language Translation is attached.

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 2 hours 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.

If you need assistance in completing the form, call 1-800-PTO-9199 and select option 2.

MOUSE IN COMPUTER

Publication number: KR20010028369 (A)
Publication date: 2001-04-08
Inventor(s): SIM JAE BOONG [KR]
Applicant(s): SIM JAE BOONG [KR]
Classification:
- International: G06F3/033; G06F3/033; (IPC1-7): G06F3/033
- European:
Application number: KR19990040575 19990921
Priority number(s): KR19990040575 19990921

Abstract of KR 20010028369 (A)

PURPOSE: A mouse in a computer is provided to create an effect on various programs by transmitting information on a pressed depth of an input button of a mouse and a force applied to the input button to a computer system. **CONSTITUTION:** A button unit(210) transmits one or more input buttons and a condition of input buttons to a button depth sensing unit(231). A position movement sensing unit(220) is used for inputting information on a movement of a cursor. The position movement sensing unit(220) transmits a signal which indicates a depth of an input button sensed by the button depth sensing unit (231) to a signal output unit(240).; Depth information signal and force information signal respectively sensed by the button depth sensing unit(231) and the button force sensing unit(232) are transmitted to a computer system(110) with a cursor position movement signal sensed by the position movement sensing unit(220) through the signal output unit(240).

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Electronic Acknowledgement Receipt

EFS ID:	5649181
Application Number:	11693117
International Application Number:	
Confirmation Number:	8743
Title of Invention:	Method and Apparatus for Providing Tactile Sensations
First Named Inventor/Applicant Name:	Kenneth M. Martin
Customer Number:	34300
Filer:	Carl E. Sanders/Amber Johnson
Filer Authorized By:	Carl E. Sanders
Attorney Docket Number:	IMM147.C1
Receipt Date:	06-JUL-2009
Filing Date:	29-MAR-2007
Time Stamp:	17:17:33
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	Miscellaneous Incoming Letter	Transmittal.pdf	37018 <small>39ad1552d34d5d0e938c8c35aab73181a4c53636</small>	no	1

Warnings:

Information:

APPLE INC.

2	Transmittal Letter	Certification.pdf	26876 1de2dfa048ce4c2c3b0797cb0b57f66ca6f0e258	no	1
Warnings:					
Information:					
3	Information Disclosure Statement (IDS) Filed (SB/08)	08a.pdf	87783 ad8512c593ab10482005036834762418b6caad46	no	1
Warnings:					
Information:					
This is not an USPTO supplied IDS fillable form					
4	Foreign Reference	KR20070028369.pdf	44495 a8ea6950be6d456bfe1c4bca0554c6eb7c0ebf58	no	1
Warnings:					
Information:					
5	NPL Documents	KROA.pdf	1010620 5daac2bd9c85da73c1268c294d347ea717984d2e	no	18
Warnings:					
Information:					
Total Files Size (in bytes):			1206792		
<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>					

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Application of : Martin et al.
Application No. : 11/693,117
Filed : March 29, 2007
For : **Method and Apparatus for Providing Tactile Sensations**
Examiner : Ricardo Osorio
Art Unit : 2629
Confirmation No. : 8743

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

TRANSMITTAL

Sir:

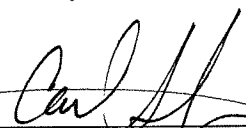
Transmitted herewith are copies of the following documents for filing in the above-identified application:

Information Disclosure Statement Letter;
Form PTO/SB/08a;
Foreign Patent Document; and
Non Patent Literature Document.

The Commissioner is hereby authorized to charge any deficiency to Deposit Account Number 16-1435.


Respectfully submitted,

Date: July 6, 2009
KILPATRICK STOCKTON LLP
1001 West Fourth Street
Winston-Salem, NC 27101-2400
(336) 607-7300

By: 
Carl Sanders (Reg. No. 57,203)

Certificate of Electronic Filing

I hereby certify that this correspondence is being electronically filed with The United States Patent Office via EFS-Web, on 7-6-09.


Amber C. Johnson

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

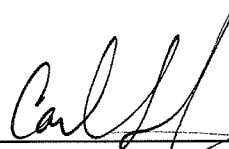
In re Application of	:	Martin et al.
Serial No.	:	11/693,117
For	:	Method and Apparatus for Providing Tactile Sensations
Filed	:	March 29, 2007
Examiner	:	Ricardo Osorio
Art Group	:	2817

Information Disclosure Statement Letter

This Information Disclosure Statement is being submitted prior to the mailing date of a first Office Action in this application. Accordingly, no fee is believed to be required. However, should any fees be due, the Commissioner is authorized to charge such fees to Deposit Account No. 16-1435.

Respectfully submitted,

Date: 7/6/2009



Carl Sanders (Reg. No. 57,203)

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Application of : Kenneth M. Martin
Application No. : 11/693,117
For : **Method and Apparatus for Providing Tactile Sensations**
Filed : March 29, 2007
Examiner : Ricardo Osorio
Art Unit : 2629

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

AMENDMENT AND RESPONSE TO ELECTION OF SPECIES REQUIREMENT

Sir:

The following Amendment and Remarks are submitted in response to the Office
Action mailed June 24, 2009.

Amendments to the Claims begin on page 2 of this paper.

Remarks begin on page 12 of this paper.

AMENDMENTS TO THE CLAIMS

1. (Previously Presented) A method, comprising:
 - outputting a display signal configured to display a graphical object on a touch-sensitive input device;
 - receiving a sensor signal from the touch-sensitive input device, the sensor signal indicating an object contacting the touch-sensitive input device;
 - determining an interaction between the object contacting the touch-sensitive input device and the graphical object;
 - generating an actuator signal based at least in part on the interaction; and
 - outputting the actuator signal.
2. (Original) The method of claim 1 wherein, the actuator signal is configured to cause a haptic effect to be output.
3. (Original) The method of claim 1, wherein the actuator signal is generated when the object contacts the touch-sensitive device at a location corresponding to the graphical object.
4. (Original) The method of claim 1, wherein the actuator signal is generated when the object contacts the touch-sensitive device at a location not corresponding to the graphical object.

5. (Original) The method of claim 1, wherein the display signal is configured to display a keypad comprising a plurality of softkeys.
6. (Original) The method of claim 5, wherein the haptic effect is caused to be output when a user contacts the touch-sensitive device at a location corresponding to a softkey in a home position.
7. (Original) The method of claim 5, wherein the plurality of softkeys comprises one softkey for each digit from 0 to 9.
8. (Original) The method of claim 5, wherein the plurality of softkeys comprises the key configuration of a standard 101-key keyboard.
9. (Original) The method of claim 1, wherein the graphical object comprises a first graphical object and a second graphical object, the haptic effect comprises a first haptic effect and a second haptic effect, and wherein the first haptic effect is configured to be output when the object contacts the first graphical object, and the second haptic effect is configured to be output when the object contacts the second graphical object.
10. (Original) A system, comprising:
a touch sensitive input device configured to output a sensor signal indicating an object contacting the touch-sensitive input device;

an actuator coupled to the touch-sensitive input device, the actuator configured to receive an actuator signal and output a haptic effect to the touch-sensitive surface based at least in part on the actuator signal; and

a processor in communication with the sensor and the actuator, the processor configured to:

output a display signal configured to display a graphical object on the touch-sensitive input device;

receive the sensor signal from the touch-sensitive input device;

determine an interaction between the object contacting the touch-sensitive surface and the graphical object,

generate the actuator signal based at least in part on the interaction; and

transmit the actuator signal to the actuator.

11. (Original) The system of claim 10, wherein the processor is configured to generate the actuator signal when the object contacts the touch-sensitive input device at a location corresponding to the graphical object.

12. (Original) The system of claim 10, wherein the processor is configured to output the actuator signal when the object contacts the touch-sensitive device at a location not corresponding to the graphical object.

13. (Original) The system of claim 10, wherein the display signal is configured to display a keypad comprising a plurality of softkeys.

14. (Original) The system of claim 13, wherein the haptic effect is caused to be output when a user contacts the touch-sensitive device at a location corresponding to a softkey in a home position.
15. (Original) The method of claim 13, wherein the plurality of softkeys comprises one softkey for each digit from 0 to 9.
16. (Original) The method of claim 13, wherein the plurality of softkeys comprises the key configuration of a standard 101-key keyboard.
17. (Original) The method of claim 10, wherein the graphical object comprises a first graphical object and a second graphical object, the haptic effect comprises a first haptic effect and a second haptic effect, and wherein the first haptic effect is configured to be output when the object contacts the first graphical object, and the second haptic effect is configured to be output when the object contacts the second graphical object.
18. (Previously Presented) A computer-readable medium comprising program code, comprising:
- program code for outputting a display signal configured to display a graphical object on a touch-sensitive input device;
 - program code for receiving a sensor signal from the touch-sensitive input device, the sensor signal indicating an object contacting the touch-sensitive input device;
 - program code for determining an interaction between the object contacting the touch-sensitive input device and the graphical object;

program code for generating an actuator signal based at least in part on the interaction, the actuator signal configured to cause a haptic effect to be output; and program code for outputting the actuator signal.

19. (Original) The computer-readable medium of claim 18, wherein the actuator signal is generated when the object contacts the touch-sensitive device at a location corresponding to the graphical object.

20. (Original) The computer-readable medium of claim 18, wherein the actuator signal is generated when the object contacts the touch-sensitive device at a location not corresponding to the graphical object.

21. (Original) The computer-readable medium of claim 18, wherein the display signal is configured to display a keypad comprising a plurality of softkeys.

22. (Original) The computer-readable medium of claim 21, wherein the haptic effect is caused to be output when a user contacts the touch-sensitive device at a location corresponding to a softkey in a home position.

23. (Original) The computer-readable medium of claim 21, wherein the plurality of softkeys comprises one softkey for each digit from 0 to 9.

24. (Original) The computer-readable medium of claim 21, wherein the plurality of softkeys comprises the key configuration of a standard 101-key keyboard.

25. (Currently Amended) The computer-readable medium of claim 21, wherein the graphical object comprises a first graphical object and a second graphical object, the haptic effect comprises a first haptic effect and a second haptic effect, and wherein the first haptic effect is configured to be output when the object contacts the first graphical object, and the second haptic effect is configured to be output when the object contacts the second graphical object.

26. (Withdrawn) An apparatus comprising:

at least one input device comprising a first position and a second position, the input device moveable to the first position upon application of a first pressure to the input device, and moveable to the second position upon application of a second pressure to the input device, the second pressure greater than the first pressure;

at least one actuator in communication with the input device, the actuator configured to output tactile sensations to the apparatus; and

at least one processor in communication with the input device, the processor configured to:

receive a first input signal from the input device, the first input signal associated with the first position,

receive a second input signal from the input device, the second input signal associated with the second position,

transmit a first actuator signal to the actuator, the first actuator signal configured to cause the actuator to output a first tactile sensation associated with the first position, and

transmit a second actuator signal to the actuator, the second actuator signal configured to cause the actuator to output a second tactile sensation associated with the second position.

27. (Withdrawn) The apparatus of claim 26, wherein the input device comprises at least one of an analog switch, a force sensing resistor, a strain gauge based sensor, a capacitive touch switch, or a touchpad.

28. (Withdrawn) The apparatus of claim 26, wherein the at least one input device comprises a plurality of input devices, and the at least one actuator comprising a plurality of actuators, each actuator coupled to a distinct input device.

29. (Withdrawn) The apparatus of claim 26, wherein the actuator comprises at least one of a piezo-electric actuator, a voice coil, a moving magnet actuator, or a flexure coupled to a motor.

30. (Previously Presented) The apparatus of claim 26, wherein the input device comprises a pressure-sensitive touchpad, and the apparatus further comprises:

a display panel in communication with the pressure-sensitive touchpad, the display panel configured to receive the tactile sensations from the pressure-sensitive touchpad; and

at least one software-generated button configured to be displayed on the display panel.

31. (Previously Presented) The apparatus of claim 30, wherein the touchpad comprises a pressure calculator to measure the distinct amount of pressure.
32. (Previously Presented) The apparatus of claim 30, further comprising:
an interface object configured to be used to contact a location on the display panel corresponding to the at least one software-generated button; and
a pressure calculator to calculate an amount of pressure based upon an amount of area of the interface object in contact with the display panel.
33. (Previously Presented) The apparatus of claim 32, wherein the interface object comprises a stylus.
34. (Previously Presented) The apparatus of claim 26, the apparatus comprising at least one of a mobile telephone, a personal computer, or a hand-held computing device.
35. (Withdrawn) An apparatus comprising:
an input device configured to communicate an input signal indicating a position of the input device to an electronic device, the input device configured to move between multiple positions;
at least one actuator in communication with the input device, the actuator configured to output a plurality of tactile sensations to the input device; and
at least one processor in communication with the input device and the actuator, the processor configured to:
receive the input signal,

detect the position of the input device,

to generate an actuator signal configured to cause the actuator to output one of the plurality of tactile sensations based at least on the position of the input device.

36. (Withdrawn) The apparatus of claim 35, wherein the actuator is configured to vary the magnitude of the produced tactile sensation in accordance with the detected position of the input device.

37. (Withdrawn) The apparatus of claim 35, the input device associated with the selection of at least one function of the apparatus, and the actuator further produces a function failure notification tactile sensation upon receipt of the input signal associated with the function and notification of failure of that function.

38. (Withdrawn) The apparatus of claim 35, further comprising a plurality of input devices, each input device capable of communicating a unique input signal to the electronic device and moving between multiple positions.

39. (Withdrawn) A mobile phone comprising the apparatus of claim 38.

40. (Withdrawn) The mobile phone of claim 39, comprising a keypad comprising the plurality of input devices.

41. (Withdrawn) The mobile phone of claim 39, wherein the at least one actuator comprising a plurality of actuators, each actuator coupled to a separate input device.

42. (Withdrawn) The mobile phone of claim 39, comprising a plurality of keys associated, each of the plurality of keys configured to activate a predetermined mobile phone function, and wherein the actuator is configured to produce the tactile sensation associated with each mobile phone function upon receipt of the associated input signal.

43. (Withdrawn) The mobile phone of claim 42, wherein the actuator is configured to produce a function failure notification tactile sensation upon receipt of a function input signal and a notification of failure of that function.

REMARKS

This paper is filed in response to the Office Action mailed June 24, 2009.

Claims 1-43 are pending in this application. Claims 26-29 and 35-43 have been withdrawn as being directed to unelected species. Applicant amended claim 25 to correctly depend from claim 21 rather than claim 1.

In the Office Action, the Examiner identified 5 species and required the Applicant to elect one species for prosecution. The Examiner further indicated that each independent claim was generic for its respective dependent claims. The Examiner identified the following 5 species:

- Species 1: The embodiment depicted in Figure 1.
- Species 2: The embodiment depicted in Figure 2.
- Species 3: The embodiments depicted in Figures 3 and 4.
- Species 4: The embodiments depicted in Figures 5 and 6.
- Species 5: The embodiment depicted in Figure 11.

In view of the foregoing identified species, Applicant hereby elects Species 4 corresponding to claims 1-25 and 30-34 for further prosecution on the merits.

Applicant traverses the election of species requirement on the basis that it would not be unduly burdensome on the Examiner to examine all species because the Examiner has already formulated search strategies for all claims and performed prior art searches for all claims, as indicated in the prosecution history. During a conversation with the undersigned on July 24, 2009, the Examiner indicated that it was necessary to refresh his search results after receiving Applicant's response to the previous Office Action. However, because the search strategies have already been formulated and because no claims have been substantively amended, the burden on the Examiner to refresh his search does not appear to be unreasonable.

In view of the foregoing, Applicant respectfully requests the Examiner withdraw the election of species requirement and substantively examine each of claim 1-43.

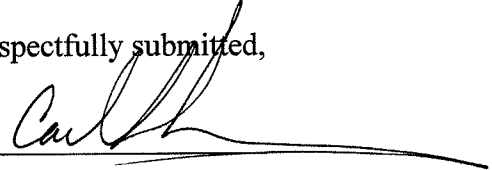
CONCLUSION

Applicant respectfully asserts that all pending claims are allowable and Applicant respectfully requests the allowance of all claims.

Should the Examiner have any comments, questions, or suggestions of a nature necessary to expedite the prosecution of the application, or to place the case in condition for allowance, the Examiner is courteously requested to telephone the undersigned at the number listed below.

Date: August 24, 2009

Respectfully submitted,



Carl Sanders
Reg. No. 57,203

KILPATRICK STOCKTON LLP
1001 West Fourth Street
Winston-Salem, NC 27101
(336) 607-7474 (voice)
(336) 734-2629 (fax)

Electronic Patent Application Fee Transmittal

Application Number:	11693117
Filing Date:	29-Mar-2007
Title of Invention:	Method and Apparatus for Providing Tactile Sensations
First Named Inventor/Applicant Name:	Kenneth M. Martin
Filer:	Carl E. Sanders/Laura Smith
Attorney Docket Number:	IMM147.C1

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:				
Extension - 1 month with \$0 paid	1251	1	130	APPLE INC.30

Description	Fee Code	Quantity	Amount	Sub-Total in USD(\$)
Miscellaneous:				
Total in USD (\$)				130

Electronic Acknowledgement Receipt

EFS ID:	5939028
Application Number:	11693117
International Application Number:	
Confirmation Number:	8743
Title of Invention:	Method and Apparatus for Providing Tactile Sensations
First Named Inventor/Applicant Name:	Kenneth M. Martin
Customer Number:	34300
Filer:	Carl E. Sanders/Laura Smith
Filer Authorized By:	Carl E. Sanders
Attorney Docket Number:	IMM147.C1
Receipt Date:	24-AUG-2009
Filing Date:	29-MAR-2007
Time Stamp:	13:54:41
Application Type:	Utility under 35 USC 111(a)

Payment information:

Submitted with Payment	yes
Payment Type	Credit Card
Payment was successfully received in RAM	\$130
RAM confirmation Number	151
Deposit Account	
Authorized User	

File Listing:

Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part / zip <small>APPLE INC.</small>	Pages (if appl.)
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1	Miscellaneous Incoming Letter	Transmittal342043.pdf	47158 3b34b8276cb1737731f5c4c20f8b93a35b8ee6b2	no	1
Warnings:					
Information:					
2	Extension of Time	ExtensionofTime342043.pdf	77924 14a8080015731ae493f8fbd6a28fbcacba3ce749	no	1
Warnings:					
Information:					
3	Response to Election / Restriction Filed	Response342043.pdf	431453 e89a45fcbc13a406c73f6c1ec121f15d3a7a881d	no	13
Warnings:					
Information:					
4	Fee Worksheet (PTO-875)	fee-info.pdf	29859 def8b0fa787b24292af453f0955bb8d25ee9160b	no	2
Warnings:					
Information:					
Total Files Size (in bytes):			586394		

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.

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Application of : Kenneth M. Martin et al.
 Application No. : 11/693,117
 Filed : March 29, 2007
 For : METHOD AND APPARATUS FOR PROVIDING
 TACTILE SENSATIONS
 Examiner : Ricardo Osorio
 Art Unit : 2629
 Conf. No. : 8743

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

TRANSMITTAL

Sir:

Transmitted herewith is a copy of the following documents for filing in the above-identified application:

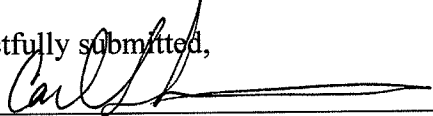
1. Transmittal;
2. Petition for Extension of Time (1 month);
3. Amendment and Response to Election of Species Requirement; and
4. EFS-Web Payment in the amount of \$130.00

Shown below are the fees for the presentation of the amended claims:

	Claims Remaining	Highest # Previously Paid For	Extra	Rate	Fee
TOTAL	43	43	0	\$52	\$ 0
Ind. Cls.	5	5	0	\$220	\$ 0
Multiple Dependent Claim Added.....					NO
TOTAL					\$ 0

The Commissioner is hereby authorized to charge any deficiency to Deposit Account Number 16-1435.

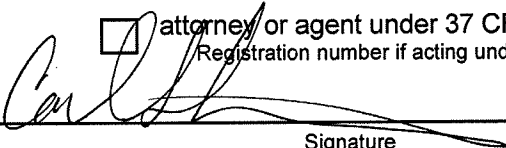
Date: August 24, 2009
 KILPATRICK STOCKTON LLP
 1001 West Fourth Street
 Winston-Salem, NC 27101-2400
 Telephone: (336) 607-7474
 Fax: (336) 734-2629

Respectfully submitted,
 By: 
 Carl Sanders (Reg. No. 57,203)

Certificate of Electronic Filing
 I hereby certify that this correspondence is being electronically filed with The United States Patent Office via EFS-Web, on August 24, 2009.


 Laura J. Smith

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.

PETITION FOR EXTENSION OF TIME UNDER 37 CFR 1.136(a) FY 2009 <i>(Fees pursuant to the Consolidated Appropriations Act, 2005 (H.R. 4818).)</i>		Docket Number (Optional) IMM147.C1 (51851/342043)	
Application Number 11/693,117		Filed March 29, 2007	
For Method And Apparatus For Providing Tactile Sensations			
Art Unit 2629		Examiner Ricardo Osorio	
This is a request under the provisions of 37 CFR 1.136(a) to extend the period for filing a reply in the above identified application.			
The requested extension and fee are as follows (check time period desired and enter the appropriate fee below):			
	<u>Fee</u>	<u>Small Entity Fee</u>	
<input checked="" type="checkbox"/> One month (37 CFR 1.17(a)(1))	\$130	\$65	\$ <u>130.00</u>
<input type="checkbox"/> Two months (37 CFR 1.17(a)(2))	\$490	\$245	\$ _____
<input type="checkbox"/> Three months (37 CFR 1.17(a)(3))	\$1110	\$555	\$ _____
<input type="checkbox"/> Four months (37 CFR 1.17(a)(4))	\$1730	\$865	\$ _____
<input type="checkbox"/> Five months (37 CFR 1.17(a)(5))	\$2350	\$1175	\$ _____
<input type="checkbox"/> Applicant claims small entity status. See 37 CFR 1.27.			
<input type="checkbox"/> A check in the amount of the fee is enclosed.			
<input checked="" type="checkbox"/> Payment by credit card. Form PTO-2038 is attached.			
<input type="checkbox"/> The Director has already been authorized to charge fees in this application to a Deposit Account.			
<input checked="" type="checkbox"/> The Director is hereby authorized to charge any fees which may be required, or credit any overpayment, to Deposit Account Number <u>16-1435</u> .			
WARNING: Information on this form may become public. Credit card information should not be included on this form. Provide credit card information and authorization on PTO-2038.			
I am the <input type="checkbox"/> applicant/inventor.			
<input type="checkbox"/> assignee of record of the entire interest. See 37 CFR 3.71. Statement under 37 CFR 3.73(b) is enclosed (Form PTO/SB/96).			
<input checked="" type="checkbox"/> attorney or agent of record. Registration Number <u>57,203</u>			
<input type="checkbox"/> attorney or agent under 37 CFR 1.34. Registration number if acting under 37 CFR 1.34 _____			
 Signature		<u>August 24, 2009</u> Date	
<u>Carl Sanders</u> Typed or printed name		<u>336/607-7300</u> Telephone Number	
NOTE: Signatures of all the inventors or assignees of record of the entire interest or their representative(s) are required. Submit multiple forms if more than one signature is required, see below.			
<input type="checkbox"/> Total of _____ forms are submitted.			

This collection of information is required by 37 CFR 1.136(a). 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 6 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.**

If you need assistance in completing the form, call 1-800-PTO-9199 and select option 2.

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 11/693,117	Filing Date 03/29/2007	<input type="checkbox"/> To be Mailed
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APPLICATION AS FILED – PART I			OTHER THAN SMALL ENTITY				
FOR	NUMBER FILED (Column 1)	NUMBER EXTRA (Column 2)	RATE (\$)	FEE (\$)		RATE (\$)	FEE (\$)
<input type="checkbox"/> BASIC FEE <small>(37 CFR 1.16(a), (b), or (c))</small>	N/A	N/A	N/A		OR	N/A	
<input type="checkbox"/> SEARCH FEE <small>(37 CFR 1.16(k), (l), or (m))</small>	N/A	N/A	N/A		OR	N/A	
<input type="checkbox"/> EXAMINATION FEE <small>(37 CFR 1.16(o), (p), or (q))</small>	N/A	N/A	N/A		OR	N/A	
TOTAL CLAIMS <small>(37 CFR 1.16(i))</small>	minus 20 =	*	X \$ =		OR	X \$ =	
INDEPENDENT CLAIMS <small>(37 CFR 1.16(h))</small>	minus 3 =	*	X \$ =		OR	X \$ =	
<input type="checkbox"/> APPLICATION SIZE FEE <small>(37 CFR 1.16(s))</small>	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).				OR		
<input type="checkbox"/> MULTIPLE DEPENDENT CLAIM PRESENT <small>(37 CFR 1.16(j))</small>					OR		
			TOTAL		OR	TOTAL	

* If the difference in column 1 is less than zero, enter "0" in column 2.

APPLICATION AS AMENDED – PART II					OTHER THAN SMALL ENTITY				
	(Column 1)	(Column 2)	(Column 3)						
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 \$ =	OR	X \$ =	
	Independent (37 CFR 1.16(h))	*	Minus	***	=	X \$ =	OR	X \$ =	
	<input type="checkbox"/> Application Size Fee (37 CFR 1.16(s))						OR		
<input type="checkbox"/> FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM (37 CFR 1.16(j))						OR			
					TOTAL ADD'L FEE		OR	TOTAL ADD'L FEE	

AMENDMENT	08/24/2009	CLAIMS REMAINING AFTER AMENDMENT	HIGHEST NUMBER PREVIOUSLY PAID FOR	PRESENT EXTRA	RATE (\$)	ADDITIONAL FEE (\$)	OR	RATE (\$)	ADDITIONAL FEE (\$)
	Total (37 CFR 1.16(i))	* 43	Minus	** 43	= 0	X \$ =	OR	X \$52 =	0
	Independent (37 CFR 1.16(h))	* 5	Minus	*** 5	= 0	X \$ =	OR	X \$220 =	0
	<input type="checkbox"/> Application Size Fee (37 CFR 1.16(s))						OR		
<input type="checkbox"/> FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM (37 CFR 1.16(j))						OR			
					TOTAL ADD'L FEE		OR	TOTAL ADD'L FEE	0

* 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".

Legal Instrument Examiner:
 /THERESA LINDSAY/

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.**

If you need assistance in completing the form, call 1-800-PTO-9199 and select option 2.



UNITED STATES PATENT AND TRADEMARK OFFICE

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Table with 5 columns: APPLICATION NO., FILING DATE, FIRST NAMED INVENTOR, ATTORNEY DOCKET NO., CONFIRMATION NO.
11/693,117 03/29/2007 Kenneth M. Martin IMM147.C1 8743

34300 7590 09/16/2009
PATENT DEPARTMENT (51851)
KILPATRICK STOCKTON LLP
1001 WEST FOURTH STREET
WINSTON-SALEM, NC 27101

EXAMINER

OSORIO, RICARDO

ART UNIT PAPER NUMBER

2629

MAIL DATE DELIVERY MODE

09/16/2009

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 Non-Compliant
Amendment (37 CFR 1.121)**

Application No. 11/693,117	Applicant(s) MARTIN ET AL.	
Examiner RICARDO L. OSORIO	Art Unit 2629	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

The amendment document filed on 24 August 2009 is considered non-compliant because it has failed to meet the requirements of 37 CFR 1.121 or 1.4. In order for the amendment document to be compliant, correction of the following item(s) is required.

THE FOLLOWING MARKED (X) ITEM(S) CAUSE THE AMENDMENT DOCUMENT TO BE NON-COMPLIANT:

- 1. Amendments to the specification:
 - A. Amended paragraph(s) do not include markings.
 - B. New paragraph(s) should not be underlined.
 - C. Other _____.
- 2. Abstract:
 - A. Not presented on a separate sheet. 37 CFR 1.72.
 - B. Other _____.
- 3. Amendments to the drawings:
 - A. The drawings are not properly identified in the top margin as "Replacement Sheet," "New Sheet," or "Annotated Sheet" as required by 37 CFR 1.121(d).
 - B. The practice of submitting proposed drawing correction has been eliminated. Replacement drawings showing amended figures, without markings, in compliance with 37 CFR 1.84 are required.
 - C. Other _____.
- 4. Amendments to the claims:
 - A. A complete listing of all of the claims is not present.
 - B. The listing of claims does not include the text of all pending claims (including withdrawn claims)
 - C. Each claim has not been provided with the proper status identifier, and as such, the individual status of each claim cannot be identified. Note: the status of every claim must be indicated after its claim number by using one of the following status identifiers: (Original), (Currently amended), (Canceled), (Previously presented), (New), (Not entered), (Withdrawn) and (Withdrawn-currently amended).
 - D. The claims of this amendment paper have not been presented in ascending numerical order.
 - E. Other: C. Claims 30-33 status identifier shows (Previously Presented). However, they are dependent on claim 26 which has status identifier (Withdrawn).
- 5. Other (e.g., the amendment is unsigned or not signed in accordance with 37 CFR 1.4):

For further explanation of the amendment format required by 37 CFR 1.121, see MPEP § 714.

TIME PERIODS FOR FILING A REPLY TO THIS NOTICE:

1. Applicant is given **no new time period** if the non-compliant amendment is an after-final amendment or an amendment filed after allowance. If applicant wishes to resubmit the non-compliant after-final amendment with corrections, the **entire corrected amendment** must be resubmitted.
2. Applicant is given **one month**, or thirty (30) days, whichever is longer, from the mail date of this notice to supply the correction, if the non-compliant amendment is one of the following: a preliminary amendment, a non-final amendment (including a submission for a request for continued examination (RCE) under 37 CFR 1.114), a supplemental amendment filed within a suspension period under 37 CFR 1.103(a) or (c), and an amendment filed in response to a *Quayle* action. If any of above boxes 1. to 4. are checked, the correction required is only the **corrected section** of the non-compliant amendment in compliance with 37 CFR 1.121.

Extensions of time are available under 37 CFR 1.136(a) only if the non-compliant amendment is a non-final amendment or an amendment filed in response to a *Quayle* action.

Failure to timely respond to this notice will result in:

Abandonment of the application if the non-compliant amendment is a non-final amendment or an amendment filed in response to a *Quayle* action; or

Non-entry of the amendment if the non-compliant amendment is a preliminary amendment or supplemental amendment.

/RICARDO L OSORIO/
Primary Examiner, Art Unit 2629

Notice of Non-Compliant Amendment (37 CFR 1.121)

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Application of : Kenneth M. Martin
Application No. : 11/693,117
For : **Method and Apparatus for Providing Tactile Sensations**
Filed : March 29, 2007
Examiner : Ricardo Osorio
Art Unit : 2629

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

AMENDMENT AND RESPONSE TO ELECTION OF SPECIES REQUIREMENT

Sir:

The following Amendment and Remarks are submitted in response to the Office Action mailed June 24, 2009 and the Notice of Non-Compliant Amendment mailed September 16, 2009.

Amendments to the Claims begin on page 2 of this paper.

Remarks begin on page 13 of this paper.

AMENDMENTS TO THE CLAIMS

1. (Previously Presented) A method, comprising:
 - outputting a display signal configured to display a graphical object on a touch-sensitive input device;
 - receiving a sensor signal from the touch-sensitive input device, the sensor signal indicating an object contacting the touch-sensitive input device;
 - determining an interaction between the object contacting the touch-sensitive input device and the graphical object;
 - generating an actuator signal based at least in part on the interaction; and
 - outputting the actuator signal.

2. (Original) The method of claim 1 wherein, the actuator signal is configured to cause a haptic effect to be output.

3. (Original) The method of claim 1, wherein the actuator signal is generated when the object contacts the touch-sensitive device at a location corresponding to the graphical object.

4. (Original) The method of claim 1, wherein the actuator signal is generated when the object contacts the touch-sensitive device at a location not corresponding to the graphical object.

5. (Original) The method of claim 1, wherein the display signal is configured to display a keypad comprising a plurality of softkeys.
6. (Original) The method of claim 5, wherein the haptic effect is caused to be output when a user contacts the touch-sensitive device at a location corresponding to a softkey in a home position.
7. (Original) The method of claim 5, wherein the plurality of softkeys comprises one softkey for each digit from 0 to 9.
8. (Original) The method of claim 5, wherein the plurality of softkeys comprises the key configuration of a standard 101-key keyboard.
9. (Original) The method of claim 1, wherein the graphical object comprises a first graphical object and a second graphical object, the haptic effect comprises a first haptic effect and a second haptic effect, and wherein the first haptic effect is configured to be output when the object contacts the first graphical object, and the second haptic effect is configured to be output when the object contacts the second graphical object.
10. (Original) A system, comprising:
a touch sensitive input device configured to output a sensor signal indicating an object contacting the touch-sensitive input device;

an actuator coupled to the touch-sensitive input device, the actuator configured to receive an actuator signal and output a haptic effect to the touch-sensitive surface based at least in part on the actuator signal; and

a processor in communication with the sensor and the actuator, the processor configured to:

output a display signal configured to display a graphical object on the touch-sensitive input device;

receive the sensor signal from the touch-sensitive input device;

determine an interaction between the object contacting the touch-sensitive surface and the graphical object,

generate the actuator signal based at least in part on the interaction; and

transmit the actuator signal to the actuator.

11. (Original) The system of claim 10, wherein the processor is configured to generate the actuator signal when the object contacts the touch-sensitive input device at a location corresponding to the graphical object.

12. (Original) The system of claim 10, wherein the processor is configured to output the actuator signal when the object contacts the touch-sensitive device at a location not corresponding to the graphical object.

13. (Original) The system of claim 10, wherein the display signal is configured to display a keypad comprising a plurality of softkeys.

14. (Original) The system of claim 13, wherein the haptic effect is caused to be output when a user contacts the touch-sensitive device at a location corresponding to a softkey in a home position.
15. (Original) The method of claim 13, wherein the plurality of softkeys comprises one softkey for each digit from 0 to 9.
16. (Original) The method of claim 13, wherein the plurality of softkeys comprises the key configuration of a standard 101-key keyboard.
17. (Original) The method of claim 10, wherein the graphical object comprises a first graphical object and a second graphical object, the haptic effect comprises a first haptic effect and a second haptic effect, and wherein the first haptic effect is configured to be output when the object contacts the first graphical object, and the second haptic effect is configured to be output when the object contacts the second graphical object.
18. (Previously Presented) A computer-readable medium comprising program code, comprising:
 - program code for outputting a display signal configured to display a graphical object on a touch-sensitive input device;
 - program code for receiving a sensor signal from the touch-sensitive input device, the sensor signal indicating an object contacting the touch-sensitive input device;
 - program code for determining an interaction between the object contacting the touch-sensitive input device and the graphical object;

program code for generating an actuator signal based at least in part on the interaction, the actuator signal configured to cause a haptic effect to be output; and program code for outputting the actuator signal.

19. (Original) The computer-readable medium of claim 18, wherein the actuator signal is generated when the object contacts the touch-sensitive device at a location corresponding to the graphical object.
20. (Original) The computer-readable medium of claim 18, wherein the actuator signal is generated when the object contacts the touch-sensitive device at a location not corresponding to the graphical object.
21. (Original) The computer-readable medium of claim 18, wherein the display signal is configured to display a keypad comprising a plurality of softkeys.
22. (Original) The computer-readable medium of claim 21, wherein the haptic effect is caused to be output when a user contacts the touch-sensitive device at a location corresponding to a softkey in a home position.
23. (Original) The computer-readable medium of claim 21, wherein the plurality of softkeys comprises one softkey for each digit from 0 to 9.
24. (Original) The computer-readable medium of claim 21, wherein the plurality of softkeys comprises the key configuration of a standard 101-key keyboard.

25. (Currently Amended) The computer-readable medium of claim 21, wherein the graphical object comprises a first graphical object and a second graphical object, the haptic effect comprises a first haptic effect and a second haptic effect, and wherein the first haptic effect is configured to be output when the object contacts the first graphical object, and the second haptic effect is configured to be output when the object contacts the second graphical object.

26. (Withdrawn) An apparatus comprising:

at least one input device comprising a first position and a second position, the input device moveable to the first position upon application of a first pressure to the input device, and moveable to the second position upon application of a second pressure to the input device, the second pressure greater than the first pressure;

at least one actuator in communication with the input device, the actuator configured to output tactile sensations to the apparatus; and

at least one processor in communication with the input device, the processor configured to:

receive a first input signal from the input device, the first input signal associated with the first position,

receive a second input signal from the input device, the second input signal associated with the second position,

transmit a first actuator signal to the actuator, the first actuator signal configured to cause the actuator to output a first tactile sensation associated with the first position, and

transmit a second actuator signal to the actuator, the second actuator signal configured to cause the actuator to output a second tactile sensation associated with the second position.

27. (Withdrawn) The apparatus of claim 26, wherein the input device comprises at least one of an analog switch, a force sensing resistor, a strain gauge based sensor, a capacitive touch switch, or a touchpad.

28. (Withdrawn) The apparatus of claim 26, wherein the at least one input device comprises a plurality of input devices, and the at least one actuator comprising a plurality of actuators, each actuator coupled to a distinct input device.

29. (Withdrawn) The apparatus of claim 26, wherein the actuator comprises at least one of a piezo-electric actuator, a voice coil, a moving magnet actuator, or a flexure coupled to a motor.

30. (Currently Amended) ~~The apparatus of claim 26,~~ An apparatus comprising:
at least one input device comprising a first position and a second position, the
input device moveable to the first position upon application of a first pressure to the input
device, and moveable to the second position upon application of a second pressure to the
input device, the second pressure greater than the first pressure;
at least one actuator in communication with the input device, the actuator
configured to output tactile sensations to the apparatus; and

at least one processor in communication with the input device, the processor configured to:

receive a first input signal from the input device, the first input signal associated with the first position,

receive a second input signal from the input device, the second input signal associated with the second position,

transmit a first actuator signal to the actuator, the first actuator signal configured to cause the actuator to output a first tactile sensation associated with the first position, and

transmit a second actuator signal to the actuator, the second actuator signal configured to cause the actuator to output a second tactile sensation associated with the second position;

wherein the input device comprises a pressure-sensitive touchpad, and the apparatus further comprises:

a display panel in communication with the pressure-sensitive touchpad, the display panel configured to receive the tactile sensations from the pressure-sensitive touchpad; and

at least one software-generated button configured to be displayed on the display panel.

31. (Previously Presented) The apparatus of claim 30, wherein the touchpad comprises a pressure calculator to measure the distinct amount of pressure.

32. (Previously Presented) The apparatus of claim 30, further comprising:

an interface object configured to be used to contact a location on the display panel corresponding to the at least one software-generated button; and

a pressure calculator to calculate an amount of pressure based upon an amount of area of the interface object in contact with the display panel.

33. (Previously Presented) The apparatus of claim 32, wherein the interface object comprises a stylus.

34. (Currently Amended) ~~The apparatus of claim 26,~~ An apparatus comprising:
at least one input device comprising a first position and a second position, the input device moveable to the first position upon application of a first pressure to the input device, and moveable to the second position upon application of a second pressure to the input device, the second pressure greater than the first pressure;

at least one actuator in communication with the input device, the actuator configured to output tactile sensations to the apparatus; and

at least one processor in communication with the input device, the processor configured to:

receive a first input signal from the input device, the first input signal associated with the first position,

receive a second input signal from the input device, the second input signal associated with the second position,

transmit a first actuator signal to the actuator, the first actuator signal configured to cause the actuator to output a first tactile sensation associated with the first position, and

transmit a second actuator signal to the actuator, the second actuator signal configured to cause the actuator to output a second tactile sensation associated with the second position; wherein the apparatus comprises[[ing]] at least one of a mobile telephone, a personal computer, or a hand-held computing device.

35. (Withdrawn) An apparatus comprising:

an input device configured to communicate an input signal indicating a position of the input device to an electronic device, the input device configured to move between multiple positions;

at least one actuator in communication with the input device, the actuator configured to output a plurality of tactile sensations to the input device; and

at least one processor in communication with the input device and the actuator, the processor configured to:

receive the input signal,

detect the position of the input device,

to generate an actuator signal configured to cause the actuator to output one of the plurality of tactile sensations based at least on the position of the input device.

36. (Withdrawn) The apparatus of claim 35, wherein the actuator is configured to vary the magnitude of the produced tactile sensation in accordance with the detected position of the input device.

37. (Withdrawn) The apparatus of claim 35, the input device associated with the selection of at least one function of the apparatus, and the actuator further produces a

function failure notification tactile sensation upon receipt of the input signal associated with the function and notification of failure of that function.

38. (Withdrawn) The apparatus of claim 35, further comprising a plurality of input devices, each input device capable of communicating a unique input signal to the electronic device and moving between multiple positions.

39. (Withdrawn) A mobile phone comprising the apparatus of claim 38.

40. (Withdrawn) The mobile phone of claim 39, comprising a keypad comprising the plurality of input devices.

41. (Withdrawn) The mobile phone of claim 39, wherein the at least one actuator comprising a plurality of actuators, each actuator coupled to a separate input device.

42. (Withdrawn) The mobile phone of claim 39, comprising a plurality of keys associated, each of the plurality of keys configured to activate a predetermined mobile phone function, and wherein the actuator is configured to produce the tactile sensation associated with each mobile phone function upon receipt of the associated input signal.

43. (Withdrawn) The mobile phone of claim 42, wherein the actuator is configured to produce a function failure notification tactile sensation upon receipt of a function input signal and a notification of failure of that function.

REMARKS

This paper is filed in response to the Office Action mailed June 24, 2009.

Claims 1-43 are pending in this application. Claims 26-29 and 35-43 have been withdrawn as being directed to unelected species. Applicant amended claim 25 to correctly depend from claim 21 rather than claim 1.

In the Office Action, the Examiner identified 5 species and required the Applicant to elect one species for prosecution. The Examiner further indicated that each independent claim was generic for its respective dependent claims. The Examiner identified the following 5 species:

- Species 1: The embodiment depicted in Figure 1.
- Species 2: The embodiment depicted in Figure 2.
- Species 3: The embodiments depicted in Figures 3 and 4.
- Species 4: The embodiments depicted in Figures 5 and 6.
- Species 5: The embodiment depicted in Figure 11.

In view of the foregoing identified species, Applicant hereby elects Species 4 corresponding to claims 1-25 and 30-34 for further prosecution on the merits.

Applicant has amended claims 30 and 34 to be independent claims by incorporating the limitations of each claim from which they depend.

Applicant traverses the election of species requirement on the basis that it would not be unduly burdensome on the Examiner to examine all species because the Examiner has already formulated search strategies for all claims and performed prior art searches for all claims, as indicated in the prosecution history. During a conversation with the undersigned on July 24, 2009, the Examiner indicated that it was necessary to refresh his search results after receiving Applicant's response to the previous Office Action. However, because the search strategies have already been formulated and because no claims have been substantively amended, the burden on the Examiner to refresh his search for all claims is not unreasonable.

In view of the foregoing, Applicant respectfully requests the Examiner withdraw the election of species requirement and substantively examine each of claim 1-43.

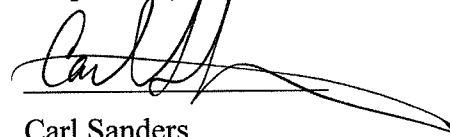
CONCLUSION

Applicant respectfully asserts that all pending claims are allowable and Applicant respectfully requests the allowance of all claims.

Should the Examiner have any comments, questions, or suggestions of a nature necessary to expedite the prosecution of the application, or to place the case in condition for allowance, the Examiner is courteously requested to telephone the undersigned at the number listed below.

Date: September 30, 2009

Respectfully submitted,



Carl Sanders
Reg. No. 57,203

KILPATRICK STOCKTON LLP
1001 West Fourth Street
Winston-Salem, NC 27101
(336) 607-7474 (voice)
(336) 734-2629 (fax)

Electronic Patent Application Fee Transmittal

Application Number:	11693117
Filing Date:	29-Mar-2007
Title of Invention:	Method and Apparatus for Providing Tactile Sensations
First Named Inventor/Applicant Name:	Kenneth M. Martin
Filer:	Carl E. Sanders/Laura Smith
Attorney Docket Number:	IMM147.C1

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:				
Independent claims in excess of 3	1201	1	220	220

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:				
Total in USD (\$)				220

Electronic Acknowledgement Receipt

EFS ID:	6173872
Application Number:	11693117
International Application Number:	
Confirmation Number:	8743
Title of Invention:	Method and Apparatus for Providing Tactile Sensations
First Named Inventor/Applicant Name:	Kenneth M. Martin
Customer Number:	34300
Filer:	Carl E. Sanders/Laura Smith
Filer Authorized By:	Carl E. Sanders
Attorney Docket Number:	IMM147.C1
Receipt Date:	30-SEP-2009
Filing Date:	29-MAR-2007
Time Stamp:	12:13:45
Application Type:	Utility under 35 USC 111(a)

Payment information:

Submitted with Payment	yes
Payment Type	Credit Card
Payment was successfully received in RAM	\$220
RAM confirmation Number	1469
Deposit Account	
Authorized User	

File Listing:

Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part / zip (if appl.)	Pages (if appl.)
				APPLE INC.	

1	Miscellaneous Incoming Letter	Transmittal342043.pdf	46284 be90d8af60865a689f078d856e533bdc16b cc50f	no	1
Warnings:					
Information:					
2	Amendment Copy Claims/Response to Suggested Claims	Response342043.pdf	510899 3cd8ffe480f28a6759cb9b0937ae06b2ba9a 6342	no	14
Warnings:					
Information:					
3	Fee Worksheet (PTO-875)	fee-info.pdf	29630 210a3c2202164aeac0c08232b7c7a297440 e386f	no	2
Warnings:					
Information:					
Total Files Size (in bytes):			586813		

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.

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Application of : Kenneth M. Martin et al.
 Application No. : 11/693,117
 Filed : March 29, 2007
 For : METHOD AND APPARATUS FOR PROVIDING
 TACTILE SENSATIONS
 Examiner : Ricardo Osorio
 Art Unit : 2629
 Conf. No. : 8743

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

TRANSMITTAL

Sir:

Transmitted herewith is a copy of the following documents for filing in the above-identified application:

1. Transmittal;
2. Amendment and Response to Election of Species Requirement; and
3. EFS-Web payment in the amount of \$220.00

Shown below are the fees for the presentation of the amended claims:

	Claims Remaining	Highest # Previously Paid For	Extra	Rate	Fee
TOTAL	43	43	0	\$52	\$ 0
Ind. Cls.	6	5	1	\$220	\$ 220
Multiple Dependent Claim Added.....					NO
TOTAL					\$ 220

The Commissioner is hereby authorized to charge any deficiency to Deposit Account Number 16-1435.

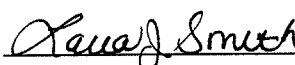
Respectfully submitted,

By: 
 Carl Sanders (Reg. No. 57,203)

Date: September 30, 2009
 KILPATRICK STOCKTON LLP
 1001 West Fourth Street
 Winston-Salem, NC 27101-2400
 Telephone: (336) 607-7474
 Fax: (336) 734-2629

Certificate of Electronic Filing

I hereby certify that this correspondence is being electronically filed with the United States Patent Office via EFS-Web, on September 30, 2009.


 Laura J. Smith

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 11/693,117	Filing Date 03/29/2007	<input type="checkbox"/> To be Mailed
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APPLICATION AS FILED – PART I			OTHER THAN SMALL ENTITY				
	(Column 1)	(Column 2)	SMALL ENTITY <input type="checkbox"/>	OR			
FOR	NUMBER FILED	NUMBER EXTRA	RATE (\$)	FEE (\$)	OR	RATE (\$)	FEE (\$)
<input type="checkbox"/> BASIC FEE <small>(37 CFR 1.16(a), (b), or (c))</small>	N/A	N/A	N/A			N/A	
<input type="checkbox"/> SEARCH FEE <small>(37 CFR 1.16(k), (l), or (m))</small>	N/A	N/A	N/A			N/A	
<input type="checkbox"/> EXAMINATION FEE <small>(37 CFR 1.16(o), (p), or (q))</small>	N/A	N/A	N/A			N/A	
TOTAL CLAIMS <small>(37 CFR 1.16(i))</small>	minus 20 =	*	X \$ =		OR	X \$ =	
INDEPENDENT CLAIMS <small>(37 CFR 1.16(h))</small>	minus 3 =	*	X \$ =			X \$ =	
<input type="checkbox"/> APPLICATION SIZE FEE <small>(37 CFR 1.16(s))</small>	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 <small>(37 CFR 1.16(j))</small>							
* If the difference in column 1 is less than zero, enter "0" in column 2.			TOTAL			TOTAL	

APPLICATION AS AMENDED – PART II					OTHER THAN SMALL ENTITY				
	(Column 1)	(Column 2)	(Column 3)		SMALL ENTITY	OR			
AMENDMENT	09/30/2009	CLAIMS REMAINING AFTER AMENDMENT	HIGHEST NUMBER PREVIOUSLY PAID FOR	PRESENT EXTRA	RATE (\$)	ADDITIONAL FEE (\$)	OR	RATE (\$)	ADDITIONAL FEE (\$)
	Total <small>(37 CFR 1.16(i))</small>	* 43	Minus	** 43 = 0	X \$ =		OR	X \$52=	0
	Independent <small>(37 CFR 1.16(h))</small>	* 6	Minus	***5 = 1	X \$ =		OR	X \$220=	220
<input type="checkbox"/> Application Size Fee <small>(37 CFR 1.16(s))</small>									
<input type="checkbox"/> FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM <small>(37 CFR 1.16(j))</small>							OR		
					TOTAL ADD'L FEE		OR	TOTAL ADD'L FEE	220

APPLICATION AS AMENDED – PART II					OTHER THAN SMALL ENTITY			
	(Column 1)	(Column 2)	(Column 3)		SMALL ENTITY	OR		
AMENDMENT	CLAIMS REMAINING AFTER AMENDMENT	HIGHEST NUMBER PREVIOUSLY PAID FOR	PRESENT EXTRA	RATE (\$)	ADDITIONAL FEE (\$)	OR	RATE (\$)	ADDITIONAL FEE (\$)
	Total <small>(37 CFR 1.16(i))</small>	*	Minus	** =	X \$ =		OR	X \$ =
	Independent <small>(37 CFR 1.16(h))</small>	*	Minus	*** =	X \$ =		OR	X \$ =
<input type="checkbox"/> Application Size Fee <small>(37 CFR 1.16(s))</small>								
<input type="checkbox"/> FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM <small>(37 CFR 1.16(j))</small>							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 number found in the appropriate box in column 1.

Legal Instrument Examiner:
 /MARQUITA D. JONES/

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.**

If you need assistance in completing the form, call 1-800-PTO-9199 and select option 2.

Document code: WFEE

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Table with 5 columns: APPLICATION NO., FILING DATE, FIRST NAMED INVENTOR, ATTORNEY DOCKET NO., CONFIRMATION NO.
11/693,117 03/29/2007 Kenneth M. Martin IMM147.C1 8743

34300 7590 12/29/2009
PATENT DEPARTMENT (51851)
KILPATRICK STOCKTON LLP
1001 WEST FOURTH STREET
WINSTON-SALEM, NC 27101

EXAMINER

OSORIO, RICARDO

ART UNIT PAPER NUMBER

2629

MAIL DATE DELIVERY MODE

12/29/2009

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. 11/693,117	Applicant(s) MARTIN ET AL.	
	Examiner RICARDO L. OSORIO	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 30 September 2009.
- 2a) This action is **FINAL**.
- 2b) This action is non-final.
- 3) 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

- 4) Claim(s) 1-43 is/are pending in the application.
- 4a) Of the above claim(s) 26-29 and 35-43 is/are withdrawn from consideration.
- 5) Claim(s) _____ is/are allowed.
- 6) Claim(s) 1-25 and 30-34 is/are rejected.
- 7) Claim(s) _____ is/are objected to.
- 8) Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

- 9) The specification is objected to by the Examiner.
- 10) 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).
- 11) 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

- 12) 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 Draftperson's Patent Drawing Review (PTO-948)
- 3) Information Disclosure Statement(s) (PTO/SB/08)
Paper No(s)/Mail Date 7/6/2009.
- 4) Interview Summary (PTO-413)
Paper No(s)/Mail Date. _____.
- 5) Notice of Informal Patent Application
- 6) Other: _____.

Art Unit: 2629

DETAILED ACTION

Election/Restrictions

1. Applicant's election with traverse of Species 4, claims 1-25 and 30-34 in the reply filed on 9/30/2009 is acknowledged. The traversal is on the ground(s) that the examiner has already done a search result on all the species. This is not found persuasive because during further consideration of the claims, the examiner has found that keeping these patentably distinct species together for search and examination would cause a serious burden on the search and examination of the case.

The requirement is still deemed proper and is therefore made FINAL.

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 –

(b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.

3. Claims 1-25 and 30-34 are rejected under 35 U.S.C. 102(b) as being anticipated by Rosenberg et al (US 2008/0060350).

Regarding claims 1, 2, 10 and 18, Rosenberg discloses A system, method and program code comprising:

a touch sensitive input device configured to output a sensor signal indicating an object contacting the touch-sensitive input device (see Fig. 8, character 82 and paragraph 32, lines 1-6); an actuator

Art Unit: 2629

coupled to the touch-sensitive input device, the actuator configured to receive an actuator signal and output a haptic effect to the touch-sensitive surface based at least in part on the actuator signal (paragraph 32, lines 1-9); and a processor in communication with the sensor and the actuator (paragraph 32, lines 1-12);, the processor configured to: output a display signal configured to display a graphical object on the touch-sensitive input device (par. 56, lines 1-2); receive the sensor signal from the touch-sensitive input device; determine an interaction between the object contacting the touch-sensitive surface and the graphical object, generate the actuator signal based at least in part on the interaction; and transmit the actuator signal to the actuator (see paragraphs 57 and 59).

As to claims 3, 11 and 19, Rosenberg teaches of the processor is configured to generate the actuator signal when the object contacts the touch-sensitive input device at a location corresponding to the graphical object (see paragraphs 57 and 59).

As to claims 4, 12, and 20, Rosenberg teaches of the processor is configured to output the actuator signal when the object contacts the touch-sensitive device at a location not corresponding to the graphical object (see paragraphs 57 and 59).

As to claims 5, 13, and 21, Rosenberg teaches of the display signal is configured to display a keypad comprising a plurality of softkeys (see Fig. 8A).

As to claims 6, 14, and 22, Rosenberg teaches of the haptic effect is caused to be output when a user contacts the touch-sensitive device at a location corresponding to a softkey in a home position (see paragraphs 57 and 59).

As to claims 7, 15, and 23, Rosenberg teaches of the plurality of softkeys comprises one softkey for each digit from 0 to 9 (Rosenberg teaches of a PDA, Fig 8A, and also of a cellular phone having touch screen (see paragraph 71). It is inherent for a cell phone having touchscreen to also have a softkey for each digit from 0 to 9 for a user to make a phone call.

As to claims 8, 16 and 24, 16, Rosenberg teaches of the plurality of softkeys comprises the key configuration of a standard 101-key keyboard (In paragraphs 71-73, Rosenberg mentions other optional devices that include from a standard computer screen to a cell phone and many different types of graphical objects. Although not specifically mentioning a standard 101-key keyboard, it is inherent that such a graphic keyboard can also be used having more graphic objects being the only difference.

Art Unit: 2629

As to claims 9, 17 and 25, Rosenberg discloses that the graphical object comprises a first graphical object and a second graphical object, the haptic effect comprises a first haptic effect and a second haptic effect, and wherein the first haptic effect is configured to be output when the object contacts the first graphical object, and the second haptic effect is configured to be output when the object contacts the second graphical object (see paragraphs 57 and 59).

As to claims 30 and 34, Rosenberg discloses an apparatus comprising: at least one input device comprising a first position and a second position, the input device moveable to the first position upon application of a first pressure to the input device, and moveable to the second position upon application of a second pressure to the input device, the second pressure greater than the first pressure; at least one actuator in communication with the input device, the actuator configured to output tactile sensations to the apparatus; and at least one processor in communication with the input device (see paragraphs 75 and 77), the processor configured to: receive a first input signal from the input device, the first input signal associated with the first position, receive a second input signal from the input device, the second input signal associated with the second position, transmit a first actuator signal to the actuator, the first actuator signal configured to cause the actuator to output a first tactile sensation associated with the first position, and transmit a second actuator signal to the actuator, the second actuator signal configured to cause the actuator to output a second tactile sensation associated with the second position; wherein the input device comprises a pressure-sensitive touchpad, and the apparatus further comprises: a display panel in communication with the pressure-sensitive touchpad, the display panel configured to receive the tactile sensations from the pressure-sensitive touchpad (see paragraphs 73-77); and at least one software-generated button configured to be displayed on the display panel (see paragraphs 75 and 77), wherein the apparatus comprises at least one of a mobile telephone, a personal computer, or a hand-held computing device (see paragraph 71).

As to claim 31, Rosenberg discloses the touchpad comprises a pressure calculator to measure the distinct amount of pressure (see paragraph 5).

As to claim 32, Rosenberg discloses an interface object configured to be used to contact a location on the display panel corresponding to the at least one software-generated button; and a pressure calculator to calculate an amount of pressure based upon an amount of area of the interface object in contact with the display panel (paragraphs 72-77)

As to claim 33, Rosenberg discloses the interface object comprises a stylus (paragraph 73).

Art Unit: 2629

Any inquiry concerning this communication or earlier communications from the examiner should be directed to RICARDO L. OSORIO whose telephone number is (571) 272-7676. The examiner can normally be reached on MONDAY-THURSDAY 7:00 am-5:30 PM.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, AMARE MENGISTU can be reached on (571) 272-7674. 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.

/RICARDO L OSORIO/
Primary Examiner, Art Unit 2629

Notice of References Cited	Application/Control No. 11/693,117	Applicant(s)/Patent Under Reexamination MARTIN ET AL.	
	Examiner RICARDO L. OSORIO	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-6,429,846 B2	08-2002	Rosenberg et al.	345/156
*	B US-7,202,851 B2	04-2007	Cunningham et al.	345/156
*	C US-2008/0068350 A1	03-2008	Rosenberg et al.	345/173
	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

*	Document Number Country Code-Number-Kind Code	Date MM-YYYY	Country	Name	Classification
	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.

Search Notes 	Application/Control No. 11693117	Applicant(s)/Patent Under Reexamination MARTIN ET AL.
	Examiner RICARDO L OSORIO	Art Unit 2629

SEARCHED			
Class	Subclass	Date	Examiner
345	156, 161, 163, 173, 167-169	12/22/09	RLO

SEARCH NOTES		
Search Notes	Date	Examiner
EAST	12/22/09	RLO

INTERFERENCE SEARCH			
Class	Subclass	Date	Examiner

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EAST Search History

EAST Search History (Prior Art)

Ref #	Hits	Search Query	DBs	Default Operator	Plurals	Time Stamp
L1	2	("6597347").PN.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2009/12/22 11:13
L2	192024	(touch adj (pad or panel or input or screen or sensitive) or touchscreen)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2009/12/22 12:18
L3	164588	2 and display	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2009/12/22 12:19
L4	11866	3 and (object or icon or graphic\$4 or gui) near3 touch \$4	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2009/12/22 12:20
L5	11925	3 and (object or icon or graphic\$4 or gui) near3 (touch \$4 or touch-sensitive)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2009/12/22 12:21
L6	11866	3 and (object or icon or graphic\$4 or gui) near3 (touch \$4)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2009/12/22 12:21
L7	1143	6 and actuator	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2009/12/22 12:21

L8	274	7 and (haptic or force adj feedback or force-feedback or haptic-effect or haptic-feedback)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2009/12/22 12:22
L9	602	5 and (haptic or force adj feedback or force-feedback or haptic-effect or haptic-feedback)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2009/12/22 12:22
L10	274	9 and actuator	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2009/12/22 12:23
L11	274	8 10	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2009/12/22 12:23
L12	266	11 and sens\$4	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2009/12/22 12:23
L13	272	11 and (sens\$4 or detect\$4)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2009/12/22 12:24
L14	25	13 and first adj2 (feddback or haptic)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2009/12/22 12:25
L15	16	14 and second adj2 (feedback or haptic)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2009/12/22 12:25
L16	1	15 and softkey	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2009/12/22 12:25

L17	4	15 and key	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2009/12/22 12:26
L18	12	15 not 17	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2009/12/22 12:27
L19	0	18 and numeric	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2009/12/22 12:29
L20	12	18 and (cell or cellular or mobile or phone or telephone)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2009/12/22 12:31
L21	2	"6429846".pn.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2009/12/22 13:21

12/22/09 1:23:19 PM

C:\Documents and Settings\rosorio\My Documents\EAST\Workspaces\tactile sensations first through fourth.wsp

Substitute for form 1449A/PTO				Complete if Known	
INFORMATION DISCLOSURE STATEMENT BY APPLICANT <i>(Use as many sheets as necessary)</i>				Application Number	11/693,117
				Filing Date	March 29, 2007
				First Named Inventor	Martin
				Art Unit	2629
				Examiner Name	Ricardo Osorio
Sheet	1	of	1	Attorney Docket Number	IMM147C

U.S. PATENT DOCUMENTS					
Examiner Initials *	Cite No. ¹	Document Number	Publication Date MM-DD-YYYY	Name of Patentee or Applicant of Cited Document	Pages, Columns, Lines, Where Relevant Passages or Relevant Figures Appear
		Number - Kind Code ² (if known)			
		US-			
		US-			
		US-			
		US-			
		US-			
		US-			
		US-			
		US-			

FOREIGN PATENT DOCUMENTS						
Examiner Initials *	Cite No. ¹	Foreign Patent Document	Publication Date MM-DD-YYYY	Name of Patentee or Applicant of Cited Document	Pages, Columns, Lines, Where Relevant Passages or Relevant Figures Appear	T ⁶
		Country Code ³ - Number ⁴ - Kind Code ⁵ (if known)				
	1.	KR 2001-0028369	04-06-2001	Sim Jae Boong		

NON PATENT LITERATURE DOCUMENTS			
Examiner Initials *	Cite No. ¹	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, page(s), volume-issue number(s), publisher, city and/or country where published.	T ²
	2.	KIPO Notice of Preliminary Rejection, Korean Patent Application No. 10-2004-7006627, mailed April 16, 2009.	

Examiner Signature	/Ricardo Osorio/	Date Considered	12/22/2009
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*EXAMINER: Initial if reference considered, whether or not citation is in conformance with MPEP 609. Draw line through citation if not in conformance and not considered. Include copy of this form with next communication to applicant. ¹ Applicant's unique citation designation number (optional). ² See Kinds Codes of USPTO Patent Documents at www.uspto.gov or MPEP 901.04. ³ Enter Office that issued the document, by the two-letter code (WIPO Standard ST.3). ⁴ For Japanese patent documents, the indication of the year of the reign of the Emperor must precede the serial number of the patent document. ⁵ Kind of document by the appropriate symbols as indicated on the document under WIPO Standard ST. 16 if possible. ⁶ Applicant is to place a check mark here if English language Translation is attached.

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 2 hours 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.

If you need assistance in completing the form, call 1-800-PTO-9199 and select option 2.

Electronic Patent Application Fee Transmittal

Application Number:	11693117
Filing Date:	29-Mar-2007
Title of Invention:	Method and Apparatus for Providing Tactile Sensations
First Named Inventor/Applicant Name:	Kenneth M. Martin
Filer:	Carl E. Sanders/Renee Prevette
Attorney Docket Number:	IMM147.C1

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:	7296730
Application Number:	11693117
International Application Number:	
Confirmation Number:	8743
Title of Invention:	Method and Apparatus for Providing Tactile Sensations
First Named Inventor/Applicant Name:	Kenneth M. Martin
Customer Number:	34300
Filer:	Carl E. Sanders/Renee Prevette
Filer Authorized By:	Carl E. Sanders
Attorney Docket Number:	IMM147.C1
Receipt Date:	26-MAR-2010
Filing Date:	29-MAR-2007
Time Stamp:	16:21:46
Application Type:	Utility under 35 USC 111(a)

Payment information:

Submitted with Payment	yes
Payment Type	Credit Card
Payment was successfully received in RAM	\$180
RAM confirmation Number	4176
Deposit Account	110855
Authorized User	KILPATRICK STOCKTON LLP

The Director of the USPTO is hereby authorized to charge indicated fees and credit any overpayment as follows:

Charge any Additional Fees required under 37 C.F.R. Section 1.16 (National application filing, search, and examination fees)

File Listing:					
Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
1	Miscellaneous Incoming Letter	SIDSTransmittal.pdf	35120 cfd24a287c2f6cec945f646a689693bf23ba08b0	no	1
Warnings:					
Information:					
2	Transmittal Letter	SIDSLetter.pdf	169596 ec1adea456360469af4b0bc15ffe01ed4de35002	no	5
Warnings:					
Information:					
3	Information Disclosure Statement (IDS) Filed (SB/08)	PTOSB08.pdf	58322 12f2b18f3443a866734a564fa801ae37b00a8426	no	1
Warnings:					
Information:					
This is not an USPTO supplied IDS fillable form					
4	NPL Documents	OAIMM147KR-12-4-09.pdf	631352 a75dc684063d6280b6233983edd744d6561bde84	no	12
Warnings:					
Information:					
5	NPL Documents	OAIMM147KRDIV-12-15-09.pdf	417609 f6635d94300fe619dcb0a9c457d997bd07b669e6	no	10
Warnings:					
Information:					
6	NPL Documents	OAIMM147CNDIV-7-17-09.pdf	889283 54d2b099600e53c2f14c94f985a25dfaa9ab736c	no	14
Warnings:					
Information:					
7	Fee Worksheet (PTO-875)	fee-info.pdf	30037 96f45c9ddd2519725b51089eb1a46b48bd b77901	no	2
Warnings:					
Information:					
Total Files Size (in bytes):			2231319		

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.

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Application of:)
) Conf No.: 8743
Kenneth M. Martin et al.)
) Art Unit: 2629
 Serial No. 11/693,117)
) Examiner: **Ricardo Osorio**
 Filed: March 29, 2007)
)
 For: METHOD AND APPARATUS FOR
 PROVIDING TACTILE SENSATIONS

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

TRANSMITTAL

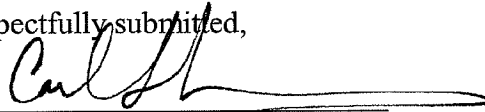
Sir:

Transmitted herewith are the following documents for filing in the above-identified application:

1. Information Disclosure Statement; and
2. Information Disclosure Statement by Applicant (Form PTO/SB/08); and
3. Three (3) Non-Patent References.

The Commissioner is hereby authorized to charge any deficiency to Deposit Account Number 16-1435.

Respectfully submitted,



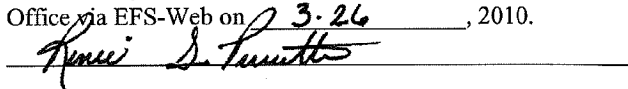
Carl Sanders
 Reg. No. 57,203

Date: March 26, 2010

KILPATRICK STOCKTON LLP
 1001 West Fourth Street
 Winston-Salem, NC 27101-2400
 (336) 607-7300

Certificate of Electronic Filing

I hereby certify that this correspondence is being electronically filed with The United States Patent Office via EFS-Web on 3-26, 2010.



IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Applicant: Kenneth M. Martin et al
Appl. No.: 11/693,117
For: Method and Apparatus for Providing Tactile Sensations
Filed: March 29, 2007
Examiner: Ricardo Osorio
Art Unit: 2629
Attorney Docket No: IMM 147.C1 (51851-342043)

SUPPLEMENTAL INFORMATION DISCLOSURE STATEMENT
(SUBMISSION AFTER FILING OF AN APPLICATION
BUT BEFORE FINAL REJECTION OR NOTICE OF ALLOWANCE
OR CONCURRENTLY WITH A RULE 1.114 RCE APPLICATION)

Sir:

Pursuant to 37 C.F.R. §§ 1.97 and 1.98, applicant(s) hereby submit(s) an Information Disclosure Statement for consideration by the Examiner.

I. LIST OF PATENTS, PUBLICATIONS OR OTHER INFORMATION

The patents, publications, or other information submitted for consideration by the Office are listed on the PTO/SB/08 forms, attached hereto.

II. COPIES (check at least one box)

- a. This application was filed before June 30, 2003. Accordingly, submitted herewith is a legible copy of (i) each U.S. and foreign patent; (ii) each publication or that portion which caused it to be listed; and (iii) all other information or that portion which caused it to be listed.
- b. This application was filed on or after June 30, 2003. Accordingly, copies of cited U.S. patents and patent application publications therefore are not included. Copies of foreign patent documents and non-patent literature are included.

- c. Some or all of the documents listed on the PTO/SB/08A are not enclosed because they were cited in the International Search Report and copies should already be in the PTO file. If copies are needed, please contact the undersigned.

III. CONCISE EXPLANATION OF THE RELEVANCE

(check at least one box)

- a. **DOCUMENTS IN THE ENGLISH LANGUAGE**

The patents, publications, or other information listed on the attached PTO/SB/08 forms are in the English language and therefore, do not require a statement of relevancy.

- b. **DOCUMENTS NOT IN THE ENGLISH LANGUAGE**

A concise explanation of the relevance of all patents, publications, or other information listed that is not in the English language is as follows:

- c. **ENGLISH LANGUAGE SEARCH REPORT**

An English language version of the search report or action that indicates the degree of relevance found by the foreign office is attached, thereby satisfying the requirement for a concise explanation. See MPEP 609(III)(A)(3).

- d. **OTHER**

The following additional information is provided for the Examiner's consideration.

FEES

IV. THIS IDS IS BEING FILED UNDER 37 C.F.R. § 1.97(b):
(check one box)

- a. within three months of the filing date of a national application (37 C.F.R. § 1.97(b)(1)). No fee or statement is required. *(This section is not to be used with RCE's.)*
- b. within three months of the date of entry of the national stage as set forth in § 1.491 in an international application (37 C.F.R. § 1.97(b)(2)). No fee or statement is required.
- c. concurrently with the filing of a Request for Continued Examination under § 1.114 (37 C.F.R. § 1.97(b)(4)). No fee or statement is required.
- d. before the mailing date of a first Action on the merits (37 C.F.R. § 1.97(b)(3)). No fee or statement is required.

In the event that a first Office Action on the merits has been issued, please consider this IDS under 37 C.F.R. § 1.97(c) and see the statement under 37 C.F.R. § 1.97(e) below, or, if no statement has been made, charge our deposit account in the amount of \$180.00 as required by 37 C.F.R. § 1.17(p).

V. THIS IDS IS BEING FILED UNDER 37 C.F.R. § 1.97(c):
(check one box)

before the mailing date of a Final Office Action under 37 C.F.R. § 1.113 (See 37 C.F.R. § 1.97(c)(1)) or before the mailing date of a Notice of Allowance under 37 C.F.R. § 1.311 (See 37 C.F.R. § 1.97(c)(2)).

- a. No statement; therefore, a fee in the amount of \$180.00 as required by 37 C.F.R. § 1.17(p).
- or
- b. See the statement below. No fee is required.

VI. STATEMENT UNDER 37 C.F.R. § 1.97(e) (check only one box)

The undersigned hereby states that

- a. each item of information contained in the IDS 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 this IDS; or
- b. no item of information contained in the IDS 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 IDS was known to any individual designated in 37 C.F.R. § 1.56(c) more than three months prior to the filing of the IDS.
- c. Some of the items of information were cited in a communication from a foreign Patent Office. As to this information, the undersigned states that each item of information contained in the IDS was first cited in a communication from a foreign Patent Office in a counterpart foreign application not more than three months prior to the filing of this IDS. As to the remaining information, the undersigned hereby states that no item of this remaining information contained in the IDS was cited in a communication from a foreign Patent Office in a counterpart foreign application and, to the best of my knowledge after making reasonable inquiry, was known to any individual designated in 37 C.F.R. § 1.56(c) more than three months prior to the filing of this statement.

VII. PAYMENT OF FEES (check one box)

- Payment by credit card Form PTO-2038 in the amount of \$180 required by 37 C.F.R. § 1.17(p) is enclosed for the above-identified fee.
- Please charge Deposit Account No. 16-1435 in the amount required by 37 C.F.R. § 1.17(p) for the above-indicated fee. A triplicate copy of this paper is attached.
- No fee is required.


If the Examiner has any questions concerning this IDS, he/she is requested to contact the undersigned. If it is determined that this IDS has been filed under the wrong rule, the PTO is requested to consider this IDS under the proper rule and charge the appropriate fee to Deposit Account No. 16-1435.

If necessary, the Commissioner is hereby authorized in this, concurrent, and future replies, to charge payment or credit any overpayment to Deposit Account No. 16-1435 for any additional fees required under 37 C.F.R. § 1.16 or under § 1.17.

Respectfully submitted,

KILPATRICK STOCKTON LLP

Date: March 26, 2010

By: 
Carl Sanders (Reg. No. 57,203)
1001 West Fourth Street
Winston-Salem, NC 27101-2400

- Attachment(s):
- PTO/SB/08
 - Documents
 - Fee
 - Other:

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Application of : Kenneth M. Martin
Application No. : 11/693,117
For : **Method and Apparatus for Providing Tactile Sensations**
Filed : March 29, 2007
Examiner : Ricardo Osorio
Art Unit : 2629

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

AMENDMENT AND RESPONSE TO NON-FINAL OFFICE ACTION

Sir:

The following Amendment and Remarks are submitted in response to the Office Action mailed December 29, 2009.

Amendments to the Claims begin on page 2 of this paper.

Remarks begin on page 15 of this paper.

AMENDMENTS TO THE CLAIMS

1. (Currently Amended) A method, comprising:
 - outputting a display signal configured to display a graphical object on a touch-sensitive input device;
 - receiving a sensor signal from the touch-sensitive input device, the sensor signal indicating an object contacting the touch-sensitive input device and a pressure of the contact;
 - determining an interaction between the object contacting the touch-sensitive input device and the graphical object based at least in part on the pressure;
 - generating an actuator signal based at least in part on the interaction, wherein the actuator signal is configured to cause a first haptic effect if the pressure is less than a first pressure threshold and cause a second haptic effect if the pressure is between the first pressure threshold and a second pressure threshold; and
 - outputting the actuator signal.
2. (Cancelled)
3. (Original) The method of claim 1, wherein the actuator signal is generated when the object contacts the touch-sensitive device at a location corresponding to the graphical object.

4. (Original) The method of claim 1, wherein the actuator signal is generated when the object contacts the touch-sensitive device at a location not corresponding to the graphical object.
5. (Original) The method of claim 1, wherein the display signal is configured to display a keypad comprising a plurality of softkeys.
6. (Original) The method of claim 5, wherein the haptic effect is caused to be output when a user contacts the touch-sensitive device at a location corresponding to a softkey in a home position.
7. (Original) The method of claim 5, wherein the plurality of softkeys comprises one softkey for each digit from 0 to 9.
8. (Original) The method of claim 5, wherein the plurality of softkeys comprises the key configuration of a standard 101-key keyboard.
9. (Currently Amended) The method of claim 1, wherein the graphical object comprises a first graphical object and a second graphical object, ~~the haptic effect comprises a first haptic effect and a second haptic effect, and~~
if the object contacts the first graphical object, wherein the first haptic effect is configured to be output when the object contacts the first graphical object if the pressure is less than the first pressure threshold and the second haptic effect is configured to be

output if the pressure is between the first pressure threshold and the second pressure threshold, and

if ~~when~~ the object contacts the second graphical object ~~a third~~ the second haptic effect is configured to be output ~~when the object contacts the second graphical object~~ if the pressure is less than the first pressure threshold and a fourth haptic effect is configured to be output if the pressure is between the first pressure threshold and the second pressure threshold.

10. (Currently Amended) A system, comprising:

a touch sensitive input device configured to output a sensor signal indicating an object contacting the touch-sensitive input device and a pressure of the contact;

an actuator coupled to the touch-sensitive input device, the actuator configured to receive an actuator signal and output a haptic effect to the touch-sensitive surface bas[[t]]ed at least in part on the actuator signal, wherein the actuator signal is configured to cause a first haptic effect if the pressure is less than a first pressure threshold and cause a second haptic effect if the pressure is between the first pressure threshold and a second pressure threshold; and

a processor in communication with the sensor and the actuator, the processor configured to:

output a display signal configured to display a graphical object on the touch-sensitive input device;

receive the sensor signal from the touch-sensitive input device;

determine an interaction between the object contacting the touch-sensitive surface and the graphical object based at least in part on the pressure,

generate the actuator signal based at least in part on the interaction; and
transmit the actuator signal to the actuator.

11. (Original) The system of claim 10, wherein the processor is configured to generate the actuator signal when the object contacts the touch-sensitive input device at a location corresponding to the graphical object.

12. (Original) The system of claim 10, wherein the processor is configured to output the actuator signal when the object contacts the touch-sensitive device at a location not corresponding to the graphical object.

13. (Original) The system of claim 10, wherein the display signal is configured to display a keypad comprising a plurality of softkeys.

14. (Original) The system of claim 13, wherein the haptic effect is caused to be output when a user contacts the touch-sensitive device at a location corresponding to a softkey in a home position.

15. (Original) The method of claim 13, wherein the plurality of softkeys comprises one softkey for each digit from 0 to 9.

16. (Original) The method of claim 13, wherein the plurality of softkeys comprises the key configuration of a standard 101-key keyboard.

17. (Currently Amended) The method of claim 10, wherein the graphical object comprises a first graphical object and a second graphical object, ~~the haptic effect comprises a first haptic effect and a second haptic effect, and~~

if the object contacts the first graphical object, wherein the first haptic effect is configured to be output when the object contacts the first graphical object if the pressure is less than the first pressure threshold and the second haptic effect is configured to be output if the pressure is between the first pressure threshold and the second pressure threshold, and

if when the object contacts the second graphical object a third the second haptic effect is configured to be output when the object contacts the second graphical object if the pressure is less than the first pressure threshold and a fourth haptic effect is configured to be output if the pressure is between the first pressure threshold and the second pressure threshold.

18. (Currently Amended) A computer-readable medium comprising program code, comprising:

program code for outputting a display signal configured to display a graphical object on a touch-sensitive input device;

program code for receiving a sensor signal from the touch-sensitive input device, the sensor signal indicating an object contacting the touch-sensitive input device and a pressure of the contact;

program code for determining an interaction between the object contacting the touch-sensitive input device and the graphical object based at least in part on the pressure;

program code for generating an actuator signal based at least in part on the interaction, the actuator signal configured to cause a haptic effect to be output, wherein the actuator signal is configured to cause a first haptic effect if the pressure is less than a first pressure threshold and cause a second haptic effect if the pressure is between the first pressure threshold and a second pressure threshold; and

program code for outputting the actuator signal.

19. (Original) The computer-readable medium of claim 18, wherein the actuator signal is generated when the object contacts the touch-sensitive device at a location corresponding to the graphical object.

20. (Original) The computer-readable medium of claim 18, wherein the actuator signal is generated when the object contacts the touch-sensitive device at a location not corresponding to the graphical object.

21. (Original) The computer-readable medium of claim 18, wherein the display signal is configured to display a keypad comprising a plurality of softkeys.

22. (Original) The computer-readable medium of claim 21, wherein the haptic effect is caused to be output when a user contacts the touch-sensitive device at a location corresponding to a softkey in a home position.

23. (Original) The computer-readable medium of claim 21, wherein the plurality of softkeys comprises one softkey for each digit from 0 to 9.

24. (Original) The computer-readable medium of claim 21, wherein the plurality of softkeys comprises the key configuration of a standard 101-key keyboard.

25. (Currently Amended) The computer-readable medium of claim 21, wherein the graphical object comprises a first graphical object and a second graphical object, ~~the haptic effect comprises a first haptic effect and a second haptic effect, and~~

if the object contacts the first graphical object, wherein the first haptic effect is configured to be output when the object contacts the first graphical object if the pressure is less than the first pressure threshold and the second haptic effect is configured to be output if the pressure is between the first pressure threshold and the second pressure threshold, and

if when the object contacts the second graphical object a third the second haptic effect is configured to be output when the object contacts the second graphical object if the pressure is less than the first pressure threshold and a fourth haptic effect is configured to be output if the pressure is between the first pressure threshold and the second pressure threshold.

26. (Withdrawn) An apparatus comprising:

at least one input device comprising a first position and a second position, the input device moveable to the first position upon application of a first pressure to the input device, and moveable to the second position upon application of a second pressure to the input device, the second pressure greater than the first pressure;

at least one actuator in communication with the input device, the actuator configured to output tactile sensations to the apparatus; and

at least one processor in communication with the input device, the processor configured to:

receive a first input signal from the input device, the first input signal associated with the first position,

receive a second input signal from the input device, the second input signal associated with the second position,

transmit a first actuator signal to the actuator, the first actuator signal configured to cause the actuator to output a first tactile sensation associated with the first position, and

transmit a second actuator signal to the actuator, the second actuator signal configured to cause the actuator to output a second tactile sensation associated with the second position.

27. (Withdrawn) The apparatus of claim 26, wherein the input device comprises at least one of an analog switch, a force sensing resistor, a strain gauge based sensor, a capacitive touch switch, or a touchpad.

28. (Withdrawn) The apparatus of claim 26, wherein the at least one input device comprises a plurality of input devices, and the at least one actuator comprising a plurality of actuators, each actuator coupled to a distinct input device.

29. (Withdrawn) The apparatus of claim 26, wherein the actuator comprises at least one of a piezo-electric actuator, a voice coil, a moving magnet actuator, or a flexure coupled to a motor.

30. (Previously Presented) An apparatus comprising:

at least one input device comprising a first position and a second position, the input device moveable to the first position upon application of a first pressure to the input device, and moveable to the second position upon application of a second pressure to the input device, the second pressure greater than the first pressure;

at least one actuator in communication with the input device, the actuator configured to output tactile sensations to the apparatus; and

at least one processor in communication with the input device, the processor configured to:

receive a first input signal from the input device, the first input signal associated with the first position,

receive a second input signal from the input device, the second input signal associated with the second position,

transmit a first actuator signal to the actuator, the first actuator signal configured to cause the actuator to output a first tactile sensation associated with the first position, and

transmit a second actuator signal to the actuator, the second actuator signal configured to cause the actuator to output a second tactile sensation associated with the second position;

wherein the input device comprises a pressure-sensitive touchpad, and the apparatus further comprises:

a display panel in communication with the pressure-sensitive touchpad, the display panel configured to receive the tactile sensations from the pressure-sensitive touchpad; and

at least one software-generated button configured to be displayed on the display panel.

31. (Previously Presented) The apparatus of claim 30, wherein the touchpad comprises a pressure calculator to measure the distinct amount of pressure.

32. (Previously Presented) The apparatus of claim 30, further comprising:

an interface object configured to be used to contact a location on the display panel corresponding to the at least one software-generated button; and

a pressure calculator to calculate an amount of pressure based upon an amount of area of the interface object in contact with the display panel.

33. (Previously Presented) The apparatus of claim 32, wherein the interface object comprises a stylus.

34. (Previously Presented) An apparatus comprising:

at least one input device comprising a first position and a second position, the input device moveable to the first position upon application of a first pressure to the input

device, and moveable to the second position upon application of a second pressure to the input device, the second pressure greater than the first pressure;

at least one actuator in communication with the input device, the actuator configured to output tactile sensations to the apparatus; and

at least one processor in communication with the input device, the processor configured to:

receive a first input signal from the input device, the first input signal associated with the first position,

receive a second input signal from the input device, the second input signal associated with the second position,

transmit a first actuator signal to the actuator, the first actuator signal configured to cause the actuator to output a first tactile sensation associated with the first position, and

transmit a second actuator signal to the actuator, the second actuator signal configured to cause the actuator to output a second tactile sensation associated with the second position;

wherein the apparatus comprises at least one of a mobile telephone, a personal computer, or a hand-held computing device.

35. (Withdrawn) An apparatus comprising:

an input device configured to communicate an input signal indicating a position of the input device to an electronic device, the input device configured to move between multiple positions;

at least one actuator in communication with the input device, the actuator configured to output a plurality of tactile sensations to the input device; and

at least one processor in communication with the input device and the actuator, the processor configure to:

- receive the input signal,
- detect the position of the input device,
- to generate an actuator signal configured to cause the actuator to output one of the plurality of tactile sensations based at least on the position of the input device.

36. (Withdrawn) The apparatus of claim 35, wherein the actuator is configured to vary the magnitude of the produced tactile sensation in accordance with the detected position of the input device.

37. (Withdrawn) The apparatus of claim 35, the input device associated with the selection of at least one function of the apparatus, and the actuator further produces a function failure notification tactile sensation upon receipt of the input signal associated with the function and notification of failure of that function.

38. (Withdrawn) The apparatus of claim 35, further comprising a plurality of input devices, each input device capable of communicating a unique input signal to the electronic device and moving between multiple positions.

39. (Withdrawn) A mobile phone comprising the apparatus of claim 38.

40. (Withdrawn) The mobile phone of claim 39, comprising a keypad comprising the plurality of input devices.
41. (Withdrawn) The mobile phone of claim 39, wherein the at least one actuator comprising a plurality of actuators, each actuator coupled to a separate input device.
42. (Withdrawn) The mobile phone of claim 39, comprising a plurality of keys associated, each of the plurality of keys configured to activate a predetermined mobile phone function, and wherein the actuator is configured to produce the tactile sensation associated with each mobile phone function upon receipt of the associated input signal.
43. (Withdrawn) The mobile phone of claim 42, wherein the actuator is configured to produce a function failure notification tactile sensation upon receipt of a function input signal and a notification of failure of that function.

REMARKS

This paper is filed in response to the Office Action mailed December 29, 2009.

Following the amendments above, claims 1, 3-25 and 30-34 are currently pending in this application. Claims 26-29 and 35-43 have been withdrawn. Claims 1-25 and 30-34 are rejected under 35 U.S.C. § 102(b) as allegedly being anticipated by U.S. Patent Publication No. 2008/0068350 to Rosenberg et al (“Rosenberg”).

Applicant has amended claims 1, 9, 10, 17, 18, and 25, and cancelled claim 2. No new matter is added by these amendments and support may be found in the specification and claims as originally filed.

Applicant respectfully traverses each of the Examiner’s rejections of the claims and requests reconsideration and allowance of all claims in light of the amendments above and the remarks below.

I. Claim Amendments

Applicant has amended independent claims 1, 10, and 18 to recite that an actuator signal is based on a pressure relative to two different pressure thresholds. Dependent claims 9, 17, and 25 were amended to recite that different haptic effects may be generated based both on amounts of pressures and which object is contacted by an object. Support for these amendments may be found in the as-filed specification, such in paragraphs 61-67.

II. § 102(b) – Rosenberg – Claims 1-25 and 30-34

Applicant respectfully traverses the rejection of claims 1-25 and 30-34 under 35 U.S.C. § 102(b) as allegedly being anticipated by Rosenberg.

To anticipated a claim under 35 U.S.C. § 102(b), a reference must disclose each and every element of the claimed invention.¹

Because Rosenberg does not disclose “wherein the actuator signal is configured to cause a first haptic effect if the pressure is less than a first pressure threshold and cause a

¹ See M.P.E.P. § 2131.

second haptic effect if the pressure is between the first pressure threshold and a second pressure threshold” as recited in amended claim 1, Rosenberg does not anticipate amended claim 1. Rosenberg discloses outputting haptic effects to a touch-sensitive surface upon an object contacting a graphical object; however, Rosenberg does not disclose outputting different haptic effects based on the sensed amount of pressure when an object contacts the touch-sensitive surface. Therefore, Rosenberg does not anticipate amended claim 1. Applicant respectfully requests the Examiner withdraw the rejection of claim 1.

Like claim 1, claims 10 and 18 each recites “wherein the actuator signal is configured to cause a first haptic effect if the pressure is less than a first pressure threshold and cause a second haptic effect if the pressure is between the first pressure threshold and a second pressure threshold.” Therefore, claims 10 and 18 are each patentable over Rosenberg for at least the same reasons as claim 1. Applicant respectfully requests the Examiner withdraw the rejection of claims 10 and 18.

Regarding claim 30, Rosenberg does not anticipate claim 30 because Rosenberg does not disclose “transmit a first actuator signal to the actuator, the first actuator signal configured to cause the actuator to output a first tactile sensation associated with the first position, and transmit a second actuator signal to the actuator, the second actuator signal configured to cause the actuator to output a second tactile sensation associated with the second position.” As discussed above with respect to claim 1, Rosenberg does not disclose outputting different haptic effects based on the sensed amount of pressure when an object contacts the touch-sensitive surface. Regarding paragraphs 71-77 of Rosenberg, this disclosure relates to outputting haptic effects to a touchscreen; however it does not disclose outputting different haptic effects based on different pressures exerted on the touchscreen. Therefore, Rosenberg does not anticipate claim 30. Applicant respectfully requests the Examiner withdraw the rejection of claim 30.

Like claim 30, claim 34 recites “transmit a first actuator signal to the actuator, the first actuator signal configured to cause the actuator to output a first tactile sensation associated with the first position, and transmit a second actuator signal to the actuator, the second actuator signal configured to cause the actuator to output a second tactile sensation associated with the second position.” Therefore, claim 34 is patentable over

Rosenberg for at least the same reasons as claim 30. Applicant respectfully requests the Examiner withdraw the rejection of claim 30.

Because claims 3-9, 11-17, 19-25, and 31-33 each depend from and further limit one of claims 1, 10, 18, 30, or 34, each of claims 3-9, 11-17, 19-25, and 31-33 is patentable over Rosenberg for at least the same reasons. Applicant respectfully requests the Examiner withdraw the rejection of claims 3-9, 11-17, 19-25, and 31-33.

CONCLUSION

Applicant respectfully asserts that in view of the amendments and remarks above, all pending claims are allowable and Applicant respectfully requests the allowance of all claims.

Should the Examiner have any comments, questions, or suggestions of a nature necessary to expedite the prosecution of the application, or to place the case in condition for allowance, the Examiner is courteously requested to telephone the undersigned at the number listed below.

Date: March 29, 2010

Respectfully submitted,



Carl Sanders
Reg. No. 57,203

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1001 West Fourth Street
Winston-Salem, NC 27101
(336) 607-7474 (voice)
(336) 734-2629 (fax)

Electronic Acknowledgement Receipt

EFS ID:	7301371
Application Number:	11693117
International Application Number:	
Confirmation Number:	8743
Title of Invention:	Method and Apparatus for Providing Tactile Sensations
First Named Inventor/Applicant Name:	Kenneth M. Martin
Customer Number:	34300
Filer:	Carl E. Sanders/Laura Smith
Filer Authorized By:	Carl E. Sanders
Attorney Docket Number:	IMM147.C1
Receipt Date:	29-MAR-2010
Filing Date:	29-MAR-2007
Time Stamp:	10:16:05
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	Miscellaneous Incoming Letter	Transmittal342043.pdf	43944 <small>91943562e192e6ccb7fef454103dff2a8fb0247b</small>	no	1

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2	Amendment Copy Claims/Response to Suggested Claims	Response342043.pdf	655486	no	17
			1b48b49de3425f8e5f907424bd9c3738039a6		

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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

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IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Application of : Kenneth M. Martin et al.
 Application No. : 11/693,117
 Filed : March 29, 2007
 For : METHOD AND APPARATUS FOR PROVIDING
 TACTILE SENSATIONS
 Examiner : Ricardo Osorio
 Art Unit : 2629
 Conf. No. : 8743

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

TRANSMITTAL

Sir:

Transmitted herewith is a copy of the following documents for filing in the above-identified application:

1. Transmittal; and
2. Amendment and Response to Non-Final Office Action

Shown below are the fees for the presentation of the amended claims:

	Claims Remaining	Highest # Previously Paid For	Extra	Rate	Fee
TOTAL	42	43	0	\$52	\$ 0
Ind. Cls.	7	7	0	\$220	\$ 0
Multiple Dependent Claim Added.....					NO
TOTAL					\$ 0

The Commissioner is hereby authorized to charge any deficiency to Deposit Account Number 16-1435.

Date: March 29, 2010
 KILPATRICK STOCKTON LLP
 1001 West Fourth Street
 Winston-Salem, NC 27101-2400
 Telephone: (336) 607-7474
 Fax: (336) 734-2629

Respectfully submitted,

By: Carl Sanders
 Carl Sanders (Reg. No. 57,203)

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I hereby certify that this correspondence is being electronically filed with the United States Patent Office via EFS-Web, on March 29, 2010.

Laura J. Smith
 Laura J. Smith

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PATENT APPLICATION FEE DETERMINATION RECORD Substitute for Form PTO-875	Application or Docket Number 11/693,117	Filing Date 03/29/2007	<input type="checkbox"/> To be Mailed
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APPLICATION AS FILED – PART I			OTHER THAN SMALL ENTITY				
(Column 1)		(Column 2)	SMALL ENTITY <input type="checkbox"/>		OR	SMALL ENTITY	
FOR	NUMBER FILED	NUMBER EXTRA	RATE (\$)	FEE (\$)		RATE (\$)	FEE (\$)
<input type="checkbox"/> BASIC FEE <small>(37 CFR 1.16(a), (b), or (c))</small>	N/A	N/A	N/A		OR	N/A	
<input type="checkbox"/> SEARCH FEE <small>(37 CFR 1.16(k), (l), or (m))</small>	N/A	N/A	N/A			N/A	
<input type="checkbox"/> EXAMINATION FEE <small>(37 CFR 1.16(o), (p), or (q))</small>	N/A	N/A	N/A			N/A	
TOTAL CLAIMS <small>(37 CFR 1.16(i))</small>	minus 20 =	*	X \$ =			X \$ =	
INDEPENDENT CLAIMS <small>(37 CFR 1.16(h))</small>	minus 3 =	*	X \$ =			X \$ =	
<input type="checkbox"/> APPLICATION SIZE FEE <small>(37 CFR 1.16(s))</small>	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 <small>(37 CFR 1.16(j))</small>							
* If the difference in column 1 is less than zero, enter "0" in column 2.			TOTAL			TOTAL	

APPLICATION AS AMENDED – PART II					OTHER THAN SMALL ENTITY				
(Column 1)		(Column 2)	(Column 3)		SMALL ENTITY		OR	SMALL ENTITY	
AMENDMENT	09/30/2009	CLAIMS REMAINING AFTER AMENDMENT	HIGHEST NUMBER PREVIOUSLY PAID FOR	PRESENT EXTRA	RATE (\$)	ADDITIONAL FEE (\$)		RATE (\$)	ADDITIONAL FEE (\$)
	Total <small>(37 CFR 1.16(i))</small>	* 43	Minus	** 43 = 0	X \$ =		OR	X \$52 =	0
	Independent <small>(37 CFR 1.16(h))</small>	* 7	Minus	***5 = 2	X \$ =		OR	X \$220 =	440
	<input type="checkbox"/> Application Size Fee <small>(37 CFR 1.16(s))</small>								
	<input type="checkbox"/> FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM <small>(37 CFR 1.16(j))</small>						OR		
					TOTAL ADD'L FEE		OR	TOTAL ADD'L FEE	440

APPLICATION AS AMENDED – PART II					OTHER THAN SMALL ENTITY				
(Column 1)		(Column 2)	(Column 3)		SMALL ENTITY		OR	SMALL ENTITY	
AMENDMENT	03/29/2010	CLAIMS REMAINING AFTER AMENDMENT	HIGHEST NUMBER PREVIOUSLY PAID FOR	PRESENT EXTRA	RATE (\$)	ADDITIONAL FEE (\$)		RATE (\$)	ADDITIONAL FEE (\$)
	Total <small>(37 CFR 1.16(i))</small>	* 42	Minus	** 43 = 0	X \$ =		OR	X \$52 =	0
	Independent <small>(37 CFR 1.16(h))</small>	* 7	Minus	*** 7 = 0	X \$ =		OR	X \$220 =	0
	<input type="checkbox"/> Application Size Fee <small>(37 CFR 1.16(s))</small>								
	<input type="checkbox"/> FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM <small>(37 CFR 1.16(j))</small>						OR		
					TOTAL ADD'L FEE		OR	TOTAL ADD'L FEE	0

* If the entry in column 1 is less than the entry in column 2, write "0" in column 3.
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 *** If the "Highest Number Previously Paid For" IN THIS SPACE is less than 3, enter "3".

Legal Instrument Examiner:
 /MARQUETTA MCGEE/

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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NOTICE OF ALLOWANCE AND FEE(S) DUE

34300 7590 05/28/2010

PATENT DEPARTMENT (51851)
KILPATRICK STOCKTON LLP
1001 WEST FOURTH STREET
WINSTON-SALEM, NC 27101

EXAMINER
OSORIO, RICARDO
ART UNIT PAPER NUMBER
2629
DATE MAILED: 05/28/2010

Table with 5 columns: APPLICATION NO., FILING DATE, FIRST NAMED INVENTOR, ATTORNEY DOCKET NO., CONFIRMATION NO.

11/693,117 03/29/2007 Kenneth M. Martin IMM147.C1 8743

TITLE OF INVENTION: METHOD AND APPARATUS FOR PROVIDING TACTILE SENSATIONS

Table with 7 columns: APPLN. TYPE, SMALL ENTITY, ISSUE FEE DUE, PUBLICATION FEE DUE, PREV. PAID ISSUE FEE, TOTAL FEE(S) DUE, DATE DUE

nonprovisional NO \$1510 \$300 \$0 \$1810 08/30/2010

THE APPLICATION IDENTIFIED ABOVE HAS BEEN EXAMINED AND IS ALLOWED FOR ISSUANCE AS A PATENT. PROSECUTION ON THE MERITS IS CLOSED. THIS NOTICE OF ALLOWANCE IS NOT A GRANT OF PATENT RIGHTS. THIS APPLICATION IS SUBJECT TO WITHDRAWAL FROM ISSUE AT THE INITIATIVE OF THE OFFICE OR UPON PETITION BY THE APPLICANT. SEE 37 CFR 1.313 AND MPEP 1308.

THE ISSUE FEE AND PUBLICATION FEE (IF REQUIRED) MUST BE PAID WITHIN THREE MONTHS FROM THE MAILING DATE OF THIS NOTICE OR THIS APPLICATION SHALL BE REGARDED AS ABANDONED. THIS STATUTORY PERIOD CANNOT BE EXTENDED. SEE 35 U.S.C. 151. THE ISSUE FEE DUE INDICATED ABOVE DOES NOT REFLECT A CREDIT FOR ANY PREVIOUSLY PAID ISSUE FEE IN THIS APPLICATION. IF AN ISSUE FEE HAS PREVIOUSLY BEEN PAID IN THIS APPLICATION (AS SHOWN ABOVE), THE RETURN OF PART B OF THIS FORM WILL BE CONSIDERED A REQUEST TO REAPPLY THE PREVIOUSLY PAID ISSUE FEE TOWARD THE ISSUE FEE NOW DUE.

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B. If applicant claimed SMALL ENTITY status before, or is now claiming SMALL ENTITY status, check box 5a on Part B - Fee(s) Transmittal and pay the PUBLICATION FEE (if required) and 1/2 the ISSUE FEE shown above.

II. PART B - FEE(S) TRANSMITTAL, or its equivalent, must be completed and returned to the United States Patent and Trademark Office (USPTO) with your ISSUE FEE and PUBLICATION FEE (if required). If you are charging the fee(s) to your deposit account, section "4b" of Part B - Fee(s) Transmittal should be completed and an extra copy of the form should be submitted. If an equivalent of Part B is filed, a request to reapply a previously paid issue fee must be clearly made, and delays in processing may occur due to the difficulty in recognizing the paper as an equivalent of Part B.

III. All communications regarding this application must give the application number. Please direct all communications prior to issuance to Mail Stop ISSUE FEE unless advised to the contrary.

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34300 7590 05/28/2010

**PATENT DEPARTMENT (51851)
 KILPATRICK STOCKTON LLP
 1001 WEST FOURTH STREET
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_____ (Depositor's name)
_____ (Signature)
_____ (Date)

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
11/693,117	03/29/2007	Kenneth M. Martin	IMM147.C1	8743

TITLE OF INVENTION: METHOD AND APPARATUS FOR PROVIDING TACTILE SENSATIONS

APPLN. TYPE	SMALL ENTITY	ISSUE FEE DUE	PUBLICATION FEE DUE	PREV. PAID ISSUE FEE	TOTAL FEE(S) DUE	DATE DUE
nonprovisional	NO	\$1510	\$300	\$0	\$1810	08/30/2010

EXAMINER	ART UNIT	CLASS-SUBCLASS
OSORIO, RICARDO	2629	345-169000

<p>1. Change of correspondence address or indication of "Fee Address" (37 CFR 1.363).</p> <p><input type="checkbox"/> Change of correspondence address (or Change of Correspondence Address form PTO/SB/122) attached.</p> <p><input type="checkbox"/> "Fee Address" indication (or "Fee Address" Indication form PTO/SB/47; Rev 03-02 or more recent) attached. Use of a Customer Number is required.</p>	<p>2. For printing on the patent front page, list</p> <p>(1) the names of up to 3 registered patent attorneys or agents OR, alternatively, 1 _____</p> <p>(2) the name of a single firm (having as a member a registered attorney or agent) and the names of up to 2 registered patent attorneys or agents. If no name is listed, no name will be printed. 2 _____</p> <p>3 _____</p>
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3. ASSIGNEE NAME AND RESIDENCE DATA TO BE PRINTED ON THE PATENT (print or type)

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(A) NAME OF ASSIGNEE _____ (B) RESIDENCE: (CITY AND STATE OR COUNTRY) _____

Please check the appropriate assignee category or categories (will not be printed on the patent) : Individual Corporation or other private group entity Government

<p>4a. The following fee(s) are submitted:</p> <p><input type="checkbox"/> Issue Fee</p> <p><input type="checkbox"/> Publication Fee (No small entity discount permitted)</p> <p><input type="checkbox"/> Advance Order - # of Copies _____</p>	<p>4b. Payment of Fee(s); (Please first reapply any previously paid issue fee shown above)</p> <p><input type="checkbox"/> A check is enclosed.</p> <p><input type="checkbox"/> Payment by credit card. Form PTO-2038 is attached.</p> <p><input type="checkbox"/> The Director is hereby authorized to charge the required fee(s), any deficiency, or credit any overpayment, to Deposit Account Number _____ (enclose an extra copy of this form).</p>
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5. Change in Entity Status (from status indicated above)

a. Applicant claims SMALL ENTITY status. See 37 CFR 1.27. b. Applicant is no longer claiming SMALL ENTITY status. See 37 CFR 1.27(g)(2).

NOTE: The Issue Fee and Publication Fee (if required) will not be accepted from anyone other than the applicant; a registered attorney or agent; or the assignee or other party in interest as shown by the records of the United States Patent and Trademark Office.

Authorized Signature _____ Date _____

Typed or printed name _____ Registration No. _____

This collection of information is required by 37 CFR 1.311. 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, Virginia 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, Virginia 22313-1450.

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Table with 5 columns: APPLICATION NO., FILING DATE, FIRST NAMED INVENTOR, ATTORNEY DOCKET NO., CONFIRMATION NO.
11/693,117 03/29/2007 Kenneth M. Martin IMM147.C1 8743

34300 7590 05/28/2010
PATENT DEPARTMENT (51851)
KILPATRICK STOCKTON LLP
1001 WEST FOURTH STREET
WINSTON-SALEM, NC 27101

Table with 2 columns: EXAMINER, OSORIO, RICARDO; ART UNIT, PAPER NUMBER; 2629
DATE MAILED: 05/28/2010

Determination of Patent Term Adjustment under 35 U.S.C. 154 (b)
(application filed on or after May 29, 2000)

The Patent Term Adjustment to date is 243 day(s). If the issue fee is paid on the date that is three months after the mailing date of this notice and the patent issues on the Tuesday before the date that is 28 weeks (six and a half months) after the mailing date of this notice, the Patent Term Adjustment will be 243 day(s).

If a Continued Prosecution Application (CPA) was filed in the above-identified application, the filing date that determines Patent Term Adjustment is the filing date of the most recent CPA.

Applicant will be able to obtain more detailed information by accessing the Patent Application Information Retrieval (PAIR) WEB site (http://pair.uspto.gov).

Any questions regarding the Patent Term Extension or Adjustment determination should be directed to the Office of Patent Legal Administration at (571)-272-7702. Questions relating to issue and publication fee payments should be directed to the Customer Service Center of the Office of Patent Publication at 1-(888)-786-0101 or (571)-272-4200.

Notice of Allowability

Application No. 11/693,117	Applicant(s) MARTIN ET AL.	
Examiner RICARDO L. OSORIO	Art Unit 2629	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address--

All claims being allowable, PROSECUTION ON THE MERITS IS (OR REMAINS) CLOSED in this application. If not included herewith (or previously mailed), a Notice of Allowance (PTOL-85) or other appropriate communication will be mailed in due course. **THIS NOTICE OF ALLOWABILITY IS NOT A GRANT OF PATENT RIGHTS.** This application is subject to withdrawal from issue at the initiative of the Office or upon petition by the applicant. See 37 CFR 1.313 and MPEP 1308.

- 1. This communication is responsive to 3/29/2010.
- 2. The allowed claim(s) is/are 1,3-25 and 30-34.
- 3. 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 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)).

* Certified copies not received: _____.

Applicant has THREE MONTHS FROM THE "MAILING DATE" of this communication to file a reply complying with the requirements noted below. Failure to timely comply will result in ABANDONMENT of this application.

THIS THREE-MONTH PERIOD IS NOT EXTENDABLE.

- 4. A SUBSTITUTE OATH OR DECLARATION must be submitted. Note the attached EXAMINER'S AMENDMENT or NOTICE OF INFORMAL PATENT APPLICATION (PTO-152) which gives reason(s) why the oath or declaration is deficient.
 - 5. CORRECTED DRAWINGS (as "replacement sheets") must be submitted.
 - (a) including changes required by the Notice of Draftsperson's Patent Drawing Review (PTO-948) attached
 - 1) hereto or 2) to Paper No./Mail Date _____.
 - (b) including changes required by the attached Examiner's Amendment / Comment or in the Office action of Paper No./Mail Date _____.
- Identifying indicia such as the application number (see 37 CFR 1.84(c)) should be written on the drawings in the front (not the back) of each sheet. Replacement sheet(s) should be labeled as such in the header according to 37 CFR 1.121(d).**
- 6. DEPOSIT OF and/or INFORMATION about the deposit of BIOLOGICAL MATERIAL must be submitted. Note the attached Examiner's comment regarding REQUIREMENT FOR THE DEPOSIT OF BIOLOGICAL MATERIAL.

Attachment(s)

- 1. Notice of References Cited (PTO-892)
- 2. Notice of Draftsperson's Patent Drawing Review (PTO-948)
- 3. Information Disclosure Statements (PTO/SB/08),
Paper No./Mail Date 3/26/2010
- 4. Examiner's Comment Regarding Requirement for Deposit of Biological Material
- 5. Notice of Informal Patent Application
- 6. Interview Summary (PTO-413),
Paper No./Mail Date 5/21/2010 .
- 7. Examiner's Amendment/Comment
- 8. Examiner's Statement of Reasons for Allowance
- 9. Other _____.

Examiner-Initiated Interview Summary	Application No. 11/693,117	Applicant(s) MARTIN ET AL.	
	Examiner RICARDO L. OSORIO	Art Unit 2629	

All Participants:

(1) RICARDO L. OSORIO.

(2) CARL SANDERS.

Status of Application: Response to Non-Final

(3) _____.

(4) _____.

Date of Interview: 21 May 2010

Time: _____

Type of Interview:

- Telephonic
 Video Conference
 Personal (Copy given to: Applicant Applicant's representative)

Exhibit Shown or Demonstrated: Yes No

If Yes, provide a brief description:

Part I.

Rejection(s) discussed:

N/A

Claims discussed:

26-29 and 35-43

Prior art documents discussed:

N/A

Part II.

SUBSTANCE OF INTERVIEW DESCRIBING THE GENERAL NATURE OF WHAT WAS DISCUSSED:

Applicant's representative agreed to cancellation of non-elected claims by examiner's amendment to put case in conditions for allowance.

Part III.

- It is not necessary for applicant to provide a separate record of the substance of the interview, since the interview directly resulted in the allowance of the application. The examiner will provide a written summary of the substance of the interview in the Notice of Allowability.
 It is not necessary for applicant to provide a separate record of the substance of the interview, since the interview did not result in resolution of all issues. A brief summary by the examiner appears in Part II above.

/RICARDO L OSORIO/
Primary Examiner, Art Unit 2629

(Applicant/Applicant's Representative Signature – if appropriate)

DETAILED ACTION

EXAMINER'S AMENDMENT

1. An examiner's amendment to the record appears below. Should the changes and/or additions be unacceptable to applicant, an amendment may be filed as provided by 37 CFR 1.312. To ensure consideration of such an amendment, it MUST be submitted no later than the payment of the issue fee.

Authorization for this examiner's amendment was given in a telephone interview with Carl Sanders on 5/21/2010.

The application has been amended as follows:

Cancel claims 26-29 and 35-43.

2. The following is an examiner's statement of reasons for allowance:

Claims 1, 3-25 and 30-34 are allowable since certain key features of the claimed invention are not taught or fairly suggested by the prior art. In claims 1, 10 and 18, "**wherein the actuator signal is configured to cause a first haptic effect if the pressure is less than a first pressure threshold and cause a second haptic effect if the pressure is between the first pressure threshold and a second pressure threshold**". In claims 30 and 34, "**at least one input device comprising a first position and a second position, the input device moveable to the first position upon application of a first pressure to the input device, and moveable to the second position upon application of a second pressure to the input device, the second pressure greater than the first pressure**". The closest prior art of record however singularly or in combination fails to anticipate or render the above underlined limitations obvious.

Any comments considered necessary by applicant must be submitted no later than the payment of the issue fee and, to avoid processing delays, should preferably accompany the issue

Art Unit: 2629


fee. Such submissions should be clearly labeled "Comments on Statement of Reasons for Allowance."

Any inquiry concerning this communication or earlier communications from the examiner should be directed to RICARDO L. OSORIO whose telephone number is (571) 272-7676. The examiner can normally be reached on MONDAY-THURSDAY 7:00 am-5:30 PM.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, AMARE MENGISTU can be reached on (571) 272-7674. 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.

/RICARDO L OSORIO/
Primary Examiner, Art Unit 2629

Issue Classification 	Application/Control No. 11693117	Applicant(s)/Patent Under Reexamination MARTIN ET AL.
	Examiner RICARDO L OSORIO	Art Unit 2629

ORIGINAL						INTERNATIONAL CLASSIFICATION														
CLASS			SUBCLASS			CLAIMED					NON-CLAIMED									
345			169			G	0	9	G	5 / 00 (2006.01.01)										
CROSS REFERENCE(S)																				
CLASS	SUBCLASS (ONE SUBCLASS PER BLOCK)																			
345	156																			

<input type="checkbox"/> Claims renumbered in the same order as presented by applicant																<input type="checkbox"/> CPA		<input type="checkbox"/> T.D.		<input type="checkbox"/> R.1.47	
Final	Original	Final	Original	Final	Original	Final	Original	Final	Original	Final	Original	Final	Original	Final	Original						
1	1	16	17	28	33																
X	2	17	18	29	34																
2	3	18	19	X	35																
3	4	19	20	X	36																
4	5	20	21	X	37																
5	6	21	22	X	38																
6	7	22	23	X	39																
7	8	23	24	X	40																
8	9	24	25	X	41																
9	10	X	26	X	42																
10	11	X	27	X	43																
11	12	X	28																		
12	13	X	29																		
13	14	25	30																		
14	15	26	31																		
15	16	27	32																		

NONE		Total Claims Allowed:	
		43	
(Assistant Examiner)	(Date)	O.G. Print Claim(s)	O.G. Print Figure
/RICARDO L OSORIO/ Primary Examiner.Art Unit 2629	5/21/2010	1	6
(Primary Examiner)	(Date)		

Search Notes 	Application/Control No. 11693117	Applicant(s)/Patent Under Reexamination MARTIN ET AL.
	Examiner RICARDO L OSORIO	Art Unit 2629

SEARCHED			
Class	Subclass	Date	Examiner
345	156, 161, 163, 173, 167-169	5/19/10	RLO

SEARCH NOTES		
Search Notes	Date	Examiner
EAST update and inventor search and interference search history	5/19/10	RLO

INTERFERENCE SEARCH			
Class	Subclass	Date	Examiner
345	169, 156	5/19/10	RLO

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EAST Search History

EAST Search History (Prior Art)

Ref #	Hits	Search Query	DBs	Default Operator	Plurals	Time Stamp
L1	208595	(touch adj (pad or panel or input or screen or sensitive) or touchscreen)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2010/05/19 14:55
L2	178803	L1 and display	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2010/05/19 14:55
L3	13198	L2 and (object or icon or graphic\$4 or gui) near3 touch\$4	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2010/05/19 14:55
L4	13298	L2 and (object or icon or graphic\$4 or gui) near3 (touch\$4 or touch-sensitive)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2010/05/19 14:55
L5	13198	L2 and (object or icon or graphic\$4 or gui) near3 (touch\$4)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2010/05/19 14:55
L6	1289	L5 and actuator	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2010/05/19 14:55
L7	310	L6 and (haptic or force adj feedback or force-feedback or haptic-effect or haptic-feedback)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2010/05/19 14:55
L8	711	L4 and (haptic or force adj feedback or force-feedback or haptic-effect or haptic-feedback)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2010/05/19 14:55

L9	310	L8 and actuator	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2010/05/19 14:55
L10	310	L7 L9	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2010/05/19 14:55
L11	302	L10 and sens\$4	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2010/05/19 14:55
L12	308	L10 and (sens\$4 or detect \$4)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2010/05/19 14:55
L13	26	L12 and first adj2 (fedback or haptic)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2010/05/19 14:55
L14	17	L13 and second adj2 (feedback or haptic)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2010/05/19 14:55
L15	1	L14 and softkey	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2010/05/19 14:55
L16	4	L14 and key	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2010/05/19 14:55
L17	13	L14 not L16	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2010/05/19 14:55

L18	0	L17 and numeric	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2010/05/19 14:55
L19	13	L17 and (cell or cellular or mobile or phone or telephone)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2010/05/19 14:55
L20	2	"6429846".pn.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2010/05/19 14:55
L21	299	((KENNETH) near2 (MARTIN)).INV.	US-PGPUB; USPAT	OR	ON	2010/05/19 14:57
L22	41	((STEVEN) near2 (VASSALLO)).INV.	US-PGPUB; USPAT	OR	ON	2010/05/19 14:57
L23	30	((ALEX) near2 (GOLDENBERG)).INV.	US-PGPUB; USPAT	OR	ON	2010/05/19 14:57
L24	12	((ALEXANDER) near2 (JASSO)).INV.	US-PGPUB; USPAT	OR	ON	2010/05/19 14:57
L25	31	((KOLLIN) near2 (TIERLING)).INV.	US-PGPUB; USPAT	OR	ON	2010/05/19 14:58
L27	368	21 22 23 24 25	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2010/05/19 14:58
L28	4	27 and first adj pressure	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2010/05/19 14:59
L29	4	28 and second adj pressure	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2010/05/19 15:00
L30	0	(display and touch adj sensitive and object and first adj pressure and second adj pressure and first adj haptic adj effect and second adj haptic adj effect).clm.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2010/05/19 15:02

L31	1	(input adj device and first adj position and second adj position and first adj pressure and second adj pressure and first adj tactile adj sensation and second adj tactile adj sensation).clm.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2010/05/19 16:16
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5/19/10 4:38:18 PM

C:\Documents and Settings\rosorio\My Documents\EAST\Workspaces\tactile sensations first through fourth.wsp

PTO/SB/08b(12-09)
 Approved for use through 12/31/2009. OMB 0651-0031
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Substitute for form 1449B/PTO INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Use as many sheets as necessary)		Complete if Known	
		Application Number	11/693,117
		Filing Date	March 29, 2007
		First Named Inventor	Kenneth M. Martin
		Art Unit	2629
		Examiner Name	Ricardo Osorio
		Attorney Docket Number	IMM147.C1 (51851-342043)
Sheet	1	of	1

NON PATENT LITERATURE DOCUMENTS			
Examiner Initials *	Cite No. ¹	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, page(s), volume-issue number(s), publisher, city and/or country where published.	T ²
	1.	Office Action mailed November 25, 2009 for corresponding Korean Application No. 10-2009-7017838.	
	2.	Office Action mailed December 4, 2009 for corresponding Korean Application No. 10-2004-7006627.	
	3.	Office Action dated June 19, 2009 for corresponding Chinese Application No. 200810008845.X	

Examiner Signature	/Ricardo Osorio/	Date Considered	05/19/2010
--------------------	------------------	-----------------	------------

*EXAMINER: Initial if reference considered, whether or not citation is in conformance with MPEP 609. Draw line through citation if not in conformance and not considered.
 Include copy of this form with next communication to applicant.
¹ Applicant's unique citation designation number (optional). ² Applicant is to place a check mark here if English language Translation is attached.
 This collection of information is required by 37 CFR 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 2 hours 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. If you need assistance in completing the form, call 1-800-PTO-9199 and select option 2.



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Table with 5 columns: APPLICATION NO., FILING DATE, FIRST NAMED INVENTOR, ATTORNEY DOCKET NO., CONFIRMATION NO.
11/693,117 03/29/2007 Kenneth M. Martin IMM147.C1 8743

34300 7590 07/09/2010
PATENT DEPARTMENT (51851)
KILPATRICK STOCKTON LLP
1001 WEST FOURTH STREET
WINSTON-SALEM, NC 27101

EXAMINER

OSORIO, RICARDO

ART UNIT PAPER NUMBER

2629

MAIL DATE DELIVERY MODE

07/09/2010

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.



UNITED STATES PATENT AND TRADEMARK OFFICE

Commissioner for Patents
United States Patent and Trademark Office
P.O. Box 1450
Alexandria, VA 22313-1450
www.uspto.gov

Application No. : 11693117
Applicant : Martin
Filing Date : 03/29/2007
Date Mailed : 07/09/2010

NOTICE TO FILE CORRECTED APPLICATION PAPERS

Notice of Allowance Mailed

This application has been accorded an Allowance Date and is being prepared for issuance. The application, however, is incomplete for the reasons below.

Applicant is given 2 month(s) from the mail date of this Notice within which to respond.

The informalities requiring correction are indicated in the attachment(s). If the informality pertains to the abstract, specification (including claims) or drawings, the informality must be corrected with an amendment in compliance with 37 CFR 1.121 (or, if the application is a reissue application, 37 CFR 1.173). Such an amendment may be filed after payment of the issue fee if limited to correction of informalities noted herein. See Waiver of 37 CFR 1.312 for Documents Required by the Office of Patent Publication, 1280 Off. Gaz. Patent Office 918 (March 23, 2004). In addition, if the informality is not corrected until after payment of the issue fee, for purposes of 35 U.S.C. 154(b)(1)(iv), "all outstanding requirements" will be considered to have been satisfied when the informality has been corrected. A failure to respond within the above-identified time period will result in the application being ABANDONED. **This period for reply is NOT extendable under 37 CFR 1.136(a).**

See attachment(s).

*A copy of this notice **MUST** be returned with the reply. Please address response to "Mail Stop Issue Fee, Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450".*

/Anthony McPhail/
Publishing Division
Office of Data Management
(571) 272-4200

IDENTIFICATION OF SPECIFICATION/DRAWING INCONSISTENCIES

- On Page of the specification there is a brief description of FIG. , but the drawings filed do not include a drawing with that designation. Applicant must respond either by supplying the omitted drawing or by amending the specification to remove all references to that drawing.
- The drawings filed 06/18/2007 include FIG. 11, but the specification's brief description of the drawings does not describe a drawing with that designation. Applicant must respond either by amending the specification to add a brief description of that drawing or by correcting the drawings to remove the drawing in question.
- Drawings are present in the application and are referred to in the detailed description of the invention, but the specification does not contain a brief description of the drawings as required by 37 CFR 1.74 and 37 CFR 1.77(b)(8).
- Page of the specification refers to FIG. , but no drawing with that designation is described in the brief description of the drawings and no drawing with that designation is present in the application. Applicant must respond either by amending the specification to remove all references to that drawing, or by supplying that drawing and amending the specification to add a brief description of it.

COMMENTS:

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Application of : Kenneth M. Martin
Application No. : 11/693,117
For : **Method and Apparatus for Providing Tactile Sensations**
Filed : March 29, 2007
Examiner : Ricardo Osorio
Art Unit : 2629

Mail Stop Issue Fee
Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

AMENDMENT AND RESPONSE TO NOTICE TO FILE CORRECTED APPLICATION
PAPERS

Sir:

The following Amendment and Remarks are submitted in response to the Office Action mailed July 9, 2010.

Amendments to the Specification begin on page 2 of this paper.

Remarks begin on page 3 of this paper.

AMENDMENTS TO THE SPECIFICATION

Please amend paragraphs 18 and 19 as follows. Please add new paragraph 20 immediately following amended paragraph 19.

[0018] Figure 9 is a table illustrating a first set of data to be used in one embodiment of the present invention;~~and~~

[0019] Figure 10 is a table illustrating a second set of data to be used in another embodiment of the present invention; and[[.]]

[0020] Figure 11 shows a device for providing tactile sensations according to one embodiment of the present invention.

REMARKS

This paper is filed in response to the Notice to File Corrected Application Papers mailed July 9, 2010 (the "Notice").

The Notice indicated that while the application was filed with 11 figures, the brief description of the drawings did not include a brief description of figure 11. Applicant has amended paragraphs 18 and 19 and added new paragraph 20 to provide a description of Figure 11. In view of the foregoing amendments, Applicant believes all matters identified in the Notice have been corrected.

CONCLUSION

Should the Examiner have any comments or questions, the Examiner is courteously requested to telephone the undersigned at the number listed below.

Date: August 2, 2010

Respectfully submitted,



Carl Sanders
Reg. No. 57,203

KILPATRICK STOCKTON LLP
1001 West Fourth Street
Winston-Salem, NC 27101
(336) 607-7474 (voice)
(336) 734-2629 (fax)

Electronic Acknowledgement Receipt

EFS ID:	8132667
Application Number:	11693117
International Application Number:	
Confirmation Number:	8743
Title of Invention:	METHOD AND APPARATUS FOR PROVIDING TACTILE SENSATIONS
First Named Inventor/Applicant Name:	Kenneth M. Martin
Customer Number:	34300
Filer:	Carl E. Sanders/Laura Smith
Filer Authorized By:	Carl E. Sanders
Attorney Docket Number:	IMM147.C1
Receipt Date:	02-AUG-2010
Filing Date:	29-MAR-2007
Time Stamp:	10:11:14
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	Miscellaneous Incoming Letter	Transmittal342043.pdf	37050 490a458dc9c3296a880559a23ea5073df721fe9e	no	1

Warnings:

Information:

APPLE INC.

2	Amendment after Notice of Allowance (Rule 312)	Response342043.pdf	67355 c3c4a9a2b916d45572dcf17c1ad98c61cbf97473	no	3
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Warnings:

Information:

Total Files Size (in bytes):	104405
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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.

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Application of : Kenneth M. Martin et al.
Application No. : 11/693,117
Filed : March 29, 2007
For : METHOD AND APPARATUS FOR PROVIDING
TACTILE SENSATIONS
Examiner : Ricardo Osorio
Art Unit : 2629
Conf. No. : 8743

Mail Stop Issue Fee
Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

TRANSMITTAL

Sir:

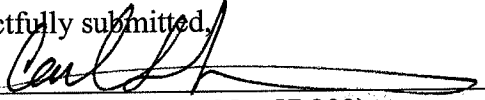
Transmitted herewith is a copy of the following documents for filing in the above-identified application:

1. Transmittal; and
2. Amendment and Response to Notice to File Corrected Application Papers

The Commissioner is hereby authorized to charge any additional fees required by this action, or credit any overpayment, to Deposit Account Number 11-0855.

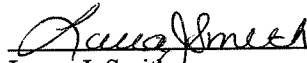
Date: August 2, 2010
KILPATRICK STOCKTON LLP
1001 West Fourth Street
Winston-Salem, NC 27101-2400
Telephone: (336) 607-7474
Fax: (336) 734-2629

Respectfully submitted,

By: 
Carl Sanders (Reg. No. 57,203)

Certificate of Electronic Filing

I hereby certify that this correspondence is being electronically filed with the United States Patent Office via EFS-Web, on August 2, 2010.


Laura J. Smith



UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
Address: COMMISSIONER FOR PATENTS
P.O. Box 1450
Alexandria, Virginia 22313-1450
www.uspto.gov

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
11/693,117	03/29/2007	Kenneth M. Martin	IMM147.C1	8743

34300 7590 08/03/2010
PATENT DEPARTMENT (51851)
KILPATRICK STOCKTON LLP
1001 WEST FOURTH STREET
WINSTON-SALEM, NC 27101

EXAMINER

OSORIO, RICARDO

ART UNIT PAPER NUMBER

2629

MAIL DATE DELIVERY MODE

08/03/2010

PAPER

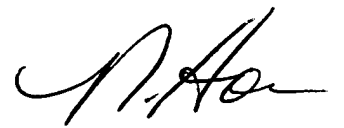
Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

Response to Rule 312 Communication	Application No.	Applicant(s)
	11/693,117	MARTIN ET AL.
	Examiner	Art Unit
	OSORIO, RICARDO	2629

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

1. The amendment filed on 02 August 2010 under 37 CFR 1.312 has been considered, and has been:
- a) entered.
 - b) entered as directed to matters of form not affecting the scope of the invention.
 - c) disapproved because the amendment was filed after the payment of the issue fee.
Any amendment filed after the date the issue fee is paid must be accompanied by a petition under 37 CFR 1.313(c)(1) and the required fee to withdraw the application from issue.
 - d) disapproved. See explanation below.
 - e) entered in part. See explanation below.


Publishing Division

PART B - FEE(S) TRANSMITTAL

Complete and send this form, together with applicable fee(s), to: **Mail** **Mail Stop ISSUE FEE**
Commissioner for Patents
P.O. Box 1450
Alexandria, Virginia 22313-1450
or Fax (571)-273-2885

INSTRUCTIONS: This form should be used for transmitting the ISSUE FEE and PUBLICATION FEE (if required). Blocks 1 through 5 should be completed where appropriate. All further correspondence including the Patent, advance orders and notification of maintenance fees will be mailed to the current correspondence address as indicated unless corrected below or directed otherwise in Block 1, by (a) specifying a new correspondence address; and/or (b) indicating a separate "FEE ADDRESS" for maintenance fee notifications.

CURRENT CORRESPONDENCE ADDRESS (Note: Use Block 1 for any change of address)

Note: A certificate of mailing can only be used for domestic mailings of the Fee(s) Transmittal. This certificate cannot be used for any other accompanying papers. Each additional paper, such as an assignment or formal drawing, must have its own certificate of mailing or transmission.

34300 7590 05/28/2010

PATENT DEPARTMENT (51851)
KILPATRICK STOCKTON LLP
1001 WEST FOURTH STREET
WINSTON-SALEM, NC 27101

Certificate of Mailing or Transmission

I hereby certify that this Fee(s) Transmittal is being deposited with the United States Postal Service with sufficient postage for first class mail in an envelope addressed to the Mail Stop ISSUE FEE address above, or being facsimile transmitted to the USPTO (571) 273-2885, on the date indicated below.

(Depositor's name)
(Signature)
(Date)

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
11/693,117	03/29/2007	Kenneth M. Martin	IMM147.C1	8743

TITLE OF INVENTION: METHOD AND APPARATUS FOR PROVIDING TACTILE SENSATIONS

APPLN. TYPE	SMALL ENTITY	ISSUE FEE DUE	PUBLICATION FEE DUE	PREV. PAID ISSUE FEE	TOTAL FEE(S) DUE	DATE DUE
nonprovisional	NO	\$1510	\$300	\$0	\$1810	08/30/2010

EXAMINER	ART UNIT	CLASS-SUBCLASS
OSORIO, RICARDO	2629	345-169000

1. Change of correspondence address or indication of "Fee Address" (37 CFR 1.363).

Change of correspondence address (or Change of Correspondence Address form PTO/SB/122) attached.

"Fee Address" indication (or "Fee Address" Indication form PTO/SB/47; Rev 03-02 or more recent) attached. Use of a **Customer Number is required.**

2. For printing on the patent front page, list

(1) the names of up to 3 registered patent attorneys or agents OR, alternatively, Kilpatrick Stockton LLP

(2) the name of a single firm (having as a member a registered attorney or agent) and the names of up to 2 registered patent attorneys or agents. If no name is listed, no name will be printed. 2 _____

(3) _____

3. ASSIGNEE NAME AND RESIDENCE DATA TO BE PRINTED ON THE PATENT (print or type)

PLEASE NOTE: Unless an assignee is identified below, no assignee data will appear on the patent. If an assignee is identified below, the document has been filed for recordation as set forth in 37 CFR 3.11. Completion of this form is NOT a substitute for filing an assignment.

(A) NAME OF ASSIGNEE Immersion Corporation

(B) RESIDENCE: (CITY and STATE OR COUNTRY) San Jose, CA

Please check the appropriate assignee category or categories (will not be printed on the patent): Individual Corporation or other private group entity Government

4a. The following fee(s) are submitted:

Issue Fee

Publication Fee (No small entity discount permitted)

Advance Order - # of Copies _____

4b. Payment of Fee(s): (Please first reapply any previously paid issue fee shown above)

A check is enclosed.

Payment by credit card. Form PTO-2038 is attached.

The Director is hereby authorized to charge the required fees, any deficiency, or credit any overpayment, to Deposit Account Number 11-0855 (enclose an extra copy of this form).

5. Change in Entity Status (from status indicated above)

a. Applicant claims SMALL ENTITY status. See 37 CFR 1.27.

b. Applicant is no longer claiming SMALL ENTITY status. See 37 CFR 1.27(g)(2).

NOTE: The Issue Fee and Publication Fee (if required) will not be accepted from anyone other than the applicant; a registered attorney or agent; or the assignee or other party in interest as shown by the records of the United States Patent and Trademark Office.

Authorized Signature Michael Morlock Date 8/27/2010

Typed or printed name Michael Morlock Registration No. 62,245

This collection of information is required by 37 CFR 1.311. 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, Virginia 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, Virginia 22313-1450.

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.

Electronic Patent Application Fee Transmittal

Application Number:	11693117
Filing Date:	29-Mar-2007
Title of Invention:	METHOD AND APPARATUS FOR PROVIDING TACTILE SENSATIONS
First Named Inventor/Applicant Name:	Kenneth M. Martin
Filer:	Michael T. Morlock/Laura Smith
Attorney Docket Number:	IMM147.C1

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:				
Utility Appl issue fee	1501	1	1510	1510
Publ. Fee- early, voluntary, or normal	1504	1	300	300

APPLE INC.

Description	Fee Code	Quantity	Amount	Sub-Total in USD(\$)
Extension-of-Time:				
Miscellaneous:				
Total in USD (\$)				1810

Electronic Acknowledgement Receipt

EFS ID:	8306094
Application Number:	11693117
International Application Number:	
Confirmation Number:	8743
Title of Invention:	METHOD AND APPARATUS FOR PROVIDING TACTILE SENSATIONS
First Named Inventor/Applicant Name:	Kenneth M. Martin
Customer Number:	34300
Filer:	Michael T. Morlock/Laura Smith
Filer Authorized By:	Michael T. Morlock
Attorney Docket Number:	IMM147.C1
Receipt Date:	27-AUG-2010
Filing Date:	29-MAR-2007
Time Stamp:	13:38:42
Application Type:	Utility under 35 USC 111(a)

Payment information:

Submitted with Payment	yes
Payment Type	Credit Card
Payment was successfully received in RAM	\$1810
RAM confirmation Number	11609
Deposit Account	
Authorized User	

File Listing:

Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part / zip (if appl.)	Pages (if appl.)
				APPLE INC.	

1	Miscellaneous Incoming Letter	Transmittal342043.pdf	39042 b680fd25ade8fbf8129505f4e93b032c1c808d16	no	1
Warnings:					
Information:					
2	Miscellaneous Incoming Letter	CommentsOnStatement342043.pdf	41242 2fdee4d0c08f4213c7728b81ae43cb1ac3907c4	no	1
Warnings:					
Information:					
3	Issue Fee Payment (PTO-85B)	PartB342043.pdf	129803 5778cb012ab655a0a982c474e55f17ae16b55423	no	1
Warnings:					
Information:					
4	Fee Worksheet (PTO-875)	fee-info.pdf	31946 38d119be8f3fa9e0b3150d2babde59c914a84d01	no	2
Warnings:					
Information:					
Total Files Size (in bytes):			242033		

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.

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Application of:)
) Conf No.: 8743
Kenneth M. Martin et al.)
) Art Unit: 2629
Serial No. 11/693,117)
) Examiner: Osorio, Ricardo
Filed: March 29, 2007)
)
For: Method And Apparatus For Providing
Tactile Sensations

Mail Stop Issue Fee
Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

TRANSMITTAL

Sir:


Transmitted herewith are the following documents for filing in the above-identified application:

1. Transmittal;
2. Comments on Statement of Reasons for Allowance;
3. Part B – Fee Transmittal (PTOL-85); and
4. EFS-Web payment in the amount of \$1,810.00
(\$1,510.00 – Issue Fee; and \$300.00 – Publication Fee)

The Commissioner is hereby authorized to charge any additional fees required by this action, or credit any overpayment, to Deposit Account Number 11-0855.

Respectfully submitted,

Date: 8/27/2010

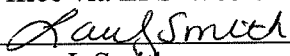


Michael Morlock
Reg. No. 62,245

KILPATRICK STOCKTON LLP
1001 West Fourth Street
Winston-Salem, NC 27101-2400
(336) 607-7300

Certificate of Electronic Filing

I hereby certify that this correspondence is being electronically filed with the United States Patent Office via EFS-Web on August 27, 2010.



Laura J. Smith

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Application of : Kenneth M. Martin et al.
Application No. : 11/693,117
For : Method And Apparatus For Providing Tactile Sensations
Filed : March 29, 2007
Examiner : Osorio, Ricardo
Art Unit : 2629

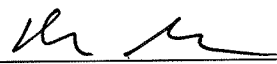
Mail Stop: Issue Fee
Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

COMMENTS ON STATEMENT OF REASONS FOR ALLOWANCE

Under 37 C.F.R. §1.104(e), reasons for allowance are intended only as a supplement to the "record as a whole" when that record is not clear, and shall not be treated as a substitute for the record or in a manner inconsistent with the record. Thus, applicant accepts the examiner's reasons only to the extent that they are consistent with the record as a whole prior to the Examiner's statement of reasons for allowance, and does not accept any claim interpretation that is broader or narrower than that afforded by the record as a whole prior to the examiner's statement of reasons for allowance. No limitation or construction should be inferred from the examiner's statement under rule 104(e).

Respectfully submitted,

Date: 8/27/2010


Michael Morlock
Reg. No. 62,245

KILPATRICK STOCKTON LLP
1001 West Fourth Street
Winston-Salem, NC 27101
(336) 607-7391 (voice)
(336) 734-2756 (fax)



APPLICATION NO.	ISSUE DATE	PATENT NO.	ATTORNEY DOCKET NO.	CONFIRMATION NO.
11/693,117	10/05/2010	7808488	IMM147.C1	8743

34300 7590 09/15/2010
PATENT DEPARTMENT (51851)
KILPATRICK STOCKTON LLP
1001 WEST FOURTH STREET
WINSTON-SALEM, NC 27101

ISSUE NOTIFICATION

The projected patent number and issue date are specified above.

Determination of Patent Term Adjustment under 35 U.S.C. 154 (b) (application filed on or after May 29, 2000)

The Patent Term Adjustment is 431 day(s). Any patent to issue from the above-identified application will include an indication of the adjustment on the front page.

If a Continued Prosecution Application (CPA) was filed in the above-identified application, the filing date that determines Patent Term Adjustment is the filing date of the most recent CPA.

Applicant will be able to obtain more detailed information by accessing the Patent Application Information Retrieval (PAIR) WEB site (<http://pair.uspto.gov>).

Any questions regarding the Patent Term Extension or Adjustment determination should be directed to the Office of Patent Legal Administration at (571)-272-7702. Questions relating to issue and publication fee payments should be directed to the Application Assistance Unit (AAU) of the Office of Data Management (ODM) at (571)-272-4200.

APPLICANT(s) (Please see PAIR WEB site <http://pair.uspto.gov> for additional applicants):

Kenneth M. Martin, Los Gatos, CA;
Steven P. Vassallo, Redwood City, CA;
Alex S. Goldenberg, Portola Valley, CA;
Alexander Jasso, Los Altos, CA;
Kollin Tierling, Milpitas, CA;

AO 120 (Rev. 08/10)

TO: Mail Stop 8 Director of the U.S. Patent and Trademark Office P.O. Box 1450 Alexandria, VA 22313-1450	REPORT ON THE FILING OR DETERMINATION OF AN ACTION REGARDING A PATENT OR TRADEMARK
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In Compliance with 35 U.S.C. § 290 and/or 15 U.S.C. § 1116 you are hereby advised that a court action has been filed in the U.S. District Court District of Delaware on the following

Trademarks or Patents. (the patent action involves 35 U.S.C. § 292.):

DOCKET NO.	DATE FILED 5/5/2016	U.S. DISTRICT COURT District of Delaware
PLAINTIFF Immersion Corporation		DEFENDANT Apple Inc., AT&T Inc., and AT&T Mobility LLC
PATENT OR TRADEMARK NO.	DATE OF PATENT OR TRADEMARK	HOLDER OF PATENT OR TRADEMARK
1 US 8,749,507 B2	6/10/2014	Immersion Corporation
2 US 7,808,488 B2	10/5/2010	Immersion Corporation
3 US 8,581,710 B2	11/12/2013	Immersion Corporation
4 US 7,336,260 B2	2/26/2008	Immersion Corporation
5		

In the above—entitled case, the following patent(s)/ trademark(s) have been included:

DATE INCLUDED	INCLUDED BY <input type="checkbox"/> Amendment <input type="checkbox"/> Answer <input type="checkbox"/> Cross Bill <input type="checkbox"/> Other Pleading	
PATENT OR TRADEMARK NO.	DATE OF PATENT OR TRADEMARK	HOLDER OF PATENT OR TRADEMARK
1		
2		
3		
4		
5		

In the above—entitled case, the following decision has been rendered or judgement issued:

DECISION/JUDGEMENT

CLERK	(BY) DEPUTY CLERK	DATE
-------	-------------------	------

Copy 1—Upon initiation of action, mail this copy to Director Copy 3—Upon termination of action, mail this copy to Director
 Copy 2—Upon filing document adding patent(s), mail this copy to Director Copy 4—Case file copy