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U.S. Patent No.:	8,432,173
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Title:	Capacitive Position Sensor

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DECLARATION OF DR. BENJAMIN B. BEDERSON IN SUPPORT OF PETITION FOR *INTER PARTES* REVIEW OF UNITED STATES PATENT NO. 8,432,173

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1. I, Dr. Benjamin B. Bederson, declare as follows:

I. INTRODUCTION

2. I have been retained by Cypress Semiconductor, Inc., and STMicroelectronics, Inc. (collectively "Petitioners") as an independent expert consultant in this *inter partes* review ("IPR") proceeding before the United States Patent and Trademark Office ("PTO").

3. I have been asked by Petitioners' Counsel ("Counsel") to consider whether certain references teach or suggest the features recited in Claims 1-3, 5-12, and 14-19 of U.S. Patent No. 8,432,173 ("the '173 Patent") (Ex-1001)[1]. My opinions and the bases for my opinions are set forth below. Previously, I provided a similar declaration in IPR2020-00267, which relates to the '173 Patent. That IPR was instituted.

4. I am being compensated at my ordinary and customary consulting rate for my work, which is $600 per hour. My compensation is in no way contingent on the nature of my findings, the presentation of my findings in testimony, or the outcome of this or any other proceeding. I have no other financial interest in this proceeding.

[1] Where appropriate, I refer to exhibits that I understand are attached to the petition for IPR of the '173 Patent.

II. BACKGROUND AND QUALIFICATIONS

5. All of my opinions stated in this declaration are based on my own personal knowledge and professional judgment. In forming my opinions, I have relied on my knowledge and experience in designing, developing, researching, and teaching the technology referenced in this declaration.

6. I am over 18 years of age and, if I am called upon to do so, I would be competent to testify as to the matters set forth herein. I understand that a copy of my current curriculum vitae, which details my education and professional and academic experience, is being submitted as Ex-1003. The following provides a brief overview of some of my experience that is relevant to the matters set forth in this declaration.

7. I am currently Professor Emeritus of Computer Science at the University of Maryland ("UMD"). From 2014 to 2018, I was the Associate Provost of Learning Initiatives and Executive Director of the Teaching and Learning Transformation Center at the UMD. I am a member and previous director of the Human-Computer Interaction Lab ("HCIL"), the oldest and one of the best known Human-Computer Interaction ("HCI") research groups in the country. I was also co-founder and Chief Scientist of Zumobi, Inc. from 2006 to 2014, a Seattle-based startup that is a publisher of content applications and

advertising platforms for smartphones. I am also co-founder and co-director of the International Children's Digital Library ("ICDL"), a web site launched in 2002 that provides the world's largest collection of freely available online children's books from around the world with an interface aimed to make it easy for children and adults to search and read children's books online. I am also cofounder and prior Chief Technology Officer of Hazel Analytics, a data analytics company to improve food safety and better public health whose product sends alerts in warranted circumstances. In addition, I have for more than 15 years consulted for numerous companies in the area of user interfaces, including Microsoft, the Palo Alto Research Center, Sony, Lockheed Martin, Hillcrest Labs, and NASA Goddard Space Flight Center.

8. The devices and methods claimed in the '173 Patent generally relate to user interface technology for electronic devices. For more than 30 years, I have studied, designed, and worked in the field of computer science and HCI. My experience includes 30 years of teaching and research, with research interests in HCI and the software and technology underlying today's interactive computing systems. This includes the design and implementation of hardware and software systems including the use of capacitive and other sensors, and interactive

applications on a range of devices, including embedded systems, controllers, smart phones and PDAs.

9. At UMD, I am focused primarily on the area of HCI, a field that relates to the development and understanding of computing systems to serve users' needs. Researchers and practitioners in this field are focused on making universally usable, useful, efficient, and appealing systems to support people in their wide range of activities. My approach is to balance the development of innovative technology that serves people's practical needs. Example systems following this approach that I have built include Cortex-I (1992 embedded computer vision system that sensed licensed plates with custom motor, camera and controller), Audio Augmented Reality (1995 embedded system for sensing a user's location and playing audio suited to that location), Fisheye Menus (2000 software for sensing movement within and selection of linear list of items in a menu), PhotoMesa (2001 software for end users to browse personal photos), DateLens (2002 software for end users to use their mobile devices to efficiently access their calendar information), SlideBar (2005 linear sensor to control scrolling), LaunchTile (2005 "home screen" software for mobile devices to allow users to navigate apps in a zoomable environment), SpaceTree (2001 software for end users

to efficiently browse very large hierarchies), ICDL (as described above), and StoryKit (a 2009 iPhone app for children to create stories).

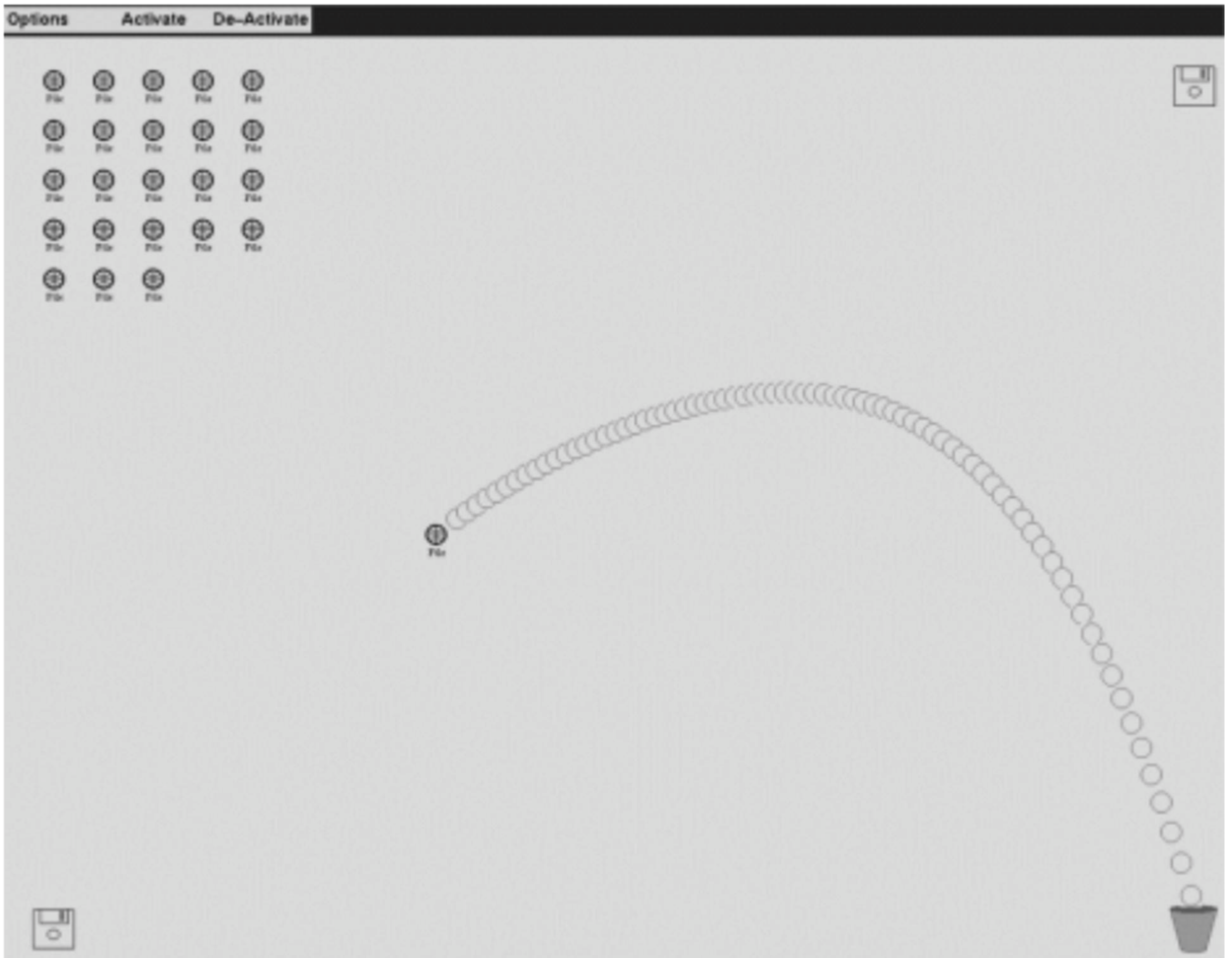
10. Throughout the 1990s and 2000s, I worked on a range of "zoomable user interfaces," which are systems that support the multi-scale and spatial organization of and magnification-based navigation among multiple documents or visual objects. I built several different "ZUI" systems over the years, including Pad++, Jazz and Piccolo. In those systems, I used a range of solutions to allow users to control zooming through the information space. The most common approach for systems with 3 button mice was to use the middle button for zooming in and the right button for zooming out. The user would hold the button down, and the system would smoothly animate zooming in or out – so that the user controlled how much the system zoomed based on the duration that the button was pressed.[2]

11. In 1995 and 1996, I supervised graduate student David Rogers and other students in the development of a user interface approach that allowed a user to "toss" an object across long distances on their screen with their mouse. Motivated by increasingly large computer screens, we recognized a need to help

[2] Benjamin B. Bederson & James D. Hollan, *Pad++: A Zooming Graphical Interface for Exploring Alternate Interface Physics*, USIT '94Proceedings of the 7th Annual ACM Symposium on User Interface Software and Technology 17 (1994), DOI: http://dx.doi.org/10.1145/192426.192435 (Ex-1016).

users move items long distances without necessarily having to drag the item that entire distance manually. Instead, we calculated the speed and direction that the user dragged an object with their mouse. When a user released the mouse button, if the speed was greater than a threshold, our code calculated the path of where to animate the object based on several factors including the speed and direction of the mouse at the time of mouse button release. The figure below from a paper we wrote in 1996 shows the path of a tossed object. This resulted in David Rogers's masters thesis in 1995 and a paper that we submitted to the 1996 Conference on Human Factors in Computing Systems (CHI 1996)[3].

[3] David Rogers et al., *Tossing Objects in a Desktop Environment*, submitted to Conference on Human Factors in Computing Systems (1996) (Ex-1017).



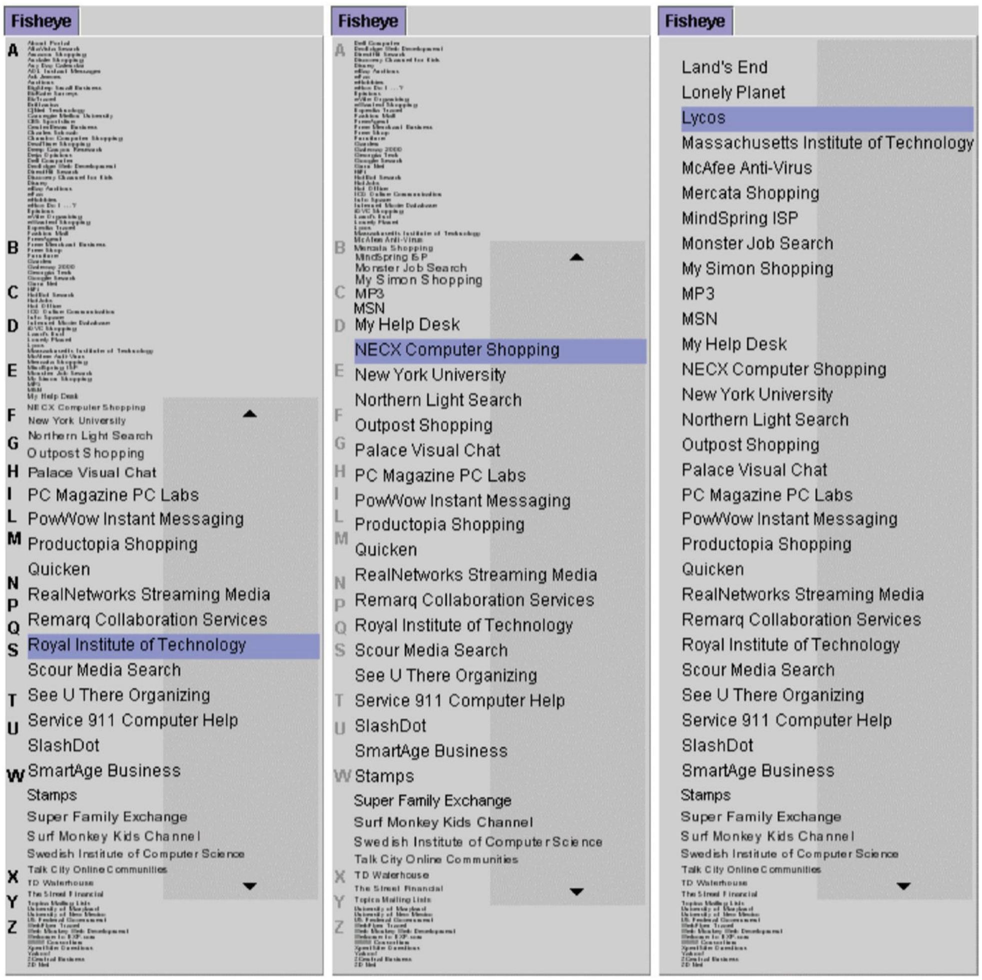
Exemplar Figure of Tossing[4].

12. In 1999 and 2000, I worked on a mechanism to address the challenge that users faced when selecting one item from a long menu. As I described in a paper entitled "Fisheye Menus" that I published in the 2000 Proceedings of the

[4] David Rogers et al., Exemplar Figure of Tossing from *Tossing Objects in a Desktop Environment*, submitted to Conference on Human Factors in Computing Systems (1996) (Ex-1018).

ACM symposium on User Interface Software and Technology,[5] existing techniques typically involved lengthy and slow scrolling techniques. I created an alternative solution that fit all of the elements onto a single screen thereby completely eliminating the need to scroll. This approach used the concept of "fisheye distortion" to shrink some of the elements, while keeping the elements that are under the cursor to be full size so the user could easily see and select them. The fisheye menu operated in two modes. The first mode allowed the user to access the full range of options by moving their finger from top to bottom on the screen. The second "focus lock" mode (accessed by using the right side of the menu) effectively magnified the items being selected by increasing the amount of movement needed to select each item. This approach as depicted in the figure below and described further at Ex-1019, was later used in a number of commercial products such as the Apple MacOS Dock.

[5] Benjamin B. Bederson, *Fisheye Menus*, UCIT '00 Proceedings of ACM Conference on User Interface Software and Technology 217 (2000), DOI: 10.1145/354401.317382 (Ex-1019).



Ex-1019, Figure 4.

13. Starting in 2000, I supervised graduate student Leslie Chipman who was working on a general solution to improve the user experience of people scrolling long documents on computers. Our solution relied on a passive haptic physical linear input device we called the "SlideBar." The SlideBar was designed to sit on either side of the keyboard to be used with the non-dominant hand for scanning and rough positioning, and then if the user wanted to switch to reading,

the dominant hand could be used for more accurate positioning. With a physical range of motion of approximately two inches, the full range could be accessed by moving just the fingers without moving the entire hand. This took advantage of human proprioception – the fact that people have excellent ability to know where their body is and allowed the user to scroll long documents completely eyes-free. They did not need to look at the device or the screen to, for example, move a mouse pointer to a graphical scroll bar. Instead they could focus on their primary task of reading. Because the document could be scrolled by a mechanism other than the SlideBar, I explained that "The control software has been designed so that as soon as the SlideBar is moved at all, the document viewing windows jumps to the position that corresponds to the SlideBar." See page 3 of a paper I published describing this work in 2004.[6]

14. In April 2000, I visited Professors Wayne Westerman and John Elias at the University of Delaware and gave a talk entitled "Zoomable User Interfaces and Single Display Groupware." This resulted in a collaboration with Professor Westerman, graduate student Hilary Browne, and others where we used their FingerWorks capacitive Multi-Touch Surface as the input device for a multi-touch

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[6] Leslie E Chipman et al., *SlideBar: Analysis of a Linear Input Device*, 23 Behaviour & Info. Tech. 1 (2004), DOI: 10.1080/01449290310001638487 (Ex-1020).

finger painting program for children. The project used this input device to support a computer painting program that allowed children to paint with their fingers by directly touching the sensing surface. In contrast to the mouse input more typically used in this time period, this approach enabled us to create a more natural interaction environment. This work, depicted in the figure below, was published in a September 2000 technical report.[7]

Ex-1021, Figure 1.

15. LaunchTile led to my creation of Zumobi in 2006, where I was responsible for investigating new software platforms and developing new user interface designs that provide efficient and engaging interfaces to permit end users

[7] Hilary Browne et al., Designing a Collaborative Finger Painting Application for Children, HCIL-2000-17, CS-TR-4184, UMIACS-TR-2000-66 (Sept. 2000), available at https://hcil.umd.edu/pub-perm-link/?id=2000-17 (Ex-1021).

to access a wide range of content on mobile platforms (including the iPhone and Android-based devices). For example, I designed and implemented software called "Ziibii," a "river" of news for iPhone that used a capacitive sensor for controlling linear movement through news, software called "ZoomCanvas," a zoomable user interface for several iPhone apps, and iPhone apps including "Inside Xbox" for Microsoft and Snow Report for REI. At the ICDL, I have since 2002 been the technical director responsible for the design and implementation of the web site, www.childrenslibrary.org (originally at www.icdlbooks.org). In particular, I have been closely involved in designing the user interface as well as the software architecture for the web site since its inception in 2002.

16. Beginning in the mid-1990s, I have been responsible for the design and implementation of numerous other web sites in addition to the ICDL. For example, I designed and built my own professional web site when I was an Assistant Professor of Computer Science at the University of New Mexico in 1995. I moved that site to UMD in 1998 and continued to update it. It is currently at http://www.cs.umd.edu/~bederson/. I have also designed and written the code for numerous project web sites, such as Pad++, http://www.cs.umd.edu/hcil/pad++/. I received the Janet Fabri Memorial Award for Outstanding Doctoral Dissertation for my Ph.D. work in robotics and computer vision. I have combined my hardware

and software skills throughout my career in HCI research, building various interactive electrical and mechanical systems that couple with software to provide an innovative user experience.

17. My work has been published extensively in more than 160 technical publications, and I have given about 100 invited talks, including 9 keynote lectures. I have won a number of awards including the Brian Shackel Award for "outstanding contribution with international impact in the field of HCI" in 2007, and the Social Impact Award in 2010 from the Association for Computing Machinery's ("ACM") Special Interest Group on Computer Human Interaction ("SIGCHI"). ACM is the primary international professional community of computer scientists, and SIGCHI is the primary international professional HCI community. I have been honored by both professional organizations. I am an "ACM Distinguished Scientist," which "recognizes those ACM members with at least 15 years of professional experience and 5 years of continuous Professional Membership who have achieved significant accomplishments or have made a significant impact on the computing field." I am a member of the "CHI Academy," which is described as follows: "The CHI Academy is an honorary group of individuals who have made substantial contributions to the field of HCI. These are the principal leaders of the field, whose efforts have shaped the disciplines and/or

industry, and led the research and/or innovation in human-computer interaction." The criteria for election to the CHI Academy are: (1) cumulative contributions to the field; (2) impact on the field through development of new research directions and/or innovations; and (3) influence on the work of others.

18. I have appeared on radio shows numerous times to discuss issues relating to user interface design and people's use and frustration with common technologies, web sites, and mobile devices. My work has been discussed and I have been quoted by mainstream media around the world over 120 times, including by the New York Times, the Wall Street Journal, the Washington Post, Newsweek, the Seattle Post Intelligencer, the Independent, Le Monde, NPR's All Things Considered, New Scientist Magazine, and MIT's Technology Review.

19. I have designed, programmed, and publicly deployed dozens of user-facing software products that have cumulatively had millions of users. My work is cited by several major companies, including Amazon, Apple, Facebook, Google, and Microsoft. I am a named inventor on 12 U.S. patents and 18 U.S. patent applications. The patents are generally directed to user interfaces/experience.

20. I received a B.S. degree in Computer Science with a minor in Electrical Engineering in 1986 from the Rensselaer Polytechnic Institute. I

received M.S. and Ph.D. degrees in Computer Science in 1989 and 1992, both from New York University.

III. INFORMATION CONSIDERED

21. In preparation for this declaration, I have considered the materials discussed in this declaration, including, for example, the ’173 Patent, the references cited by the ’173 Patent, the prosecution histories of the ’173 Patent and applications from which it derives (including the references cited therein), various background articles and materials referenced in this declaration, and the prior art references identified in this declaration. In addition, my opinions are further based on my education, training, experience, and knowledge in the relevant field.

IV. RELEVANT LEGAL STANDARDS

22. I am not an attorney and offer no legal opinions. For the purposes of this Declaration, I have been informed about certain aspects of the law that are relevant to my analysis, as summarized below.

A. Claim Interpretation

23. I have been informed and understand that in an IPR proceeding, claims are to be interpreted according to the *Phillips* claim construction standard. I have been informed and understand that claim construction is a matter of law and

that the final claim constructions for this proceeding will be determined by the Patent Trial and Appeal Board ("PTAB").

B. Perspective of One of Ordinary Skill in the Art

24. I have been informed and understand that a patent is to be understood from the perspective of a hypothetical "person of ordinary skill in the art" ("POSITA"). Such an individual is considered to possess normal skills and knowledge in a particular technical field (as opposed to being a genius). I understand that in considering what the claims of a patent require, what was known prior to that patent, what a prior art reference discloses, and whether an invention is obvious or not, one must use the perspective of such a POSITA.

C. Obviousness

25. I have been informed and understand that a patent claim is obvious under 35 U.S.C. § 103, and therefore invalid, if the claimed subject matter, as a whole, would have been obvious to a POSITA as of the priority date of the patent based on one or more prior art references and/or the knowledge of a POSITA.

26. I understand that an obviousness analysis must consider (1) the scope and content of the prior art, (2) the differences between the claims and the prior art, (3) the level of ordinary skill in the pertinent art, and (4) secondary considerations, if any, of non-obviousness (such as unexpected results, commercial success, long-

felt but unmet need, failure of others, copying by others, and skepticism of experts).

27. I understand that a prior art reference may be combined with other references to disclose each element of the invention under 35 U.S.C. § 103. I understand that a reference may also be combined with the knowledge of a POSITA, and that this knowledge may be used to combine multiple references. I further understand that a POSITA is presumed to know the relevant prior art. I understand that the obviousness analysis may take into account the inferences and creative steps that a POSITA would employ.

28. In determining whether a prior art reference would have been combined with other prior art or other information known to a POSITA, I understand that the following principles may be considered:

a. whether the references to be combined involve non-analogous art;

b. whether the references to be combined are in different fields of endeavor than the alleged invention in the Patent;

c. whether the references to be combined are reasonably pertinent to the problems to which the inventions of the Patent are directed;

d. whether the combination is of familiar elements according to known methods that yields predictable results;

e. whether a combination involves the substitution of one known element for another that yields predictable results;

f. whether the combination involves the use of a known technique to improve similar items or methods in the same way that yields predictable results;

g. whether the combination involves the application of a known technique to a prior art reference that is ready for improvement, to yield predictable results;

h. whether the combination is "obvious to try";

i. whether the combination involves the known work in one field of endeavor prompting variations of it for use in either the same field or a different one based on design incentives or other market forces, where the variations are predictable to a POSITA;

j. whether there is some teaching, suggestion, or motivation in the prior art that would have led one of ordinary skill in the art to modify the prior art reference or to combine prior art reference teachings to arrive at the claimed invention;

k. whether the combination requires modifications that render the prior art unsatisfactory for its intended use;

l. whether the combination requires modifications that change the principle of operation of the reference;

m. whether the combination is reasonably expected to be a success; and

n. whether the combination possesses the requisite degree of predictability at the time the invention was made.

29. I understand that in determining whether a combination of prior art references renders a claim obvious, it is helpful to consider whether there is some teaching, suggestion, or motivation to combine the references and a reasonable expectation of success in doing so. I understand, however, that a teaching, suggestion, or motivation to combine is not required.

V. LEVEL OF ORDINARY SKILL IN THE ART

30. I understand that in a prior ITC Investigation, the Administrative Law Judge found, with respect to the '173 Patent and the other patents at issue in that investigation, "one of ordinary skill in the art would have had a bachelor's degree

in electrical engineering, computer engineering, computer science, or a related field, and at least two years of experience in the research, design, development, and/or testing of touch sensors, human-machine interaction and interfaces, and/or graphical user interfaces, and related firmware and software, or the equivalent, with additional education substituting for experience and vice versa." I further understand that the PTAB adopted this same standard in a prior IPR relating to the '173 Patent. I agree with this statement of the level of skill in the art.

31. In determining the level of ordinary skill in the art, I considered, for example, the type of problems encountered in the art, prior art solutions to those problems, the rapidity with which innovations are made, the sophistication of the technology, and the educational level of active workers in the field.

32. I met the definition of a POSITA in 2006. I also had greater knowledge and experience than a POSITA. I worked with POSITAs in 2006, and I am able to render opinions from the perspective of a POSITA based on my knowledge and experience. My opinions concerning the '173 Patent claims and the prior art are from the perspective of a POSITA, as set forth above.

VI. SUMMARY OF MY OPINIONS

33. I have been asked to consider whether the claims of the '173 Patent are obvious over certain prior art references. As explained below in detail in this declaration, it is my opinion that:

- Claims 1-2, 8-11, and 17-19 are rendered obvious by US Patent Publication 2004/0252109 ("Trent") in light of the knowledge of a POSITA.
- Claims 1-3, 5-12, and 14-19 are rendered obvious by Trent in view of US Patent No. 6,229,456 ("Engholm"), and further in light of the knowledge of a POSITA.
- Claims 1-3, 5-12, and 14-19 are rendered obvious by U.S. Patent No. 5,559,301 ("Bryan") in view of Trent and Engholm, and further in light of the knowledge of a POSITA.

VII. TECHNOLOGICAL BACKGROUND

34. The '173 Patent is directed to well-known human user interface touch sensor technology for electronic devices comprising "receiving one or more first signals indicating one or more first capacitive couplings of an object with a sensing element that comprises a sensing path that comprises a length. The first capacitive couplings correspond to the object coming into proximity with the sensing element at a first position along the sensing path of the sensing element. The method includes determining based on one or more of the first signals the first position of the object along the sensing path and setting a parameter to an initial value based

on the first position of the object along the sensing path. The initial value includes a particular parameter value and is associated with a range of parameter values. The range of parameter values is associated with the length of the sensing path." Ex-1001, Abstract.

35. To provide background for the element-by-element analysis of the claims to follow, below I will present an overview of the state of the art existing as of the time of the alleged invention relating to the use of capacitive touch sensor technology in user interfaces for electronic devices to set and adjust the value of a parameter within a range of parameters, based on touches and displacements along a sensing path. As I will describe below, all of these technologies and techniques for adjusting the value of a parameter based within a range of parameters, based on touches and displacements along a sensing path were well-known to those of ordinary skill in the art at the time of the alleged invention claimed in the '173 Patent, and a POSITA would have readily understood the combination of elements of Claims 1-3, 5-12, and 14-19 to have been obvious.

A. Capacitive Touch Sensors Were Well-Known And Widely Used In Electronic Devices At The Time Of The Alleged Invention

36. Capacitive touch sensors were well-known and widely deployed in electronic devices well before the alleged invention claimed in the '173 Patent as

demonstrated by its disclosure in prior art references, as well as its utilization in commercial devices. The ’173 Patent admits that, at the time of filing, capacitive touch sensors had “become increasingly common and accepted in human interfaces and for machine control.” Ex-1001, 1:27-29. Moreover, the patent admits that, “[i]n the field of home appliances, it is now ***quite common*** to find capacitive touch controls operable through glass or plastic.” *Id.*, 1:29-31 (emphasis added). For example, “[e]lectrical appliances, such as TV’s, washing machines, and cooking ovens increasingly have capacitive sensor controls for adjusting various parameters, for example volume, time and temperature.” *Id.*, 1:34-37.

37. In fact, capacitive touch sensors on touch sensitive displays had been known since at least 1966. *See, e.g.*, U.S. Patent No. 3,482,241 (Ex-1022), 1:22-24 (“Either resistance change or capacitance charge across the actuated contact may be sensed.”) It was also well-known to use capacitive sensing techniques to allow a person to touch a pad that was separate from a screen as shown by Waldron in 1977. *See generally* U.S. Patent No. 4,136,291 (Ex-1023). Capacitive sensors have continued to be used for decades in a wide variety of applications, such as for the use in emulating a mice or keyboard. *See generally, e.g.*, U.S. Patent No. 5,463,388 (Ex-1024).

38. An example demonstrating that capacitive touch screens for electronic devices were well-known prior to the invention claimed in the ’173 Patent is found in EP1273851A2 which is cited and described by the ’173 Patent. Specifically, EP1273851A2 discloses a “device for adjusting temperature settings, power settings or other parameters of a cooking apparatus” using a “capacitive touch sensor” that is “sensitive to the touch of a finger.” Ex-1001, 1:45-51; Ex-1009. The ’173 Patent also lists a number of other prior art references disclosing the use of capacitive touch sensors in electronic devices. Ex-1001, 2:11-25(“[L]inear, curved and circular sensor strips for adjusting cooker settings have been known for many years, for example see U.S. Pat. No. 4,121,204 (resistive or capacitive sensor)” and “DE19645907 (capacitive sensor)” . . . . WO2006/133976A1, WO2007/006624A1 and WO2007/023067A1 are more recent examples of work on touch-sensitive control strips for domestic appliances using capacitive sensors.”).

B. Software Engineering Practices And The Irrelevance Of Particular Sensing Technology

39. Over the years, the field of software engineering has developed a number of standard technical approaches to structuring software to make computing systems more reliable and easier to develop. A key such principle is called “separation of concerns” which refers to the idea that by separating the

components of a technical system and minimizing the coordination between them, each can be developed, tested, and updated separately from each other. "Separation of concerns is at the core of software engineering, and has been for decades. In its most general form, it refers to the ability to identify, encapsulate, and manipulate only those parts of software that are relevant to a particular concept, goal, or purpose."[8] This decreases cost and complexity while increasing reliability. This principle is applied in innumerable places that are often quite visible (e.g., changing the tires on your car does not require you to change the wheels that the tires are mounted on.) In computer systems, this principle lets you upgrade your operating system without having to change your personal documents.

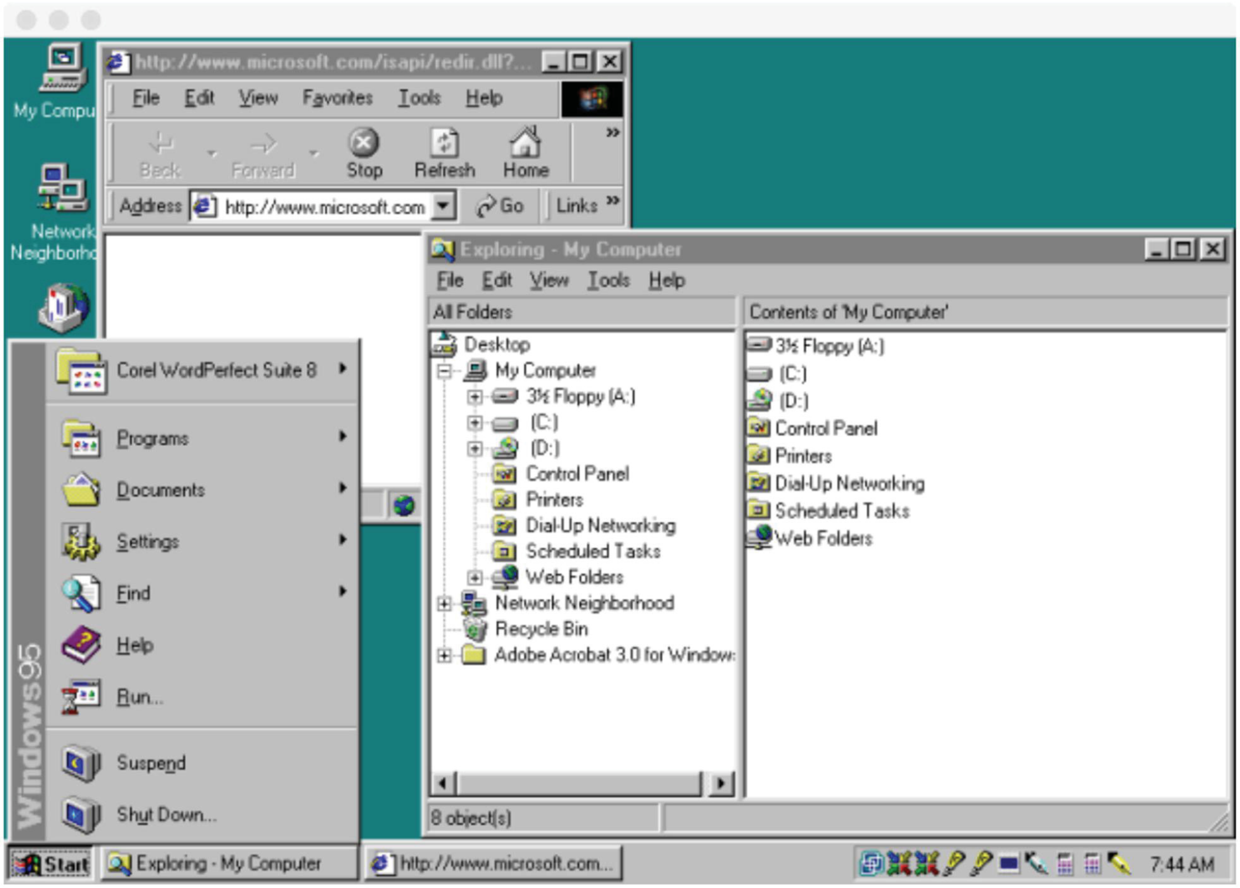
40. One application of the "separation of concerns" principle is in the separation of the specific sensing technology from an application's use of a touch sensor. In my own experience building Pad++, the application code needed to know what portion of the screen a person indicated, but it did not matter how the person indicated that position. In fact, I would sometimes use a mouse, a capacitive touch screen sensor or a resistive touch screen sensor without changing

[8] Peri Tarr et al., *Workshop on Multi-Dimensional Separation of Concerns in Software Engineering*, ICSE '00 Proceedings of the 22nd International Conference on Software Engineering 809, 809 (2000), DOI: https://doi.org/10.1145/337180.337827 (Ex-1025).

a single line of application code – because the code was completely unaware of the sensing technology. This separation of concerns was both common and a standard best practice of software engineers. Similarly, the ’173 Patent itself describes prior art U.S. Pat. No. 4,121,204 as providing either resistive or capacitive sensing capabilities to provide the claimed linear sensing application. Ex. 1001, 2:11-16.

C. User Input Disambiguation

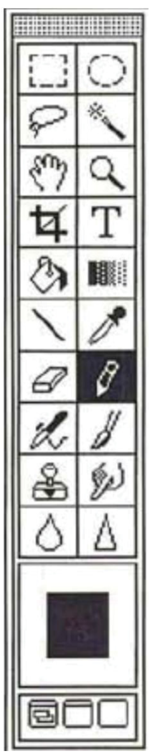
41. An essential responsibility of graphical user interface designers is to provide a way for users to trigger desired commands. The most visually obvious way to do this is to provide a different visual element such as a button or menu that can be interacted with to trigger each command, each one at a different location on the display. For example, in Windows 95, the screenshot below shows that the action of pressing the “Start” menu displays a menu. Pressing either of the two adjacent buttons labeled “Exploring - My Computer” or “http://www.microsoft.com“ would display the corresponding window on top and give it focus to accept user input. In other words, the location of the element could be used to control the command.



Windows 95 Screenshot taken by me on February 11, 2019 using VMWare emulator.

42. However, having only one command per visual element can be too limiting. To provide more command options to user, designers have developed many additional ways to trigger different actions. At a high level, these can be categorized into fixed groups including: *location, modes, different buttons, repetition, duration, and movement*. Modes are a mechanism where there is some way to control what will happen when the user performs the same interaction.

Adobe Photoshop's toolbox (depicted below)[9] is fundamentally a mode-switching tool. Whatever button is pressed will change the "mode" of the application so that subsequently, clicking on the content in the main work area will do something different depending on the mode that is set. For example, selecting the "grabber" (or "hand") tool will change the mode so that clicking and dragging on the content will drag the content to directly follow the pointer's movement.



Ex-1026, at 28.

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[9] Adobe Systems Inc., Adobe Photoshop User Guide (1990) (Ex-1026), at 28, available at https://archive.computerhistory.org/resources/access/text/2013/01/102640940-05-01-acc.pdf.

The grabber tool

The grabber tool lets you scroll through an image that is too large to fit in the active window. You can scroll in any direction without using the scroll bars on the window by temporarily switching from one of the painting tools to the grabber tool.

Grabber tool (commonly called the "hand" tool).[10]

43. Another way that different commands can be used is to provide different buttons (e.g., the secondary button of a mouse can be used to trigger a context menu in Windows 95). Or buttons on the keyboard can be depressed as a "modifier" while a mouse button is clicked. With keyboards often having modifier keys such as "Shift," "Control," "Alt," and "Command," this gives the designer the ability to provide additional options about which command should be triggered when using a mouse. For example, pressing a button while the "Alt" key is depressed might show additional options in a menu, or dragging a graphical item with the mouse while the keyboard "Shift" key is depressed might constrain the dragging to strictly horizontal or vertical movement.

44. Windows 95 also supported using repetition to distinguish between commands. The number of mouse button clicks sensed within a time period could be used to control what command was issued. For example, "single clicking" on an item in the "Explorer" file manager would select an item, but "double clicking"

[10] Ex-1026, at 31.

(that is, two clicks within a predetermined time period) that same item would open it.

45. Duration of interaction was another way that designers used to control what command a user issued. For example, moving the mouse over an element in Windows 95 and holding it steady for a fixed period ("hovering") would display a "tool tip" that described the element under the mouse pointer. The following screenshot shows the tool tip "Click here to begin" when the mouse is held steady over the "Start" menu button.

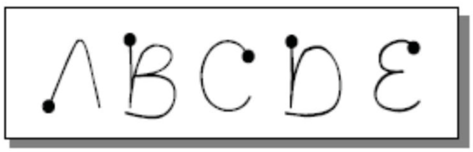
Windows 95 screenshot taken by me on February 11, 2019, using VMWare emulator.

46. The movement of a pointing device including where it moved and how fast it moved could also be interpreted to control what command was generated. For example, as shown in the 1997 PalmPilot Handbook below[11], that device let users command the system to enter different textual characters

[11] 3Com Corp., PalmPilotTM Handbook (1997) (Ex-1027), at 29, available at https://www.pdm.com.co/Articulos%20y%20Guias/Palm/Guias%20en%20ingles/PalmPilot%20User%20Guide.pdf ?x81790.

depending on what they drew with a stylus. I used speed of the input device movement to "toss" objects on a desktop in my own work in 1996 as described above in the section on my qualifications.

> ■ If you draw the character shape exactly as shown in the tables later in this chapter (like the shapes shown in the following diagram), you will achieve 100% accuracy for entering text.



Ex-1027, at 29.

47. A designer would make decisions about which of these mechanisms (i.e., location, modes, different buttons, repetition, duration, or movement) to use based on various characteristics of the system and user. One important characteristic was what kind of input devices were available to the user. For any graphical user interface with a screen, relying on location of objects was straight forward. If there were a mouse with multiple buttons and a keyboard, then relying on repetition and different buttons made a lot of sense. And because there were so many input options, duration was less important. And since it was hard to precisely control movement with a mouse, relying on gestures made less sense.

48. However, when the input device was primarily a touch screen or touch pad, then the trade-offs shifted. With what was often fewer or no buttons or keys

available, the designer would be more likely to rely on duration and gesture. Gesture was especially natural since it is generally easier to precisely control input movement on a touch screen or touch pad than it is with a mouse.

49. Additionally, another commonly used and well known method of user input was often referred to as “sliders”. For example, sliders were used in Windows XP to adjust parameters within a set range. *See, e.g.*, Exhibit 1031 (Microsoft Windows Interface Guidelines for Software Design) at 167. For example, it was well known that: “The user moves the slide indicator by dragging to a particular location or clicking in the hot zone area of the bar, which moves the slide indicator directly to that location.”

Sliders

Use a slider for setting or adjusting values on a continuous range of values, such as volume or brightness. A *slider* is a control, sometimes called a trackbar control, that consists of a bar that defines the extent or range of the adjustment, and an indicator that both shows the current value for the control and provides the means for changing the value, as shown in Figure 7.26.

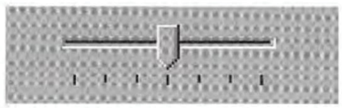


Figure 7.26 A slider

Because a slider does not include its own label, use a static text field to create one. You can also add text and graphics to the control to help the user interpret the scale and range of the control.

Sliders support a number of options. You can set the slider orientation as vertical or horizontal, define the length and height of the slide indicator and the slide bar component, define the increments of the slider, and whether to display tick marks for the control.

The user moves the slide indicator by dragging to a particular location or clicking in the hot zone area of the bar, which moves the slide indicator directly to that location. To provide keyboard interaction, support the TAB key and define an access key for the static text field you use for its label. When the control has the input focus, arrow keys can be used to move the slide indicator in the respective direction represented by the key.

VIII. THE CHALLENGED PATENT

50. The ’173 Patent describes an asserted improvement to electromechanical controls, such as the dial on an oven or TV. It utilizes known capacitive sensors and the known concept of measuring displacement from point A to point B on that sensor (e.g., angular rotation around a circle) to set and adjust a parameter, such as the temperature of a cooking oven or volume of an MP3 player. Ex-1001 at 5:27-37, 7:55-57, 7:45-49.

51. The patent explains that capacitive touch sensors, including those that are linear, curved, or circular, "have been known for many years" and were used to adjust parameters, such as the temperature on "a cooking apparatus." *Id*. at 2:1112, 1:45-49. The patent also admits that such prior art sensors included multiple modes to allow fine adjustment of a parameter. *Id*. at 1:47-2:44. For example, the patent describes prior art patent application EP1273851, which discloses a sensor having parameter values "mapped onto the [sensor] strip" that covered the entire temperature range from the minimum value (*i.e.*, "the off condition of the domestic appliance") to the "maximum value." *Id*. at 1:54-58. A user selects a temperature using a "finger touch on the capacitive touch sensor." *Id*. at 1:50-54, 2:29-31. If the user touched the strip for ten seconds, the sensor would enter a "zoom mode." *Id*. at 1:64-67. In the zoom mode, the parameter values would be remapped onto the sensor strip to include only 10% of the original parameter range. *Id*. at 1:67-2:8. Zoom mode allowed the user to make a "finer adjustment" of temperature because a smaller temperature range was mapped onto the strip. *Id*. at 2:2-10. However, prior art implementations of the zoom function allegedly had "limitations regarding the manner in which the transition [was] effected from the full range mode to the zoom mode," such as the ten-second wait time to switch to the zoom mode in EP1273851. *Id*. at 2:51-56.

52. The ’173 Patent claims to improve on the prior art with a two-mode circular capacitive touch sensor, as shown below in Figures 1 and 2A:

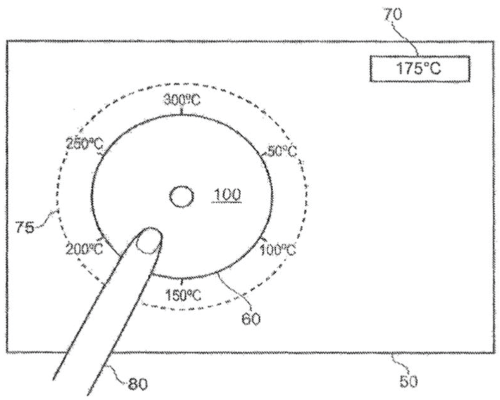


FIG. 1

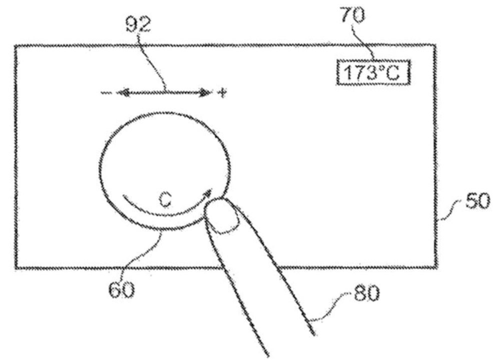


FIG. 2A

Figure 1 shows “a first mode of operation in which a user’s finger is used to select a cooking temperature” of 175° C. *Id*. at 7:61-63. Figure 2A shows a “second mode of operation” that is “automatically enter[ed] ... after a temperature has been selected in the first mode of operation.” *Id*. at 8:9-12. In the second mode, a “user is able to increase or decrease the temperature selected in a first mode” by “displac[ing] their finger in proximity with the sensing element 100 in an anti-clockwise direction to decease the temperature....” *Id*. at 8:13-23. However, the temperature is changed only if the displacement along the sensing path exceeds a “threshold angle,” such as 20°. *Id*. at 8:15-20. When that threshold is exceeded, the temperature changes only by 1° C. *Id*. This adjustment method is allegedly "advantageous[]" because it provides a "finer" resolution that "allows a user to accurately select a desired temperature." *Id*. at 8:30-36.

IX. PATENT PROSECUTION HISTORY

53. The '173 Patent issued from Application 13/332,945, which is a continuation of two prior applications, 12/703,614, and 11/868,566, and which further claims priority to provisional application 60/862,385 filed on October 20, 2006. Application 13/332,945 was filed on May 27, 2011. A first notice of allowance was issued on June 19, 2012 (with no intervening office actions having been issued). Ex-1004, at 184. After payment of the issue fee, the applicant withdrew the application from issue and submitted some additional prior art for consideration by the examiner on November 5, 2012. *Id.*, at 23. The examiner issued a second notice of allowance on January 3, 2013 (again without any substantive intervening office action). *Id.*, at 14. The issue fee was paid and the application issued as patent 8,432,173 on April 30, 2013. *Id.*, at 1. None of the prior art references in this petition were considered by the examiner during prosecution of the 13/332,945 application or any related applications.

X. PRIORITY DATE

53. For purposes of my analysis, I apply the priority date of the provisional patent application filed October 20, 2006. I take no position on the

proper priority date for each claim of the ’173 Patent. All prior art references asserted in this petition are U.S. patents or U.S. patent publications that were published more than one year before the priority date I apply in my analysis.

XI. CLAIM CONSTRUCTION

54. I interpret the claims of the ’173 Patent according to the *Phillips* claim construction standard. 83 Fed. Reg. 51340, 51340-44 (Oct. 11, 2018); *Phillips v. AWH Corp.*, 415 F.3d 1303 (Fed. Cir. 2005). I do not believe that any explicit claim construction is required to resolve the validity issues in this Petition. However, I understand that the ’173 Patent was previously construed in and ITC investigation. I identify those constructions below as potentially relevant.

A. “a sensing element that comprises a sensing path that comprises a length”

55. The term “sensing element” appears in every independent claim and in the previous ITC investigation was construed consistent with the specification’s express definition to mean “physical electrical sensing element made of conductive substances.” *See* Ex-1001 at 6:65-67.

56. In the previous ITC investigation, “sensing path” was construed as “a path for sensing that is determined for each use,” and the full limitation “a sensing element that comprises a sensing path that comprises a length” was construed as “a physical electrical sensing element made of conductive substances that comprises a

path for sensing that is determined for each use that comprises a length." Ex-1008, p. 19-22.

B. "object"

57. The term "object" appears in every independent claim and in the previous ITC investigation was construed consistent with the specification's express definition to mean "either an inanimate object, such as a wiper, pointer, or stylus, or alternatively, a human finger or other appendage any of whose presence adjacent the element will create a localized capacitive coupling from a region of the element back to a circuit reference via any circuitous path, whether galvanically or nongalvanically." *See* Ex-1001 at 6:65, 7:2-8.

C. "displacement"

58. All claims require adjusting a parameter value based on a "displacement" of an object along the sensing path of a sensing element. In the prior ITC investigation this term was construed as "distance and direction of movement." Ex-1008, p. 18.

D. "the range of parameter values being associated with the length of the sensing path" (Claims 1, 10, 19)

59. All claims recite "the range of parameter values being associated with the length of the sensing path." In the prior ITC investigation, "the range of parameter values being associated with the length of the sensing path" was

construed to have its "plain and ordinary meaning," which was "the range of parameter values being associated with the length of the sensing path." Ex-1008, p. 22-24.

E. "the sensing path comprises a closed loop" (Claims 2, 11)

60. Dependent claims 2 and 11 recite "the sensing path comprises a closed loop." In the previous ITC investigation, "the sensing path comprises a closed loop" was construed to have its "plain and ordinary meaning," which was "the sensing path comprises a closed loop." Ex-1008, p. 24-25.

XII. BRIEF DESCRIPTION OF THE PRIOR ART

A. Trent

61. Trent was published on December 16, 2004, and qualifies as prior art under at least pre-AIA 35 U.S.C. §102(b).

62. Trent is titled "Closed-loop sensor on a solid-state object position detector." Trent discloses several methods related to the construction and use of a closed loop capacitive positioning sensor, including its use as a capacitive rotary dial for software control of, for example, audio parameters such as volume, balance, treble, and bass. Trent discloses both the physical sensor, such as in Figures 4 and 5, and several different uses of the capacitive sensors for user interfaces, such as in Figure 36.

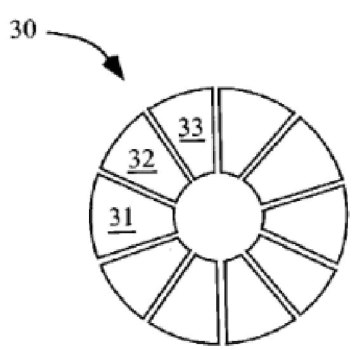


Fig. 4

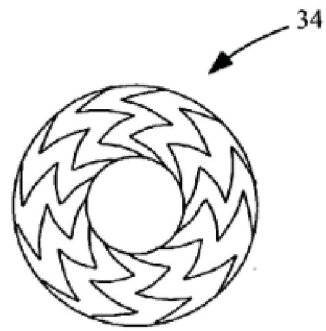


Fig. 5

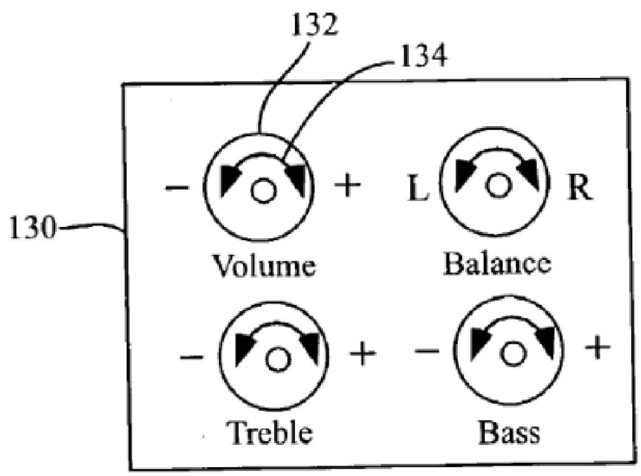


Fig. 36

63. Trent discloses several different ways to use its sensors to control various parameters in a computing system. For example, Trent discloses using its closed loop sensors to measure an "absolute position" of a user's touch on the sensor. Trent also discloses using "relative positions (or motions)" of a user's touch. *See, e.g.,* Ex-1005, [0074]. Each of these modes of operation can be used

to control parameters in several ways, such as “to indicate a starting value for a controlled parameter,” Ex-1005, [0092], or to indicate “correspondence between the motion of the user’s input object and the corresponding variation in the controlled parameter,” Ex-1005, [0139]. Trent explains that “[i]n general, any application parameter or control that needs to vary over a large range of possible values can benefit from the present invention.” Ex-1005, [0142].

B. Engholm

64. Engholm issued on May 8, 2001, and qualifies as prior art under at least pre-AIA 35 U.S.C. §102(b).

65. Engholm is titled “Method and apparatus for facilitating user interaction with a measurement instrument using a display-based control knob.” Engholm discloses “facilitating user interaction with a ... control knob glyph corresponding to a user-adjustable parameter.” Ex-1006, Abstract. The “control knob glyph” has an indicator and a “circular drag area through which the indicator can be rotated.” *Id.* Engholm explains that “the location of the indicator within the drag area” responds to inputs of “rotational movement” and updates “the value of the parameter changed in response to such inputs.” *Id.* Engholm also discloses several input mechanisms of the prior art, such as the sliders depicted in Figure 1a.

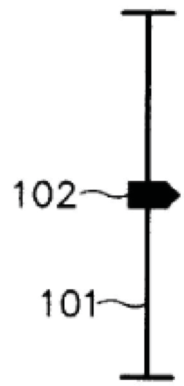


FIG.1a
(PRIOR ART)

66. Engholm states that: "one problem with sliders is the inability to make fine adjustments. Rather, the user is limited by how finely he or she can move slide box 102 in a 'click and drag' manner, as well as how 'sensitivity' parameters for the slider are set up." Ex-1006, 1:39-44. Another problem of the prior art devices discussed by Engholm is "that they lack the intuitive clockwise vs. counterclockwise mapping to increasing value vs. decreasing value found in manual control knobs to which people are accustomed." Ex-1006, 2:5-9.

67. To address this and other problems, Engholm discloses "a control knob glyph corresponding to a user-adjustable parameter of the measurement instrument is displayed, the control knob glyph having an indicator and a partially circular drag area through which the indicator can be rotated in both a clockwise and a counterclockwise manner. Inputs indicating amounts of rotational movement

for the indicator can be received, and the location of the indicator within the drag area and the value of the parameter is changed in response to such inputs.” Ex-1006, 2:21-29.

68. Examples of Engholm’s “control knob glyphs” are depicted in Figures 4A-E:

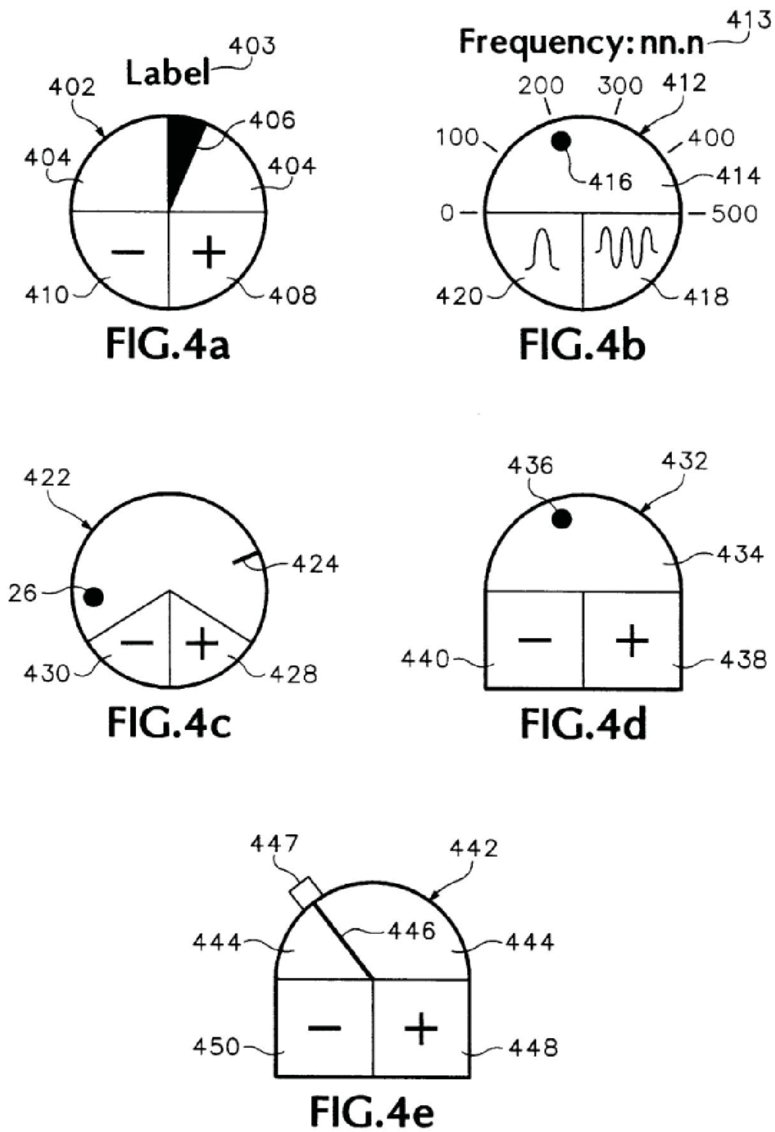


FIG.4a FIG.4b FIG.4c FIG.4d FIG.4e

69. Engholm's solution is designed for use with "touchscreens." Ex-1006, 4:5-10. Engholm also discloses threshold and sensitivity settings for such inputs to accommodate for "bounce situations" when a user touches the touchscreen. *Id.* at 10:11-56. "A bounce situation refers to the situation where, due to finger placement (for a touchscreen) or cursor/pointer placement, very slight movements of the user's finger or the cursor/pointer indicate a change in value, so that it is easy for a user to unintentionally indicate frequent changes in position." Ex-1006, 10:12-18. Engholm thus discloses a "debounce value" to help filter out and ignore small motions that do not correspond to actual intended touches or displacements.

C. Bryan

70. Bryan was issued on September 24, 1996, and qualifies as prior art under at least pre-AIA 35 U.S.C. §102(b).

71. Bryan is titled "Touchscreen interface having pop-up variable adjustment displays for controllers and audio processing systems." Bryan implements a touchscreen (22) system in an audio device, such as a keyboard, for example in Figure 1:

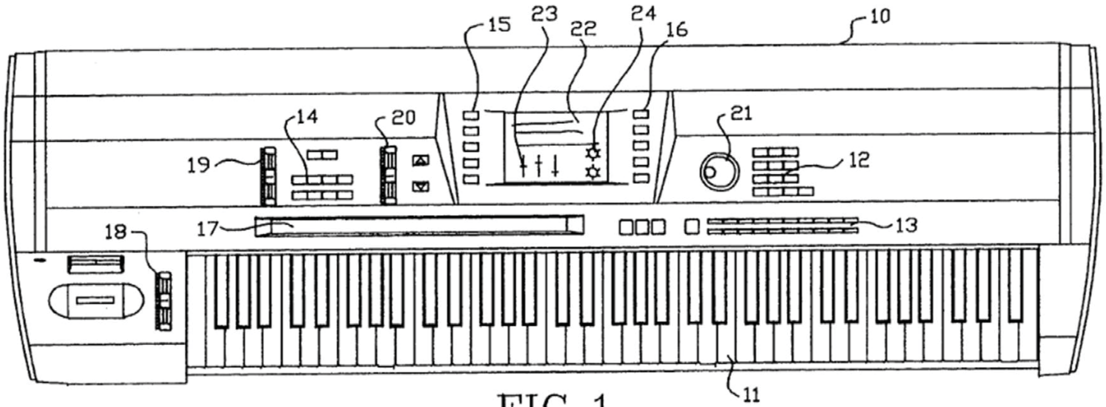
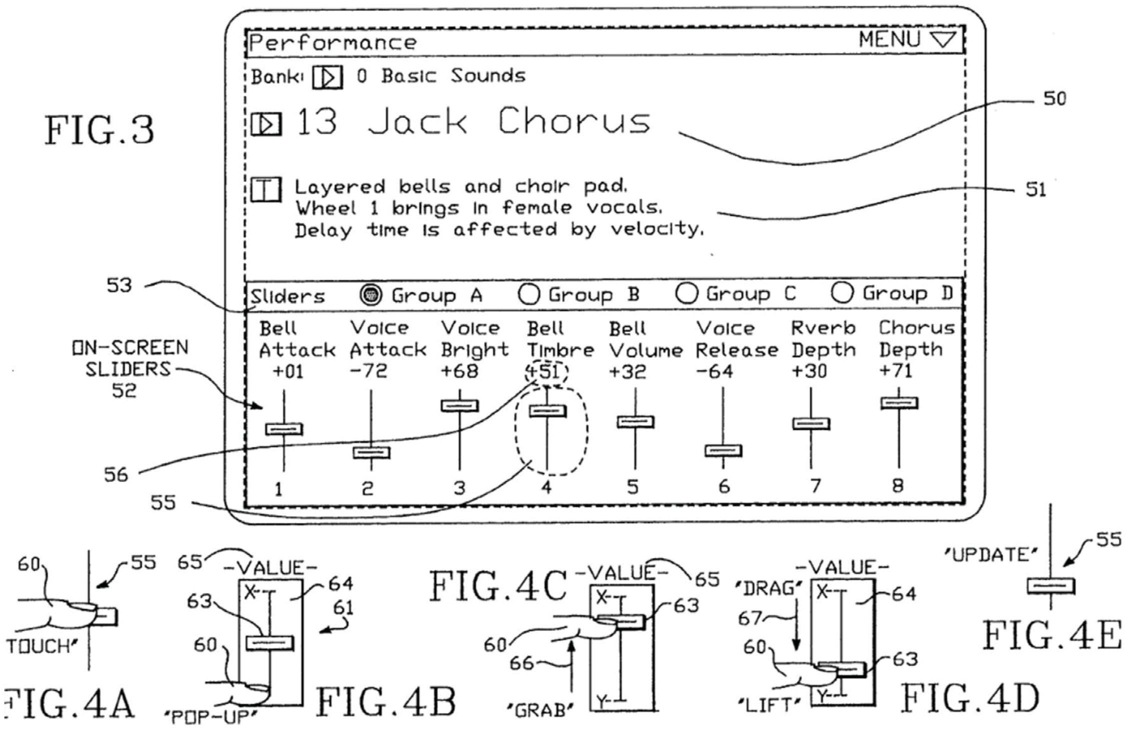


FIG. 1

72. Bryan explains that several controls need to be packed into a fairly small space, so “the use of a relatively small, flat panel touchscreen is desirable for these applications.” Ex-1007, 1:37-38. An example of the touch screen and associated user interfaces for audio parameter control is shown in Figures 3 and 4A-E:



73. Bryan further discloses flow charts and algorithms for how a user can set and adjust the parameters that are controlled by the different modes of touch input, for example in Figure 8.

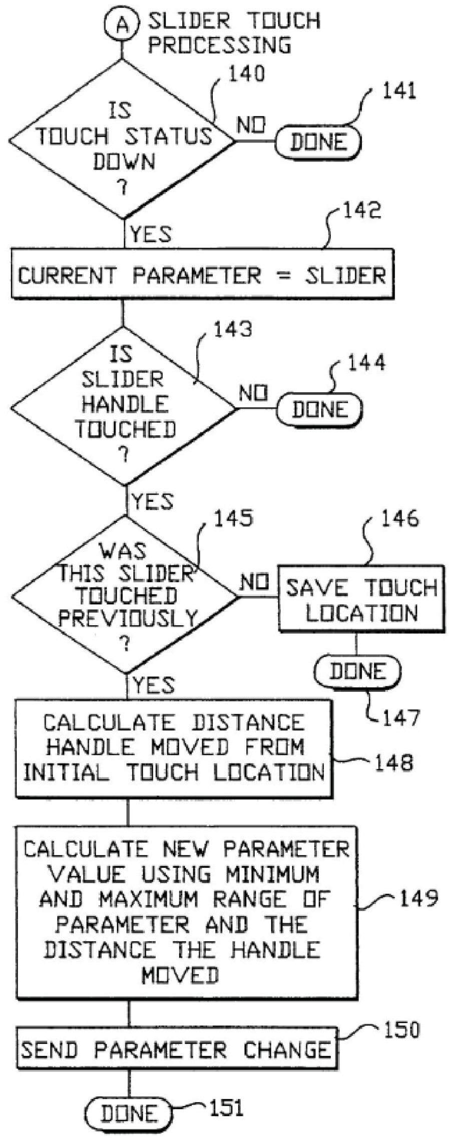

A
SLIDER TOUCH PROCESSING
140
IS TOUCH STATUS DOWN ?
NO
DONE
141
YES
142
CURRENT PARAMETER = SLIDER
143
IS SLIDER HANDLE TOUCHED ?
NO
DONE
144
YES
145
WAS THIS SLIDER TOUCHED PREVIOUSLY ?
NO
146
SAVE TOUCH LOCATION
DONE
147
YES
CALCULATE DISTANCE HANDLE MOVED FROM INITIAL TOUCH LOCATION
148
CALCULATE NEW PARAMETER VALUE USING MINIMUM AND MAXIMUM RANGE OF PARAMETER AND THE DISTANCE THE HANDLE MOVED
149
SEND PARAMETER CHANGE
150
DONE
151

FIG.8

XIII. DETAILED EXPLANATION OF THE UNPATENTABILITY GROUNDS

A. Ground 1: Claims 1-2, 8-11, and 17-19 are rendered obvious by Trent in light of the knowledge of a POSITA.

1. Independent claims 1, 10, and 19 are unpatentable over Trent.

74. Other than being drafted in different forms (claim 1 is a method, claim 10 is a computer readable medium practicing the method of claim 1, and claim 19 is an apparatus that includes a touch screen and the computer readable medium of claim 10), there is no meaningful difference between the independent claims. Accordingly, the duplicative elements of claims 1, 10, and 19 are discussed in a combined fashion. Exhibit 1030 includes a chart summarizing the grouping of terms across the different claims.

a) 1[pre]: "A method comprising:"

75. Trent discloses: "The present disclosure also discloses a method of determining motion of an object on a touch sensor of an object position detector." The method comprises receiving data of a first position of the object on a closed loop on a touch sensor of the object position detector, receiving data of a second position of the object on the closed loop, and calculating motion from the second position and the first position." Ex-1005, [0032].

76. Thus, to the extent limiting, Trent discloses or renders obvious the preamble of claim 1.

b) 10[pre], 19[b]: "One or more computer-readable non-transitory storage media embodying logic that is operable when executed to";

19[pre]: "An apparatus comprising"

77. Trent discloses that the object position detector includes a processor programmed to generate an action in response to motion on a touch sensor. Ex 1005, [0023], [0024], claim 1. Trent further discloses that the "closed loop sensor of the present invention can either use its own resources, such as a processor and sensors, or share its resources with another device." Ex-1005, [0077]. A processor that is programmed inherently requires a storage medium to store the program.

78. Thus, Trent discloses or renders obvious claim elements 10[pre] and 19[pre], to the extent limiting, and 19[b].

c) 1[a], 10[a]: "receiv[ing/e] one or more first signals indicating one or more first capacitive couplings of an object with a sensing element that comprises a sensing path that comprises a length, the first capacitive couplings corresponding to the object coming into proximity with the sensing element at a first position along the sensing path of the sensing element";

19[a]: "a sensing element that comprises a sensing path that comprises a length";
19[c]: "receive one or more first signals indicating one or more first capacitive couplings of an object

with the sensing element, the first capacitive couplings corresponding to the object coming into proximity with the sensing element at a first position along the sensing path of the sensing element"

79. Claim elements 1[a], 10[a], and 19[a]/[c] are substantively the same, with claim 19 breaking into two limitations what claims 1 and 10 recite as a single limitation.

80. Trent discloses "a sensing element that comprises a sensing path that comprises a length," *i.e.*, "a physical electrical sensing element made of conductive substances that comprises a path for sensing that is determined for each use that comprises a length." For example, Trent discloses a "touch sensor formed as a closed loop" that is "configured to sense motion of an object proximate to the closed loop." Ex-1005, [0023]. Trent discloses that the touch sensor can be a touch pad or touch screen or tablet "such as a capacitive, resistive or inductive sensor" designed to sense motions along a substantially closed loop. *Id.*, [0073]. Trent further discloses that a capacitive sensor is preferred. *Id.*, [0076]. Trent discloses that the "closed-loop sensor can have electrodes (or sensor pads) that are of various shapes and designs (*e.g.*, a simple wedge or pie-shape, a lightning-bolt or zigzag design, triangles, outward spirals, or the like) configured in a closed-loop path." *Id.*, [0079]. In these examples, the claimed "sensing path" is determined for each

use by the shape of the physical electrical sensing element, which is made of conductive substances. And the "length" is the circumference of that closed loop. Examples are shown in Figures 4 and 5:

81.

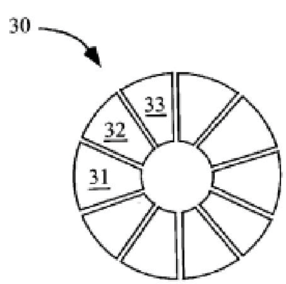


Fig. 4

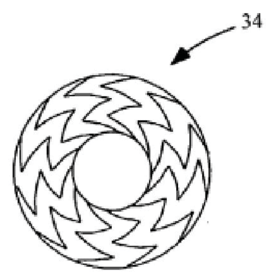


Fig. 5

82. Trent further discloses that when an input object such as a finger or pointer or stylus or pen comes into proximity with one or more of the electrodes, the electrode detects the change in capacitance. *Id.*, [0080]. Trent further discloses that the lightning-bolt electrode design in the closed path 34 of Fig. 5 "helps spread out the signal associated with an input object across many electrodes by interleaving adjacent electrodes." *Id.*, [0081]. The signals from each of the electrodes in the closed loop 34 represent capacitive couplings of the input object with the electrodes.

83. In addition to the sensors disclosed in Figures 4 and 5, Trent also discloses other configurations that can be used in linear arrangements, such as Figure 7. In such examples, the "length" is the linear extent of the electrodes.

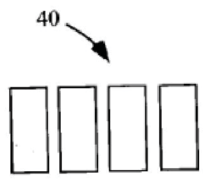


Fig. 7

84. Trent discloses "[a]n object position detector is disclosed comprising a touch (or proximity) sensor (or touch pad or touch screen or tablet), such as a capacitive, resistive, or inductive sensor designed to sense motions along a substantially closed loop, and referred to herein as a closed-loop sensor. . . . The position of an input object (or finger or pointer or pen or stylus or implement) is measured along this loop. When the input object moves along this loop, a signal is generated that causes an action at the host device." Ex-1005, [0073]. The signal generated by the finger or other object coming into contact with the closed-loop sensor corresponds to "receiving one or more first signals indicating one or more first capacitive couplings of an object with a sensing element" as claimed.

85. Trent additionally discloses that "FIG. 31 illustrates two closed-loop sensors 90 electrically connected with a touch pad 92. When an input object

comes into contact with the touch pad 92, the input is read by the sensor inputs as changes in adjacent ones of second axis sensor inputs (demarked by x's and represented by numeral 103 in FIG. 32)." Ex-1005, [0112]. This corresponds to "the first capacitive couplings corresponding to the object coming into proximity with the sensing element at a first position along the sensing path of the sensing element" as claimed.

86. Thus, Trent discloses or renders obvious claim elements 1[a], 10[a], and 19[a]/[c].

d) 1[b], 10[b], 19[d]: "determin[ing/e] based on one or more of the first signals the first position of the object along the sensing path"

87. Trent discloses determining a first position of the input object along the closed loop sensing path using interpolation. Ex-1005, [0080] and [0124]. Trent further discloses a preferred quadratic fitting method for interpolation Ex-1005, [0125]-[0129] and Fig. 40 (annotated):

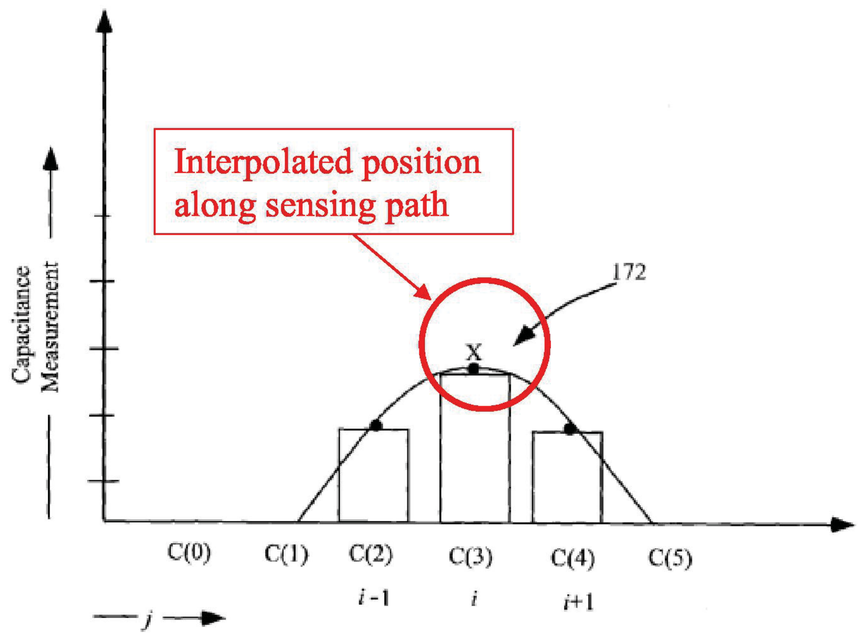


Fig. 40

88. Additionally, Trent discloses: "The absolute position of the input object on a one-dimensional closed-loop sensor can be reported in a single coordinate, such as an angular (θ) coordinate, and the relative positions (or motions) of the input object can be reported in the same (such as angular) units as well." Ex-1005, [0074].

89. Thus, Trent discloses or renders obvious claim elements 1[b], 10[b], and 19[d].

e) 1[c], 10[c], 19[e]: "set[ting] a parameter to an initial value based on the first position of the object along the sensing path, the initial value comprising a particular parameter value and being associated with a range of parameter values, the range of parameter

values being associated with the length of the sensing path"

90. Trent discloses using "absolute" positioning, corresponding to the precise location that a user touches the closed-loop sensor, to set an "initial value" for a parameter in some modes. For example, Trent states: "it may occasionally be useful to use this absolute position (*i.e.*, an exact starting point), for example, **to indicate a <u>starting value</u> for a controlled parameter** or to indicate the desired parameter to be varied." Ex-1005, [0092].

91. Consider, for example, this mode of operation in conjunction with Figure 36 (annotated).

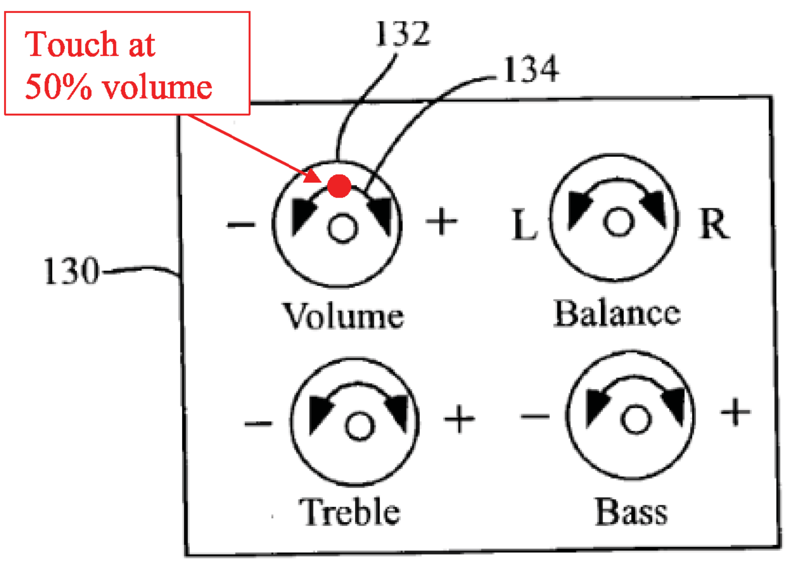


Fig. 36

92. A user may touch the "volume" closed-loop sensor in the middle, halfway between the plus and minus icons, as annotated with the red dot above. In the mode described in paragraph 92, such a touch would "indicate a starting value for a controlled parameter [e.g., the volume]" of, for example, 50%. In such an example, the range of parameter values must necessarily be "associated with the length of the sensing path," because such association is necessary to assign the starting value of the parameter based on the absolute position of the input object in the loop.

93. To the extent that this element is not expressly or inherently disclosed by Trent, setting a parameter to an initial value by a touch within a "range of parameter values being associated with the length of the sensing path" would have been obvious to one of skill in the art, based on the knowledge of those in the art. For example, Trent explains several previously known "solutions." Ex-1005, [0003], [0004]-[0011]. Such solutions, include, e.g., "A capacitive two-dimensional object position sensor that can be used for scrolling by providing a 'scrolling region,' where **users can slide their fingers to generate scrolling actions**." Ex-1005, [0011]. Furthermore, my own work with SlideBar in 2004 described in the section on my qualifications above includes an example of setting the initial position of a parameter based on the first movement of an absolute

positioning device. One of skill in the art would have been well aware of such slider operations including capacitive sensing for setting a parameter to an initial value based on its position within a range of parameter values associated with the length of the slider (the range being, for example, a minimum value on one end and a maximum value on the other).

94. Thus, Trent discloses or renders obvious claim elements 1[c], 10[c], and 19[e].

f) 1[d], 10[d], 19[f]: "receiv[ing/e] one or more second signals indicating one or more second capacitive couplings of the object with the sensing element, the second capacitive couplings corresponding to a displacement of the object along the sensing path from the first position"

95. Trent discloses with respect to Figure 4, for example, that as the input object moves along the sensing path "clockwise toward electrodes 32 and 33, the signal registered by first electrode 31 gradually decreases as the signal registered by the second electrode 32 increases; as the input object continues to move further clockwise toward third electrode 33, the first electrode 31 signal drops off and the third electrode 33 starts picking up the input object, and so on." Ex-1005, [0080]. The signals from the second and third electrodes 32 and 33 are second capacitive couplings corresponding to displacement of the input object along the sensing path.

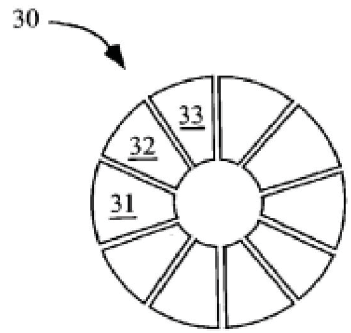


Fig. 4

96. Trent discloses that the "absolute position of the input object on the sensing path can be reported in a single coordinate, such as an angular (Θ) coordinate, and the **relative positions (or motions)** can be reported in the same (such as angular) units as well." Ex-1005, [0074]. This angular reporting of the relative position includes the distance of movement, just as disclosed in the '173 Patent.

97. Trent also discloses "[a]n object position detector is disclosed comprising a touch (or proximity) sensor (or touch pad or touch screen or tablet), such as a capacitive, resistive, or inductive sensor designed to sense motions along a substantially closed loop, and referred to herein as a closed-loop sensor. . . . When the input object moves along this loop, a signal is generated that causes an action at the host device. For example, when the input object **moves in the clockwise direction** along this loop, a signal is generated that can cause the data,

menu option, three dimensional model, or value of a setting to traverse in a particular direction; and when the input object moves in the **counter-clockwise direction**, a signal is generated that can cause traversal in an opposite direction." Ex-1005, [0073]. Thus, as in the '173 Patent, the direction and distance of movement in Trent is described in angular units and as being in the clockwise or counter-clockwise direction. Accordingly, Trent discloses receiving signals representing capacitive couplings of the object corresponding to a displacement of the object along the sensing path, where the displacement includes both a distance and direction of motion along a sensing path.

98. Thus, Trent discloses or renders obvious claim elements 1[d], 10[d], and 19[f].

g) 1[e], 10[e], 19[g]: "determin[ing/e] based on one or more of the second signals the displacement of the object along the sensing path"

99. Trent discloses an algorithm for determining the distance and direction of motion (i.e. the claimed "displacement") between two reported positions along the sensing path. Ex-1005, [0134]. According to this method, it is assumed that the difference between the two positions on the sensing path represented in polar coordinates cannot be greater than 180 degrees, so that if the difference in position is greater than 180 degrees, it is assumed that the movement

is in the opposite direction. Ex-1005, [0134]. So, for example, if the first position is 10 degrees and the second position is 40 degrees, it is assumed that the motion was 30 degrees clockwise. On the other hand, if the first position is 10 degrees and the second position is 330 degrees, it is assumed that the motion was 40 degrees counter-clockwise rather than 320 degrees clockwise (because the difference between 10 degrees and 330 degrees is greater than 180 degrees). The distance between the two points is represented/calculated as a signed modulo 360 value, where the sign indicates direction and the value represents the magnitude or distance of the motion. Ex-1005, [0134].

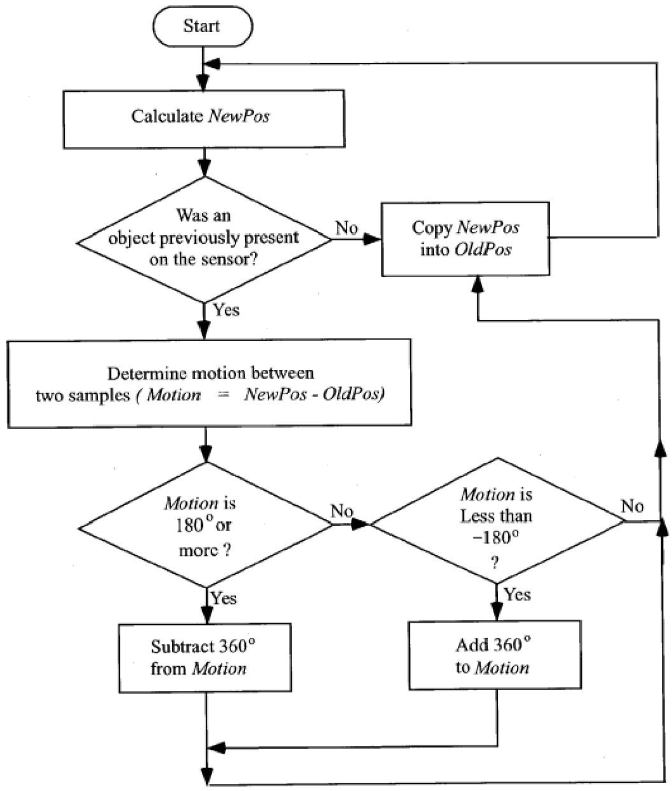


Fig.44

100. Further examples of determining displacement are provided in the context of Figure 45. "For example, given two consecutive points sampled from the closed-loop sensor, the straight-line distance is calculated between these two points (with an approximation to the Pythagorean Theorem or equivalent polar coordinate equations). Additionally, the angular positions corresponding to these two points along the closed-loop path are calculated by one of the means previously discussed. The angle of the second point is subtracted from the angle of

the first point, and **the sign of this result is used to indicate the direction of motion, while the absolute distance is used to indicate the amount of motion."** Ex-1005, [0139]. Accordingly, Trent discloses displacement that includes both a distance and direction of motion along a sensing path.

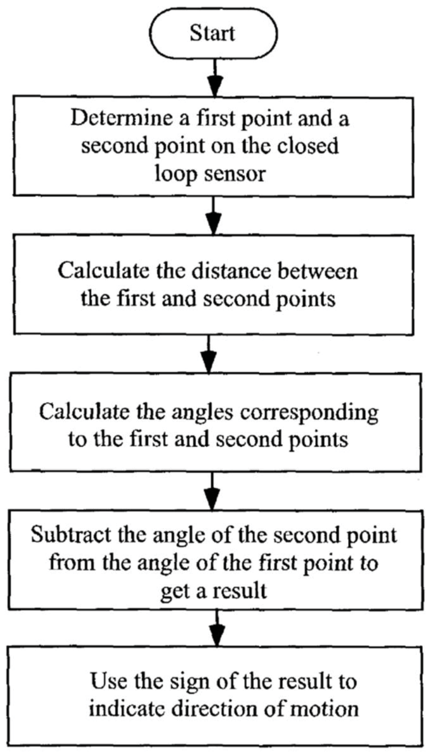


Fig. 45

101. Thus, Trent discloses or renders obvious claim elements 1[e], 10[e], and 19[g].

h) 1[f], 10[f], 19[h]: "adjust[ing/e] the parameter within the range of parameter values based on the displacement of the object along the sensing path."

102. Trent discloses that, in response to movement in clockwise or counter-clockwise directions, "the value of a setting" can be correspondingly adjusted. "For example, when the input object moves in the clockwise direction along this loop, a signal is generated that can cause the data, menu option, three dimensional model, or **value of a setting** to traverse in a particular direction; and when the input object moves in the counter-clockwise direction, a signal is generated that can cause traversal in an opposite direction." Trent further states, "For example, given two consecutive points sampled from the closed-loop sensor, the straight-line distance is calculated between these two points (with an approximation to the Pythagorean Theorem or equivalent polar coordinate equations). Additionally, the angular positions corresponding to these two points along the closed-loop path are calculated by one of the means previously discussed. The angle of the second point is subtracted from the angle of the first point, and the sign of this result is used to indicate **the direction of motion**, while the absolute **distance** is used to indicate the amount of motion. This results in a more natural feeling correspondence between the motion of the user's input object and the corresponding **variation in the controlled parameter** (e.g., scrolling distance,

menu traversal, or setting value)." Ex-1005, [0139]. Accordingly, Trent adjusts the parameter within the range of parameter values based on the displacement of the object.

103. Additionally, Trent discloses making these adjustments to various controlled parameters that fall into a "range." Trent states, for example, "any application **parameter or control that needs to vary over a large range of possible values** can benefit from the present invention. Physical processes (e.g., to control the position of a platform, the speed of a motor, the temperature or lighting in a compartment, and the like) can also benefit from the use of closed-loop sensors." Ex-1005, [0142]. Additionally, in the context of Figure 36, Trent discloses adjusting, for example, a volume parameter based on motion in either a clockwise or counter-clockwise direction: "FIG. 36 illustrates an object position detector 130 having four closed-loop sensors to vary the settings of audio controls. Although four separate closed-loop sensors are shown, any number of closed-loop sensors can be utilized. Using the volume control closed-loop sensor 132 as an example, the motions (illustrated by arrow 134) of an input object on the volume control closed-loop sensor 132 will cause the volume of the audio system to either increase or decrease." *Id.*, [0036]. Figure 36 (annotated).

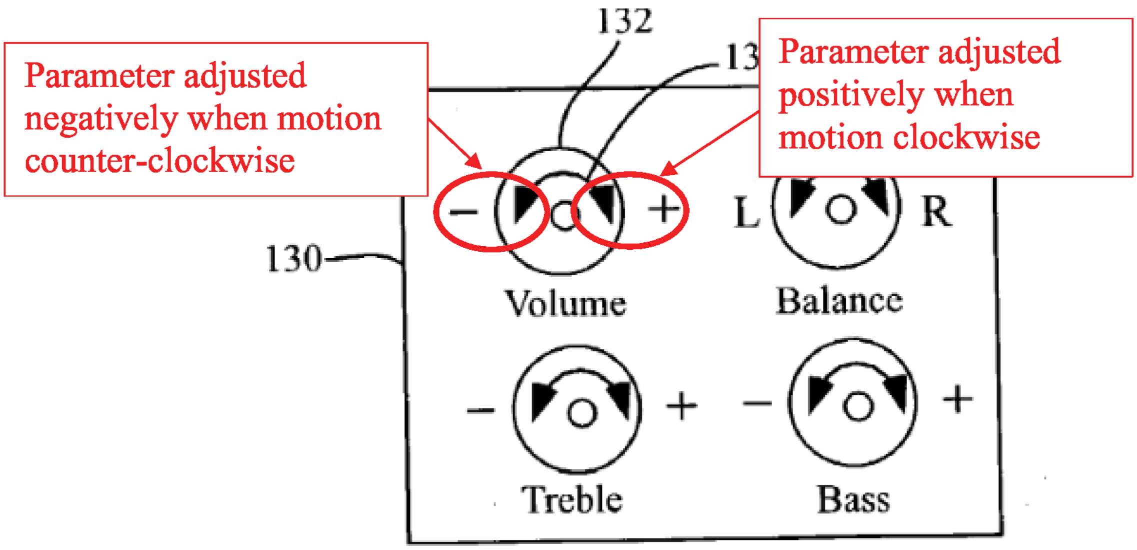


Fig. 36

104. Thus, Trent discloses or renders obvious claim elements 1[f], 10[f], and 19[h].

2. Claims 2, 11: "wherein the sensing path comprises a closed loop"

105. Dependent claims 2 and 11 are identical but for the preambles. In addition to the discussion of the independent claims above, Trent also discloses these claims. For example, Trent discloses closed-loop sensors at [0079] and in Figure 5. These closed loop sensors have a continuous shape (e.g., a closed circle) as shown in Figure 5. And Trent expressly refers to "closed-loop sensors" throughout the disclosure, including the title.

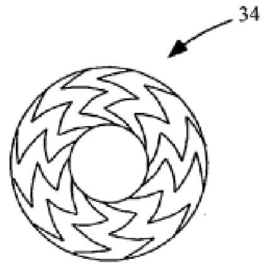


Fig. 5

106. Thus, Trent discloses or renders obvious claims 2 and 11.

3. Claims 8, 17: "wherein the parameter is selected from the group consisting of temperature, volume, contrast, brightness, and frequency"

107. Dependent claims 8 and 17 are identical but for the preambles. In addition to the discussion of the independent claims above, Trent also discloses these claims. For example, Trent discloses using a closed-loop sensor for controlling volume at [0121] and Figures 36-38:

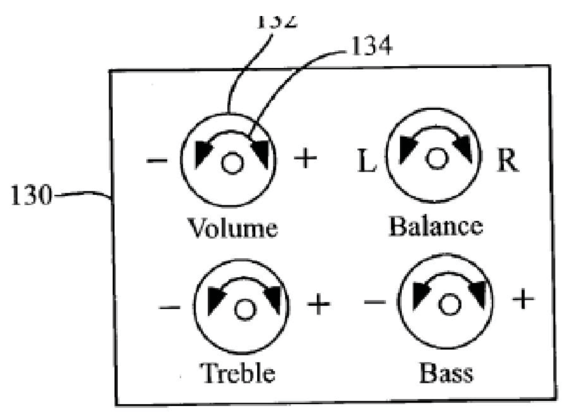


Fig. 36

108. Trent also discloses other examples, including "to control the position of a platform, the speed of a motor, **the temperature** or lighting in a compartment, and the like." Ex-1005, [0142].

109. Thus, Trent discloses or renders obvious claims 8 and 17.

4. Claims 9, 18: "wherein [the media and] the sensing element [is/are] part of an electronic appliance selected from the group consisting of a cooking oven, microwave oven, television, washing machine, MP3 player, mobile phone, and multimedia device"

110. Dependent claims 8 and 17 are substantively the same but for the preambles. In addition to the discussion of the independent claims above, Trent also discloses claims 9 and 18. For example, Trent discloses use of its closed-loop sensor in notebook computers, personal entertainment devices and PDAs, which are well-known multimedia devices. Ex-1005, [0145]. Trent specifically notes the closed-loop sensors may be used with "a computer, a laptop or handheld computer, a keyboard, a pointing device, an input device, a game device, an audio or video system, a thermostat, a knob or dial, a telephone, a **cellular telephone**, or any other similar device." *Id.*, [0076].

111. Thus, Trent discloses or renders obvious claims 9 and 18.

B. Ground 2: Claims 1-3, 5-12, and 14-19 are rendered obvious by Trent in view of Engholm, and further in light of the knowledge of a POSITA.

1. One of skill in the art would be motivated to combine the teachings of Trent and Engholm, and would have a reasonable expectation of success in doing so.

112. One of skill in the art would have been motivated to combine the teachings of Trent and Engholm. Each reference relates to using touch input devices to control parameters in software. Each also discloses similar problems in the art, namely the difficulty of inputting and changing parameters in small or otherwise limited spaces. And each attempts to solve these problems in similar and predictable ways, such as by using touch sensors and providing further control of input and adjustment of parameters. It thus would have been obvious to one of skill in the art to try to solve these similar problems with any of the well-known solutions disclosed in Trent and Engholm, and similarly to combine such well-known techniques together and with the general skill in the art.

113. For example, Trent explains that "[u]ser interfaces on digital information processing devices often have more information and options than can be easily handled with buttons or other physical controls. In particular, scrolling of documents and data, selection of menu items, and continuous value controls, such as volume controls, can be difficult to control with buttons and general purpose

pointing devices." Ex-1005, [0002]. As Trent explains, the problem arises due, in part, to the small area that is generally available for selection among a wide range of parameters. *See, e.g., Id.*, [0003]-[0011]. Faced with this difficulty, Trent proposes to use capacitive sensors to make input and selection amongst various parameters easier. *See, e.g., Id.*, [0095]. Advantageously, with the capacitive sensor of Trent, "[t]he present invention can also be made smaller than knobs or other physical controls, and requires very little space and can be custom made to almost any size." *Id.*, [0145].

114. Engholm is similarly concerned with setting parameters in touch sensitive devices, and "mechanisms [that] currently exist to allow users to adjust these parameters." Ex-1006, 1:32-33. Engholm explains that a "user is limited by how finely he or she can move" prior art input devices "in a 'click and drag' manner, as well as how 'sensitivity' parameters" are set. *Id*. 1:40-44. Engholm explains, that, in view of this and other problems, "an improved parameter adjustment mechanism is needed." Ex-1006, 2:13-14. Similar to Trent, Engholm solves this problem using a rotary touch input device, "with a partially circular drag area." *Id.* 2:24. Engholm "advantageously facilitates user interaction with a measurement instrument by providing a control knob glyph that incorporates the intuitive clockwise vs. counterclockwise mapping to increasing value vs.

decreasing value. Thus, users are able to interact with the measurement instrument using a control knob glyph having the intuitive clockwise and counterclockwise mappings to which they are accustomed." *Id.,* 12:18-25.

115. As such, one of skill in the art would have been motivated to combine the teachings of Trent and Engholm, at least because they solve similar problems, using similar known hardware and software solutions, in very similar ways. And one of skill in the art would have had a reasonable expectation of success in doing so, at least because each of these solutions involve routine software functionality that is reasonably predictable to implement and amenable to simple substitution by those of skill in the art.

2. Independent claims 1, 10, and 19 are unpatentable over Trent in view of Engholm.

116. As in Ground 1, the duplicative elements of claims 1, 10, and 19 are discussed in a combined fashion.

a) 1[pre]: "A method comprising:"

117. Trent and Engholm render obvious the preamble of claim 1 for the reasons discussed above in Section XIII.A.1.a) above.

b) 10[pre], 19[b]: "One or more computer-readable non-transitory storage media embodying logic that is operable when executed to";

19[pre]: "An apparatus comprising"

118. Trent and Engholm render obvious claim elements 10[pre] and 19[pre], to the extent limiting, and 19[b] for the reasons discussed above in Section XIII.A.1.b) above. To the extent not expressly or inherently disclosed by Trent, Engholm discloses this element.

119. For example, Engholm discloses "a computer readable medium" in claims 9-12. And an apparatus of embodying the disclosure of Engholm is depicted in Figures 2, 3, 5, and 7:

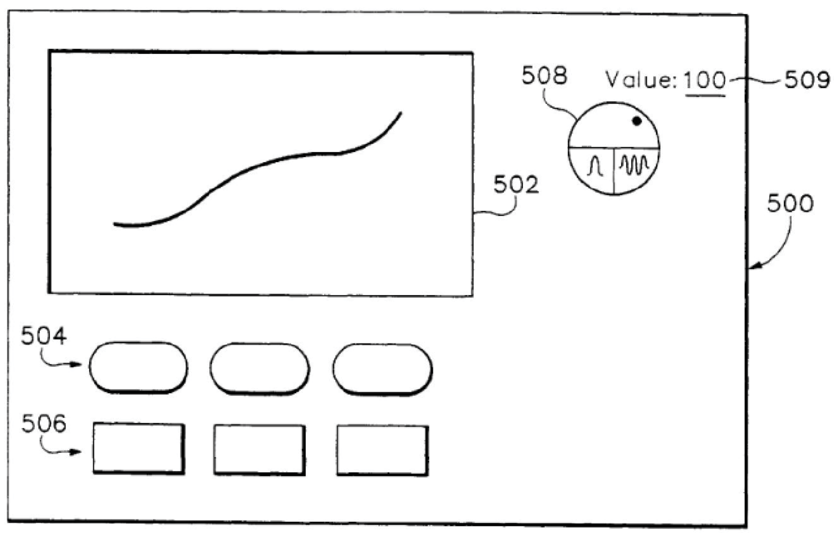


FIG.5

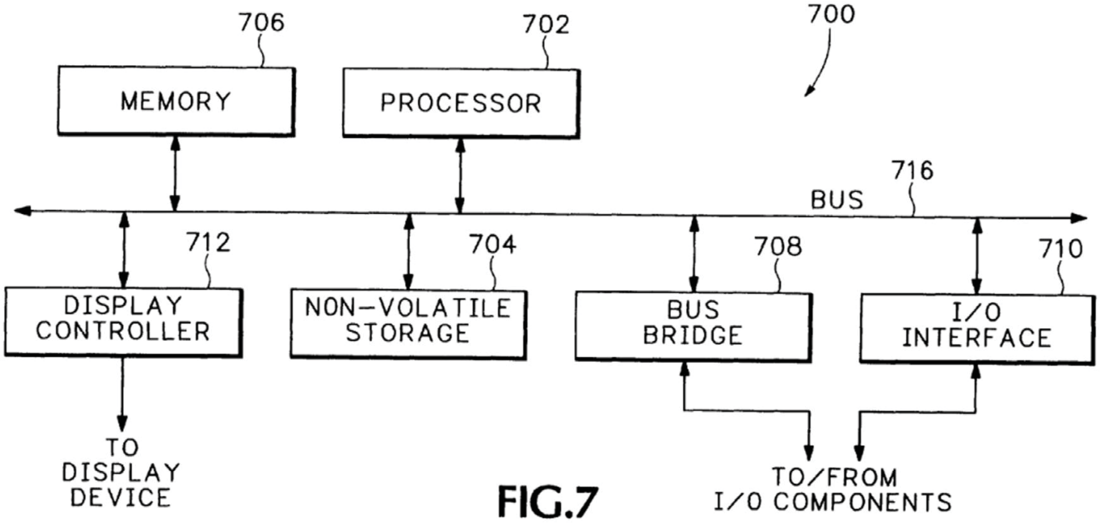


FIG.7

120. Thus, Trent and Engholm render obvious claim elements 10[pre] and 19[pre], to the extent limiting, and 19[b].

c) 1[a], 10[a]: "receiv[ing/e] one or more first signals indicating one or more first capacitive couplings of an object with a sensing element that comprises a sensing path that comprises a length, the first capacitive couplings corresponding to the object coming into proximity with the sensing element at a first position along the sensing path of the sensing element";

19[a]: "a sensing element that comprises a sensing path that comprises a length";

19[c]: "receive one or more first signals indicating one or more first capacitive couplings of an object with the sensing element, the first capacitive couplings corresponding to the object coming into proximity with the sensing element at a first position along the sensing path of the sensing element"

121. Trent and Engholm render obvious claim elements 1[a], 10[a], 19[a]/[c] for the reasons discussed above in Section XIII.A.1.c) above.

d) 1[b], 10[b], 19[d]: "determin[ing/e] based on one or more of the first signals the first position of the object along the sensing path"

122. Trent and Engholm render obvious claim elements 1[b], 10[b], and 19[d] for the reasons discussed above in Section XIII.A.1.d) above.

e) 1[c], 10[c], 19[e]: "set[ting] a parameter to an initial value based on the first position of the object along the sensing path, the initial value comprising a particular parameter value and being associated with a range of parameter values, the range of parameter values being associated with the length of the sensing path"

123. Trent and Engholm render obvious claim elements 1[c], 10[c], and 19[e] for the reasons discussed above in Section XIII.A.1.e) above.

124. To the extent not expressly or inherently disclosed by Trent, Engholm discloses "the range of parameter values being associated with the length of the sensing path."

125. For example, Engholm discloses "In one implementation, the change in current value **with respect to the possible range (maximum—minimum)** is the same as the change in location of indicator 406 with respect to drag area 404. For example, if the drag area is 180 degrees and the indicator is moved 9 degrees (*i.e.*, indicator 406 is rotated 5% of the drag area 404), and if the range of values for the parameter is 100, then the value would be changed by 5 (*i.e.*, 5% of the

range)." Ex-1006, 6:12-24. Engholm also discloses associating these ranges with particular directions: "It is also to be appreciated that although the portion including the drag area and indicator of a control knob glyph is partially circular in order to maintain **the intuitive clockwise vs. counterclockwise mapping to increasing value vs. decreasing value.**" *Id.,* 7:60-65.

126. Engholm also discloses, with respect to Figure 4b, "hash marks" that associate specific values to "drag area 414." Engholm discloses: "According to one embodiment of the present invention, additional markings are provided by control knob manager **340** along the circumference of the control knob glyph corresponding to the portion including the drag area and the indicator. An example of such markings is illustrated in FIG. 4b with the hash marks and corresponding values of 0, 100, 200, 300, 400, and 500. Alternatively, the hash marks and corresponding values could be shown within control knob glyph **412** rather than external to knob glyph **412**." Ex.-1006, 6:58-65.

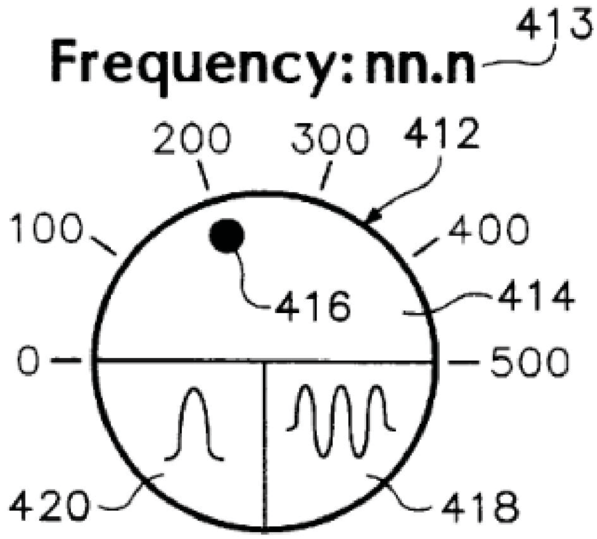


FIG.4b

127. One of skill in the art would have been motivated to combine Trent and Engholm, and would have had a reasonable expectation of success in doing so, at least for the reasons discussed in Section XIII.B.1 above. Moreover, one of skill in the art would have been motivated to combine Trent and Engholm, and would have had a reasonable expectation of success in doing so, to include Engholm's association of the range of parameter values to the length of the sensing path in Trent. At least for the reasons disclosed above, one of skill in the art would have been motivated to combine, for example, the volume dial of Trent's Figure 36 with the parameter mapping of Engholm, because it would allow a user to more easily determine the exact volume they initially selected when they touched the volume dial.

128. Thus, Trent and Engholm render obvious claim elements 1[c], 10[c], and 19[e].

f) 1[d], 10[d], 19[f]: "receiv[ing/e] one or more second signals indicating one or more second capacitive couplings of the object with the sensing element, the second capacitive couplings corresponding to a displacement of the object along the sensing path from the first position"

129. Trent and Engholm render obvious claim elements 1[d], 10[d], and 19[f] for the reasons discussed above in Section XIII.A.1.f) above.

g) 1[e], 10[e], 19[g]: "determin[ing/e] based on one or more of the second signals the displacement of the object along the sensing path"

130. Trent and Engholm render obvious claim elements 1[e], 10[e], and 19[g] for the reasons discussed above in Section XIII.A.1.g) above.

h) 1[f], 10[f], 19[h]: "adjust[ing/e] the parameter within the range of parameter values based on the displacement of the object along the sensing path."

131. Trent and Engholm render obvious claim elements 1[f], 10[f], and 19[h] for the reasons discussed above in Section XIII.A.1.h) above. To the extent not expressly or inherently disclosed by Trent, Engholm discloses this element.

132. See the discussion above in Section XIII.B.2.e) above regarding the "the range of parameter values being associated with the length of the sensing path." Moreover, Engholm discloses "the control subsystem provides a control

knob glyph on the display device corresponding to a **user-adjustable** parameter." Ex.-1006, 2:42-47.

133. Thus, Trent and Engholm render obvious claim elements 1[f], 10[f], and 19[h].

3. Claims 2, 11: "wherein the sensing path comprises a closed loop"

134. Engholm discloses a closed loop sensing path, i.e. circular sensing paths with a continuous shape. For example, the circular and similar closed shaped of Figures 4a-e.

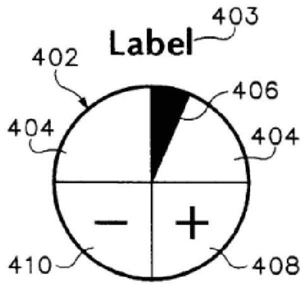


FIG.4a

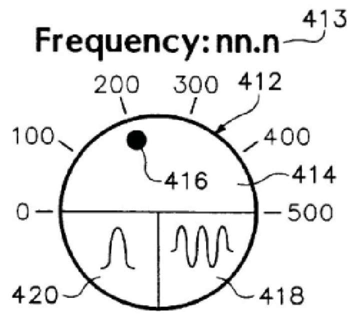


FIG.4b

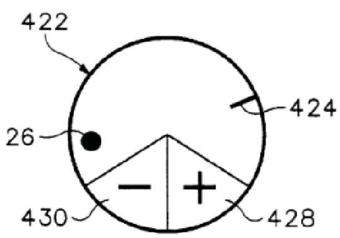


FIG.4c

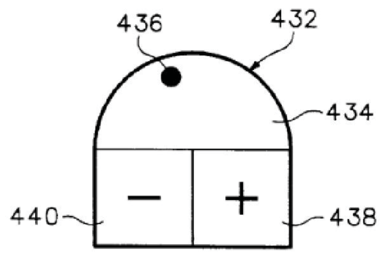


FIG.4d

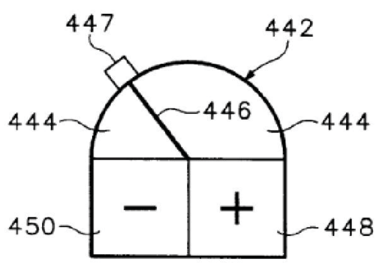


FIG.4e

135. Thus, Trent and Engholm render obvious claims 2 and 11.

4. Claims 3, 12: "[switching/operable to switch] from a first mode of operation to a second mode of operation in response to one or more of the second signals if the displacement corresponding to the second capacitive coupling indicated by the second signals exceeds a pre-determined threshold, the second mode of operation being for adjusting the parameter within the range of parameter

values based on the displacement of the object along the sensing path, the first mode of operation being for setting the parameter to the initial value"

136. Engholm discloses "a pre-determined threshold" to transition into the second "adjusting" mode of operation. For example, Engholm discloses threshold and sensitivity settings for such inputs to accommodate for "bounce situations" in a user touching the touchscreen. Ex-1006, 10:11-56. As Engholm explains: "A bounce situation refers to the situation where, due to finger placement (for a touchscreen) or cursor/pointer placement, very slight movements of the user's finger or the cursor/pointer indicate a change in value, so that it is easy for a user to unintentionally indicate frequent changes in position. For example, when using a touchscreen, if the user touches the wedge indicator 406 of FIG. 4a, then it is possible that the slight unintentional movement of the user's finger to the right is interpreted as a clockwise drag input, after which the slight unintentional movement of the user's finger to the left is interpreted as a counterclockwise drag input. This process can continue, causing the indicator to 'bounce' back and forth between two or more values." Ex.-1006, 10:12-27.

137. To address this issue, Engholm discloses a threshold value, for example of 5 degrees: "In the illustrated embodiment, the present invention corrects such bounce situations by establishing a minimum amount by which the

indicator, when selected, must be rotated through the drag area before it is interpreted by control knob manager 340 as a change in value for the parameter. This minimum amount is identified as the 'debounce value' in Table I above [reproduced below]. In the illustrated embodiment, the debounce value represents an angular change (in degrees) that must be made by a user in selecting and rotating the indicator before it is interpreted as an actual change in value (for example, five degrees). Any change in location of the indicator by selecting the indicator and rotating it less than the debounce value is ignored by control knob manager 340. Thus, by ignoring such 'small' changes (i.e., less than the debounce value), the control knob manager can reduce the potential 'bouncing' of the indicator." Ex.-1006, 10:27-43; Table I (annotated).

TABLE I

Property	Description
Control Value	The current value of the parameter being represented by the control knob glyph. The Control Value is initially passed in from an application and can be modified by user actions with the control knob glyph.
Slider Size	Sets the percentage of the top semicircle which will be consumed by the wedge or dimple indicator. Should be large enough to be easily captured by the user's finger or cursor/pointer.
Flash Color	Color of the drag area for a brief period of time following a selection of that area to indicate to the user that a selection of that area has occurred.
Large Increment	Amount by which the Control Value is changed when the drag area is selected.
Small Increment	Amount by which the Control Value is changed when the increment or decrement button is selected. In one implementation this amount is less than the amount by which the control value is changed when the drag area is selected.
Increment Picture	Image shown on the increment button to indicate what will happen when the button is pressed or the indicator is moved in the clockwise direction. In one implementation the image is a bitmap.
Decrement Picture	Image shown on the decrement button to indicate what will happen when the button is pressed or the indicator is moved in the counterclockwise direction. In one implementation the image is a bitmap.
Acceleration	Amount by which the increment/decrement action is accelerated when the increment button or decrement button or drag area is continuously selected.
Debounce Value	Minimum amount of movement of the indicator which is registered as a change to the Control Value.
Minimum Value	The smallest Control Value that the parameter can have.
Maximum Value	The largest Control Value that the parameter can have.

138. One of skill in the art would have been motivated to combine Trent and Engholm, and would have had a reasonable expectation of success in doing so,

at least for the reasons discussed in Section XIII.B.1 above. Moreover, one of skill in the art would have been motivated to combine Trent and Engholm, and would have had a reasonable expectation of success in doing so, to include this threshold or "debounce" value. One of skill in the art would have been motivated to combine, for example, the volume dial of Trent's Figure 36 with the "debounce" value, for example, because it would allow a user to more accurately select a preferred volume when moving their finger around the volume dial without unintentionally changing values after initially setting the value.

139. Thus, Trent and Engholm render obvious claims 3 and 12.

5. Claims 5, 14: "wherein adjusting the parameter comprises effecting an incremental change in the parameter from the initial value based on an amount of the displacement exceeding a pre-determined displacement threshold"

140. Engholm discloses "effecting an incremental change in the parameter from the initial value based on an amount of the displacement exceeding a pre-determined displacement threshold." For example, Engholm discloses "In the illustrated embodiment, the debounce value represents an angular change (in degrees) that must be made by a user in selecting and rotating the indicator before it is interpreted as an actual change in value (for example, five degrees)." Ex.-1006, 10:34-38. When this threshold is exceeded, a change is made. And the

Engholm explains that this change may be, for example a predefined "large increment." Ex.-1006, Table I (annotated)

TABLE I

Property	Description
Control Value	The current value of the parameter being represented by the control knob glyph. The Control Value is initially passed in from an application and can be modified by user actions with the control knob glyph.
Slider Size	Sets the percentage of the top semicircle which will be consumed by the wedge or dimple indicator. Should be large enough to be easily captured by the user's finger or cursor/pointer.
Flash Color	Color of the drag area for a brief period of time following a selection of that area to indicate to the user that a selection of that area has occurred.
Large Increment	Amount by which the Control Value is changed when the drag area is selected.
Small Increment	Amount by which the Control Value is changed when the increment or decrement button is selected. In one implementation this amount is less than the amount by which the control value is changed when the drag area is selected.
Increment Picture	Image shown on the increment button to indicate what will happen when the button is pressed or the indicator is moved in the clockwise direction. In one implementation the image is a bitmap.
Decrement Picture	Image shown on the decrement button to indicate what will happen when the button is pressed or the indicator is moved in the counterclockwise direction. In one implementation the image is a bitmap.
Acceleration	Amount by which the increment/decrement action is accelerated when the increment button or decrement button or drag area is continuously selected.
Debounce Value	Minimum amount of movement of the indicator which is registered as a change to the Control Value.
Minimum Value	The smallest Control Value that the parameter can have.
Maximum Value	The largest Control Value that the parameter can have.

141. One of skill in the art would have been motivated to combine Trent and Engholm, and would have had a reasonable expectation of success in doing so, at least for the reasons discussed in Section XIII.B.1 above. Moreover, one of skill in the art would have been motivated to combine Trent and Engholm, and would have had a reasonable expectation of success in doing so, to achieve claims 5 and 14 for the reasons explained in Section XIII.B.4 above.

142. Thus, Trent and Engholm render obvious claims 5 and 14.

6. Claims 6, 15: "wherein adjusting the parameter comprises changing the parameter from the initial value by a number of units based on a number of times an amount of the displacement exceeds a pre-determined displacement threshold"

143. Engholm discloses "Alternatively, the present invention can detect 'bounce' situations by looking for direction changes (that is, a change from increment to decrement or from decrement to increment). Any such direction change is initially ignored by the control knob manager and no change to the value or the indicator is made. However, if another change input in the same direction is received within a period of time (e.g., within 0.25 seconds), then the control knob manager assumes that it is an intentional movement in that direction and begins movement in the requested direction. Thus, by delaying the decision of whether to update the current value, the control knob manager can reduce the potential

'bouncing' of the indicator." Ex.-1006, 10:46-56. This discloses that the parameter is changed "based on a number of times an amount of the displacement exceeds a pre-determined displacement threshold." In this example, the threshold must be exceeded more than once (i.e., at least two times) in a given time period. And units are described above, e.g., a number of degrees of rotation, or the units defined as the "large increment value".

144. One of skill in the art would have been motivated to combine Trent and Engholm, and would have had a reasonable expectation of success in doing so, at least for the reasons discussed in Section XIII.B.1 above. Moreover, one of skill in the art would have been motivated to combine Trent and Engholm, and would have had a reasonable expectation of success in doing so, to achieve claims 6 and 15 for the reasons explained in Section XIII.B.4 above.

145. Thus, Trent and Engholm render obvious claims 6 and 15.

7. Claims 7, 16: "[mapping/operable to map] all or a portion of the range of parameter values onto the sensing path around the initial value"

146. Engholm discloses, for example, Figure 4b, which maps a range of parameter values around an initial value. The initial value is represented by item 416, and the range of parameter values (0-500) is mapped to the sensing path

around item 416. Engholm explains that Figure 4b may also include an "additional value field which provides a numeric readout of the current value." 6:54-55

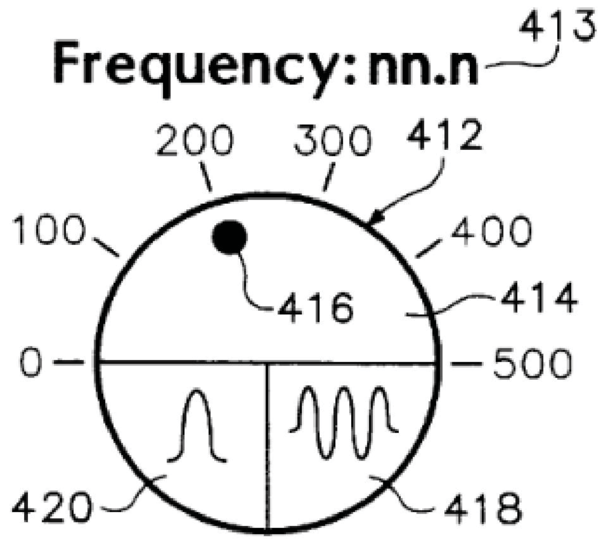


FIG.4b

147. Additionally, the '173 admits that this feature was well known in the prior art. For example, the '173 discusses "prior art implementations of the zoom function." '173, 2:51-52. One such prior art reference discussed by the '173 with regard to this well know "zoom function" is EP1273851A. The '173 explains: "One of the additional operational modes [in prior art EP1273851A] is a zoom mode which provides for fine adjustment of the parameter value. The zoom operational mode can be activated by a contact time of, for example, 10 seconds. In the zoom mode an additional digital display is activated to show the current numerical value of the parameter being adjusted. **In the zoom mode, only a**

fraction (e.g. 10%) of the original adjustment range is mapped onto the adjustment strip so that moving a finger across the full length of the sensor strip from left to right (or right to left) will only increase (decrease) the current setting of the parameter value, thereby providing a finer adjustment." 1:64-2:8. Thus, as admitted by the '173, it was well within the knowledge of the art to "map" all or a subset to the sensing path, as this would allow for finer adjustment of the initially selected parameter.

148. One of skill in the art would have been motivated to combine Trent and Engholm, or the general knowledge of the art as described in the background section of the '173 (admitted prior art), and would have had a reasonable expectation of success in doing so, at least for the reasons discussed in Section XIII.B.1 above. Moreover, one of skill in the art would have been motivated to combine Trent and Engholm, and would have had a reasonable expectation of success in doing so, to achieve claims 7 and 16 for the reasons explained in Section XIII.B.4 above.

149. Thus, Trent and Engholm render obvious claims 7 and 16.

8. Claims 8, 17: "wherein the parameter is selected from the group consisting of temperature, volume, contrast, brightness, and frequency"

150. Trent and Engholm render obvious claims 8 and 17 for the reasons discussed in Section XIII.A.3 above.

151. Engholm also discloses a frequency parameter, e.g., in Figure 4b:

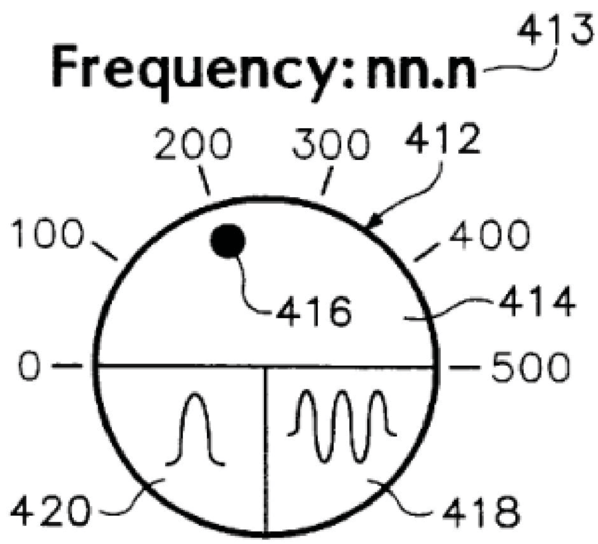


FIG.4b

152. Thus, Trent and Engholm render obvious claims 8 and 17.

9. Claims 9, 18: "wherein [the media and] the sensing element [is/are] part of an electronic appliance selected from the group consisting of a cooking oven, microwave oven, television, washing machine, MP3 player, mobile phone, and multimedia device"

153. Trent and Engholm render obvious claims 9 and 18 for the reasons discussed in Section XIII.A.4 above.

C. Ground 3: Claims 1-3, 5-12, and 14-19 are rendered obvious by Bryan in view of Trent and Engholm, and further in light of the knowledge of a POSITA.

1. One of skill in the art would be motivated to combine the teachings of Bryan, Trent, and Engholm, and would have a reasonable expectation of success in doing so.

154. One of skill in the art would be motivated to combine the teachings of Bryan with the teachings of Trent and Engholm. As explained in Section XII.B.1 above, each reference relates to using touch input devices to control parameters in software. Each also discloses similar problems in the art, namely the difficulty of inputting and changing parameters in small or otherwise limited spaces. And each attempt to solve these problems in similar and predictable ways, such as by using touch sensors, and providing further control of input and adjustment of parameters. It thus would have been obvious to one of skill in the art to try to solve these similar problems with any of the well-known solutions disclosed in Bryan, Trent, and Engholm, and similarly to combine such well-known techniques together.

155. As with Trent and Engholm, discussed above, Bryan is similarly concerned with the ease of selecting from within a wide range of values, using a small amount of display space. For example, Bryan explains that "the small display which is used for displaying the user interface limits the range of motion that can be used to set parameters, and limits the number of parameters that might

be adjusted based on a single display." Ex-1007, 1:39-42. In Bryan's solution, "it is desirable to provide a graphical user interface method and apparatus which allows use of relatively small touchscreen displays with music synthesizers or other sound processing systems, yet provides improved flexibility in the range of values which may be set using the interface, and the number of variables which may be manipulated with a single interface screen." Ex-1007, 1:46-52. And, Bryan acknowledges that its simplified control system has a wide range of applicability: "in addition to audio processor systems, the controller of the present invention can be applied to thermostats, volume and picture quality controllers for video systems, signal strength controllers, attenuators, speed controllers such as for toy trains, or other uses which benefit from a graphical user interface on a touchscreen." Ex-1007, 3:34-39.

156. Accordingly, one of skill in the art would have been motivated to combine the teachings of Bryan, Trent, and Engholm, at least because they solve similar problems, using similar known hardware and software solutions, in very similar ways. Additionally, the disclosure of Trent expressly states that capacitive technology is particularly suited for these small area control applications. And, one of skill in the art would have had a reasonable expectation of success in doing so, at least because each of these solutions involve routine software functionality

that is reasonably predictable to implement and amenable to simple substitution by those of skill in the art.

2. Independent claims 1, 10, and 19 are unpatentable over Bryan in view of Trent and Engholm.

157. As in Grounds 1 and 2, the duplicative elements of claims 1, 10, and 19 are discussed in a combined fashion.

a) 1[pre]: "A method comprising:"

158. Bryan discloses: "Accordingly, it is desirable to provide a graphical user interface method and apparatus which allows use of relatively small touchscreen displays with music synthesizers or other sound processing systems, yet provides improved flexibility in the range of values which may be set using the interface, and the number of variables which may be manipulated with a single interface screen." Ex-1007, 1:45-52

159. *See also* the analysis of Trent in view of Engholm, Section XIII.B.2.a) above.

160. Thus, to the extent limiting, Bryan, either alone or in view of Trent and Engholm, renders obvious the preamble of claim 1.

b) 10[pre], 19[b]: "One or more computer-readable non-transitory storage media embodying logic that is operable when executed to";

19[pre]: "An apparatus comprising"

161. Bryan discloses that "processing resources are coupled with the display panel and the touch sensitive panel which supply an interface display to the display panel." Bryan at 1:58-61. Bryan further discloses that the processing resources include a central processing unit CPU 30 coupled to a bus 31. Working memory 32 and instruction memory 31 are also coupled to the bus 31. The instruction memory 33, according to the present invention, stores routines for controlling the user interface and the touchscreen, such as a pop-up slide routine described below." Ex-1007, 4:38-43.

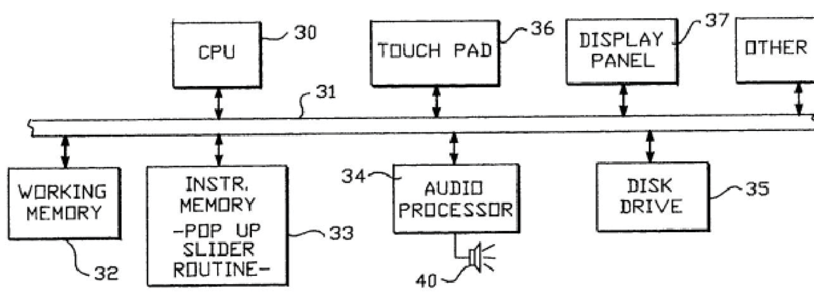


FIG.2

162. *See also* analysis of Trent in view of Engholm, Section XIII.B.2.b) above

163. Thus, to the extent limiting, Bryan, either alone or in view of Trent and Engholm, renders obvious claim elements 10[pre], 19[pre], and 19[b].

c) 1[a], 10[a]: "receiv[ing/e] one or more first signals indicating one or more first capacitive couplings of an object with a sensing element that comprises a sensing path that comprises a length, the first capacitive couplings corresponding to the object coming into

proximity with the sensing element at a first position along the sensing path of the sensing element";

19[a]: "a sensing element that comprises a sensing path that comprises a length";

19[c]: "receive one or more first signals indicating one or more first capacitive couplings of an object with the sensing element, the first capacitive couplings corresponding to the object coming into proximity with the sensing element at a first position along the sensing path of the sensing element"

164. Bryan discloses elements 1[a], 10[a], and 19[a]/19[c]. For example, Bryan discloses a keyboard with a touchscreen (22) to control several different parameters in Figure 1:

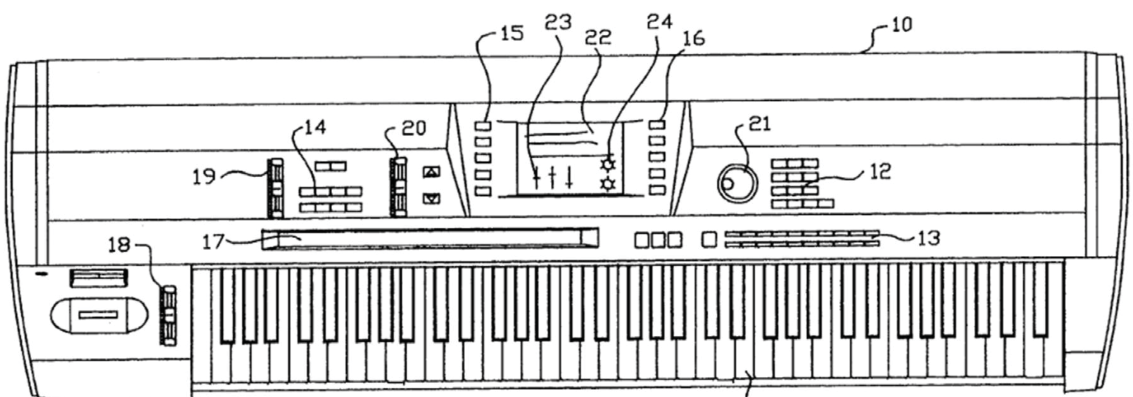
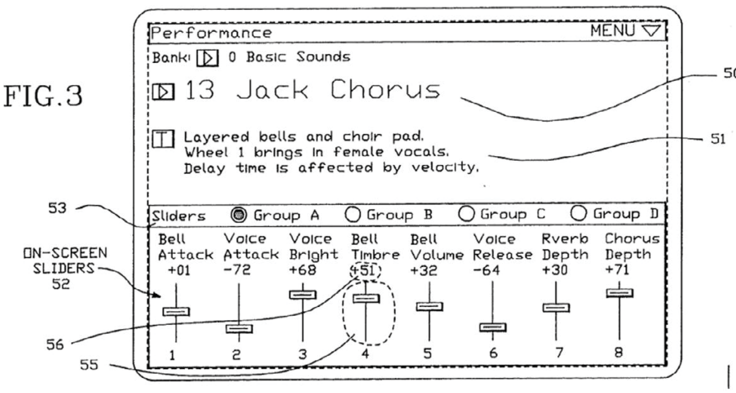


FIG. 1

165. A close-up of the touch screen is shown in Figure 3:

FIG.3



166. The touch screen includes various "sliders" design to be touched and moved, shown in Figures 4A, 4B, 4C, 4D, and 4E. Each of these sliders has "a physical electrical sensing element made of conductive substances that comprises a path for sensing that is determined for each use that comprises a length." For example, the path is determined by the slider's vertical line and its length is the distance between the max and min values. And Bryan also discloses a "the range of parameter values being associated with the length of the sensing path", for example between the "X" and "Y" depicted in the below figures.

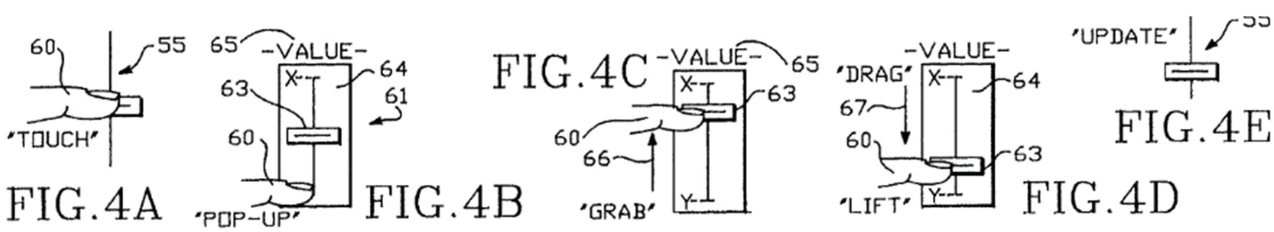


FIG.4A FIG.4B FIG.4C FIG.4D FIG.4E

167. Bryan further discloses, at item 140 in Figure 8, a finger coming into proximity with the sensing path of the sensing element (e.g., slider bar 7C) at a first position (Figure 8 annotated):

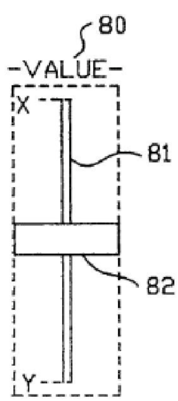


FIG.7C

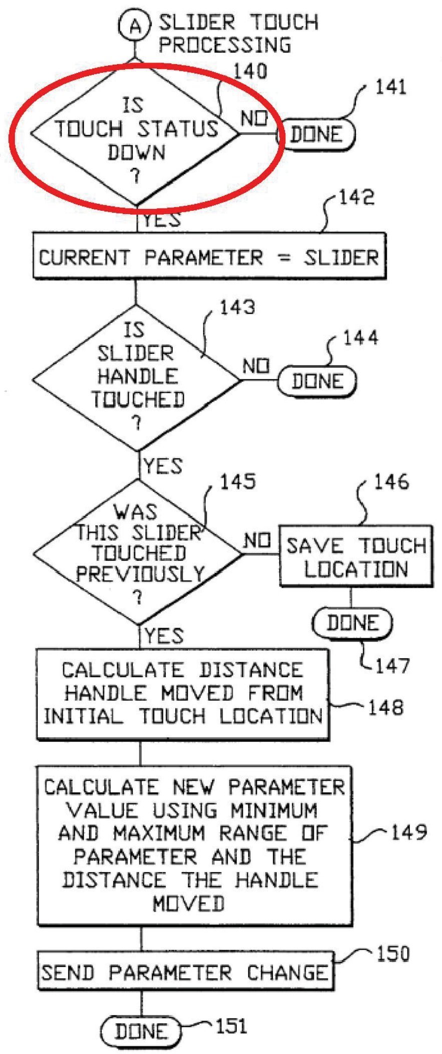


FIG.8

168. Bryan also describes using signals from such touches in the algorithm of Figure 8. "FIG. 8 illustrates the 'Process Touch for Slider' routine, which is

entered at block 131 of FIG. 6. The algorithm begins by determining whether the touch status is down at block 140. If not, the algorithm is done at block 141 returning to the process of FIG. 6. If the touch status remains down, then the current parameter is set equal to a slider at block 142. Next, the algorithm determines whether the slider handle is being touched at block 143. If not, the algorithm is done, as indicated at block 144, returning to the process of FIG. 6. If the slider handle is touched, the algorithm determines whether the slider handle had been previously touched at block 145. If not, then this is the first time the slider handle has been touched during this touch sequence, and the touch location is saved at block 146. Then the algorithm returns to the process of FIG. 6, as indicated at block 147. If it had been touched previously, then the distance the handle has moved from the initial touch location to the current touch location is calculated at block 148. Next, the new parameter value is calculated using the minimum and maximum range of the parameter, and the distance the handle had moved at block 149." Ex-1007, 8:3-23

169. Bryan discloses a "relatively small, flat panel touchscreen," but, does not expressly describe this as a capacitive touchscreen. Ex-1007, 1:33-38. But, it would have been obvious to one of skill in the art to implement such a small touch

screen with well-known capacitive touch sensing technology. *See* analysis of Trent in view of Engholm, Section XIII.B.2.c) above.

170. One of skill in the art would have been motivated to use the capacitive technology disclosed in Trent, including the capacitive sensing path discussed above in connection with Trent, and which is otherwise well known in the art. For example, Trent discloses that its capacitive controls can be made small enough as called for in Bryan: "**The present invention can also be made smaller than knobs or other physical controls, and requires very little space and can be custom made to almost any size.** Additionally, the operation of the sensor has low power requirements, making it ideal for portable notebook computers, personal digital assistants (PDAs), and personal entertainment devices." Ex-1005, [0145]. And, Trent explicitly discloses the use of capacitive inputs for volume control as in Bryan, e.g., Ex-1005, Fig. 36. Accordingly, one of skill in the art would have been motivated to implement the touchscreens of Bryan with the capacitive technology disclosed in Trent, for example because it offered well-known solutions to the well-known problem of controlling parameters with a limited amount of space in which to do so. Additionally, one of skill in the art would have been motivated to combine Bryan, Trent, and Engholm, and would

have had a reasonable expectation of success in doing so, at least for the reasons discussed in Section XIII.C.1 above.

171. Thus, Bryan, Trent, and Engholm render obvious claim elements 1[a], 10[a], and 19[a]/[c].

d) 1[b], 10[b], 19[d]: "determin[ing/e] based on one or more of the first signals the first position of the object along the sensing path"

172. Bryan inherently determines the position of the object along the sensing path, for example, in order to set the parameter to an initial value corresponding to the position the slide that was touched. *See* Section XIII.C.2.e) below. Bryan also describes determining the position of the object along the sensing path in connection with other steps in Figure 8: "FIG. 8 illustrates the 'Process Touch for Slider' routine, which is entered at block 131 of FIG. 6. The algorithm begins by determining whether the touch status is down at block 140. If not, the algorithm is done at block 141 returning to the process of FIG. 6. If the touch status remains down, then **the current parameter is set equal to a slider at block 142**. Next, the algorithm **determines whether the slider handle is being touched** at block 143. If not, the algorithm is done, as indicated at block 144, returning to the process of FIG. 6. If the slider handle is touched, the algorithm determines whether the slider handle had been previously touched at block 145. If

not, then this is the first time the slider handle has been touched during this touch sequence, and the **touch location is saved** at block 146. Then the algorithm returns to the process of FIG. 6, as indicated at block 147. If it had been touched previously, then **the distance the handle has moved from the initial touch location** to the current touch location is calculated at block 148. Next, the new parameter value is calculated using the minimum and maximum range of the parameter, and the distance the handle had moved at block 149." Ex-1007, 8:3-23.

173. *See also* analysis of Trent in view of Engholm, Section XIII.B.2.d) above.

174. Thus, Bryan, either alone or in view of Trent and Engholm, renders obvious claim elements 1[b], 10[b], and 19[d].

e) 1[c], 10[c], 19[e]: "set[ting] a parameter to an initial value based on the first position of the object along the sensing path, the initial value comprising a particular parameter value and being associated with a range of parameter values, the range of parameter values being associated with the length of the sensing path"

175. Bryan renders obvious setting a parameter to an initial value based on the first position along the sensing path, the initial value comprising a particular parameter value. Bryan discloses, for example at item 142 in Figure 8 (annotated below), setting the parameter equal to the position of the slider that was touched:

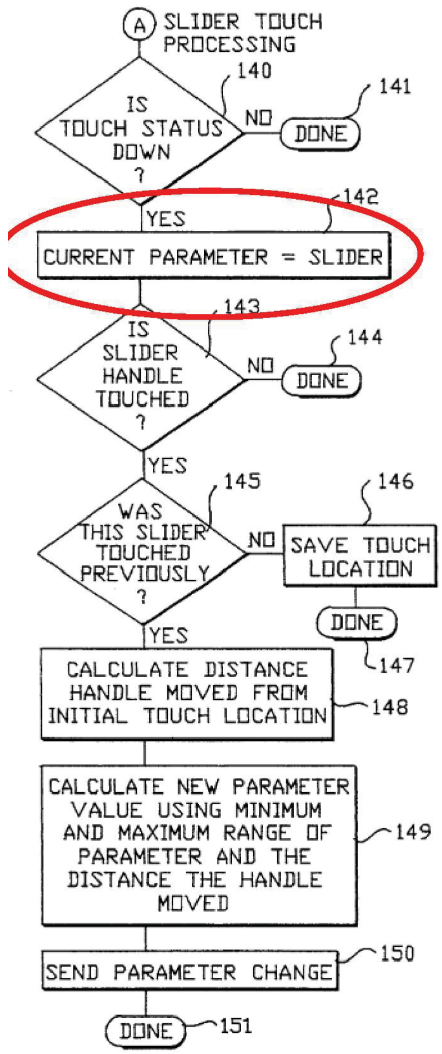


FIG.8

176. "FIG. 8 illustrates the 'Process Touch for Slider' routine, which is entered at block 131 of FIG. 6. The algorithm begins by determining whether the touch status is down at block 140. If not, the algorithm is done at block 141 returning to the process of FIG. 6. **<u>If the touch status remains down, then the current parameter is set equal to a slider at block 142.</u>**" Ex-1007, 8:3-9.

177. Based on this disclosure, it would have been obvious to set the "parameter to an initial value based on the first position of the object along the sensing path." For example, one of skill in the art would have understood that, if the user touched on a location along the sensing path other than where the slider block is located, the position of that first touch could be used to set the initial value. One of skill in the art would have understood that this would be a trivial variation of Figure 8. For example, if the result of block 143 were no, instead of ending the process, the output could set the initial value based on the touched location, and then relocate the slider to that position.

178. One of skill in the art would have been motivated to make this change because it was well known that setting an initial value based on a touch point was a useful way to select parameter values, especially in small spaces. See, for example, the "absolute" mode of Trent discussed in [0092], and Section XIII.A.1.e) above. See also my discussion of "sliders" in the Technology background. Additionally, Bryan itself discloses that "maximum flexibility" is desired because "no two musicians do things in exactly the same way." Bryan, 1:45-52. Accordingly, one of skill in the art would have been motivated to include such a well-known "absolute" touch mode, because the system would be more flexible in allowing a user to touch anywhere along the sensing path, rather than on

just one point (the original position of the slider). Allowing a broader range of operation provides more user flexibility as Bryan suggests is its stated goal.

179. The parameter is one of "the range of parameter values being associated with the length of the sensing path." For example the slider, e.g., 7C, has a max ("X") and min ("Y") for the associated parameter range that is associated with its length: "FIGS. 7A-7C are used to illustrate slider terminology for the flow chart of FIG. 8. Thus, the slider icon will consist of a slider background, as shown in FIG. 7A, which includes a current value field 80, a slide symbol 81, and **an indication of the range of values which can be achieved by this slider, such as a top maximum value X, and a minimum value Y.**" Ex-1007, 7:54-69.

180. To the extent that this element is not rendered obvious by Bryan, it would have been obvious in view of Trent and Engholm. One of skill in the art would have been motivated to combine Brian, Trent, and Engholm, and would have had a reasonable expectation of success in doing so, at least for the reasons discussed in Section XIII.C.1 above. Additionally, see the discussion of associating the range of parameter values in Engholm, discussed above in analysis of Trent in view of Engholm, Section XIII.B.2.e) above.

181. Thus, Bryan, either alone or in view of Trent and Engholm, renders obvious claim elements 1[c], 10[c], and 19[e].

f) 1[d], 10[d], 19[f]: "receiv[ing/e] one or more second signals indicating one or more second capacitive couplings of the object with the sensing element, the second capacitive couplings corresponding to a displacement of the object along the sensing path from the first position"

182. Bryan discloses, for example at item 148 in Figure 8, receiving signals corresponding to the displacement of the object along the sensing path such that displacement of the slider handle may be determined (Figure 8 annotated):

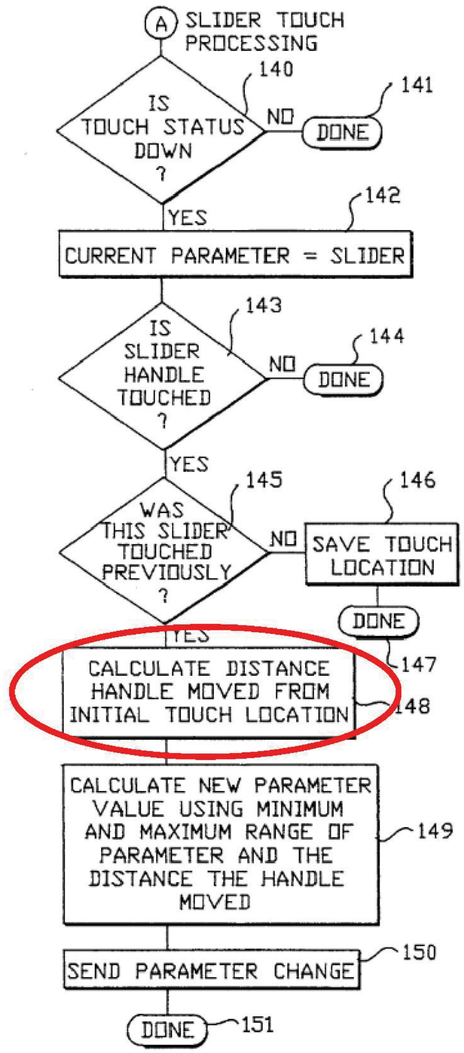


FIG.8

183. "Next, the algorithm determines whether the slider handle is being touched at block 143. …If the slider handle is touched, the algorithm determines whether the slider handle had been previously touched at block 145. …**If it had been touched previously, then the distance the handle has moved from the initial touch location to the current touch location is calculated at block 148.**

Next, the new parameter value is calculated using the minimum and maximum range of the parameter, and the distance the handle had moved at block 149." Ex-1007, 8:9-23.

184. One of ordinary skill in the art would understand that the calculation of "distance" described in Bryan would inherently include a direction, e.g., indicated by a positive or negative value of the distance relative to the first position. This would be necessary in order to determine whether the parameter is to be increased or decreased.

185. Additionally, to the extent not expressly or inherently disclosed by Bryan, see the discussion of Trent, e.g., Sections XIII.A.1.e) above, and XIII.A.1.f) above, for disclosure and discussion of why and how one of skill in the art would have been motivated to determine both a distance and direction of motion. One of skill in the art would have been motivated to combine Bryan, Trent, and Engholm, and would have had a reasonable expectation of success in doing so, at least for the reasons discussed in Section XIII.C.1 above. Additionally, see Section XIII.C.2.c) above, for why one of skill in the art would have been motivated to implement the touch sensor with capacitive technology.

186. Thus, Bryan, either alone or in view of Trent and Engholm, renders obvious claim elements 1[d], 10[d], and 19[f].

g) 1[e], 10[e], 19[g]: "determin[ing/e] based on one or more of the second signals the displacement of the object along the sensing path"

187. *See* claim elements 1[d], 10[d], 19[f], Section XII.C.2.f., above.

188. *See also* analysis of Trent in view of Engholm, Section XIII.B.2.g) above.

189. Thus, Bryan, either alone or in view of Trent and Engholm, renders obvious claim elements 1[e], 10[e], and 19[g].

h) 1[f], 10[f], 19[h]: "adjust[ing/e] the parameter within the range of parameter values based on the displacement of the object along the sensing path."

190. Bryan discloses, for example at items 149 and 150 in Figure 8, adjusting the parameter based on the displacement (Figure 8 annotated):

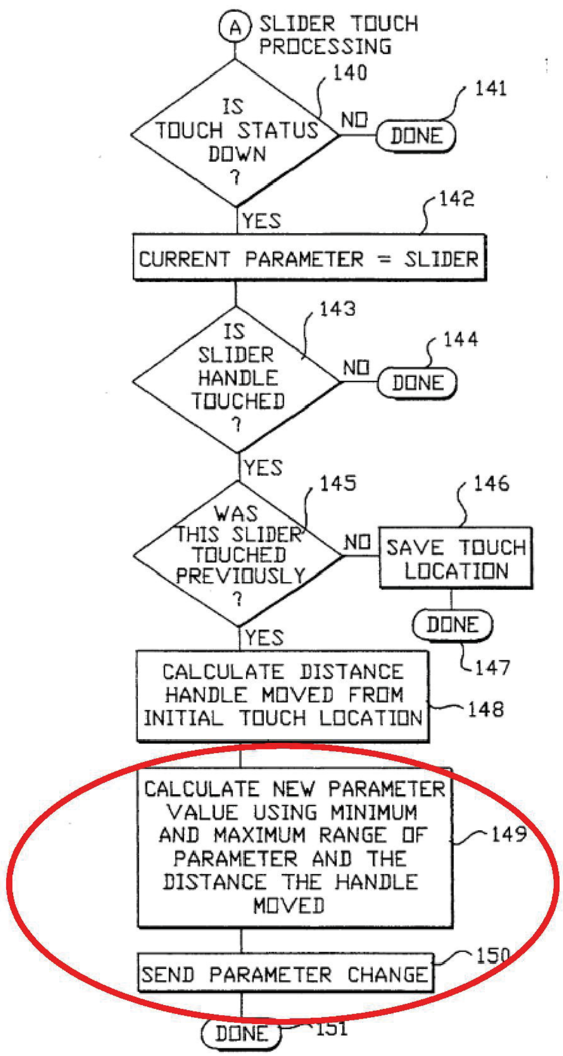


FIG.8

191. "the distance the handle has moved from the initial touch location to the current touch location is calculated at block 148. Next, **the new parameter value is calculated** using the minimum and maximum range of the parameter, and the distance the handle had moved at block 149. Next, **the parameter change is sent to the parameter management software**, as indicated at block 150, and the

process is done at block 151, returning to the algorithm of FIG. 6." Ex-1007, 8:18 28.

192. *See also* analysis of Trent in view of Engholm, Section XIII.B.2.h) above.

193. Thus, Bryan, either alone or in view of Trent and Engholm, renders obvious claim elements 1[f], 10[f], and 19[h].

3. Claims 2, 11: "wherein the sensing path comprises a closed loop"

194. Bryan discloses circular closed-loop sensing paths. For example, *see* Figures 10A-F, and related discussion in the spec, Ex-1007, 8:62-9:11.

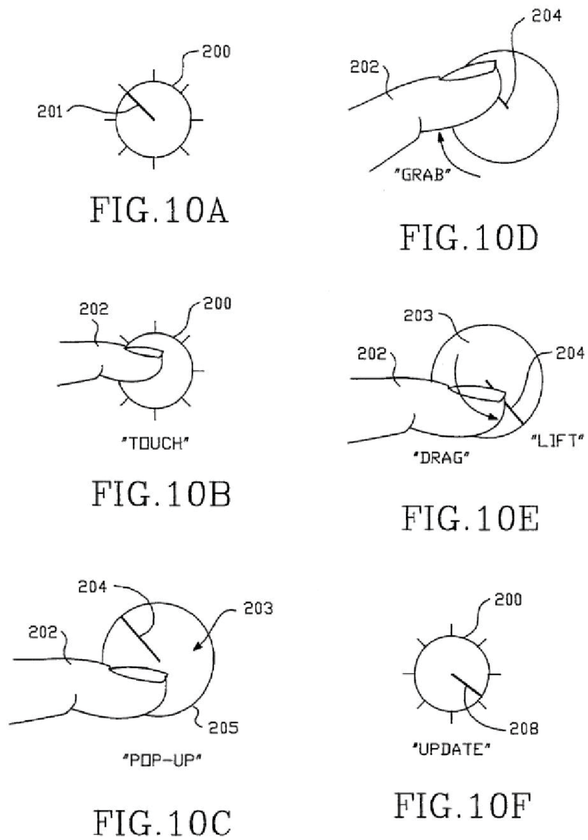


FIG.10A FIG.10D FIG.10B FIG.10E FIG.10C FIG.10F

4. Claims 3, 12: "switch[ing/operable to switch] from a first mode of operation to a second mode of operation in response to one or more of the second signals if the displacement corresponding to the second capacitive coupling indicated by the second signals exceeds a pre-determined threshold, the second mode of operation being for adjusting the parameter within the range of parameter values based on the displacement of the object along the sensing path, the first mode of operation being for setting the parameter to the initial value"

195. Bryan, Trent, and Engholm render obvious claims 3 and 12 for the reasons discussed above in Section XIII.B.4 above.

5. Claims 5, 14: "wherein adjusting the parameter comprises effecting an incremental change in the parameter from the

initial value based on an amount of the displacement exceeding a pre-determined displacement threshold"

196. Bryan, Trent, and Engholm render obvious claims 5 and 14 for the reasons discussed above in Section XIII.B.5 above.

6. Claims 6, 15: "wherein adjusting the parameter comprises changing the parameter from the initial value by a number of units based on a number of times an amount of the displacement exceeds a pre-determined displacement threshold"

197. Bryan, Trent, and Engholm render obvious claims 6 and 15 for the reasons discussed above in Section XIII.B.6 above.

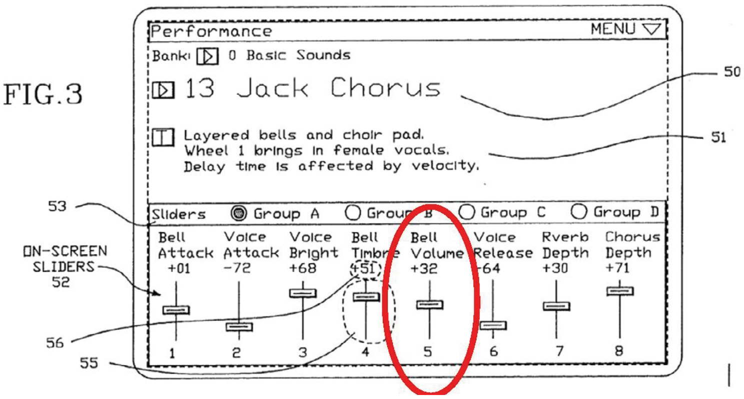
7. Claims 7, 16: "[mapping/operable to map] all or a portion of the range of parameter values onto the sensing path around the initial value"

198. Bryan, Trent, and Engholm render obvious claims 7 and 16 for the reasons discussed above in Section XIII.B.7 above.

8. Claims 8, 17: "wherein the parameter is selected from the group consisting of temperature, volume, contrast, brightness, and frequency"

199. Bryan discloses using a slider to control volume:

FIG.3



200. Additionally, Bryan, Trent, and Engholm render obvious claims 8 and 17 for the reasons discussed above in Section XIII.B.8 above.

9. Claims 9, 18: "wherein [the media and] the sensing element [is/are] part of an electronic appliance selected from the group consisting of a cooking oven, microwave oven, television, washing machine, MP3 player, mobile phone, and multimedia device"

201. Bryan, Trent, and Engholm render obvious claims 8 and 17 for the reasons discussed above in Section XIII.B.9 above.

XIV. CONCLUSION

202. Claims 1-3, 5-12, and 14-19 of the '173 Patent are unpatentable and should be cancelled for the reasons explained herein.

I declare that all statements made herein of my knowledge are true, and that all statements made on information and belief are believed to be true, and 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.

Date: June 15, 2021

Dr. Benjamin B. Bederson