

EXHIBIT 2.07

lines on the display 22 outline the so called active area 25, which in practice is perceived by the markings and/or patterns shown in the display 22. A list 26 in text form belongs to these markings and/or figures, and at the same time to the active area 25. The active area 25 is a touch sensitive area in order to control the contents, in this case the list, of the display 22. The end line formed by the elements 27 of the list 26 can be presented as an arc 28, representing a three-dimensional effect. The active area 25 of the display can be touched with a pointing means, here a finger 29, in order to scroll the list 26.

In figure 2 the display control area is the above mentioned active area 25 of the display, but alternatively it is a separate touch surface outside the display for controlling the display, as shown in figure 5.

Figure 3 shows an embodiment of the method according to the invention in the form of a flow chart. The method is applied in a device, which is a mobile station. In step 31 a list 12 is selected for display 15 (cf. figure 1) in a suitable way, for instance with a key. The list 12 is formed by elements 13, 14 arranged consecutively below each other. A look shows whether the desired element 13 can be seen on the touch sensitive display 15 (step 32). If the element 13 is not visible, then the list 12 in the active area of the display is touched with a pointing means 17, such as with a finger, a pencil or another instrument of that kind (step 33), and the list 12 is scrolled into the desired direction by moving the pointing means 17 on the surface of the display in this direction (step 34). If the pointing means 17 is moved outside the display the list 12 is left scrolling.

The movement of a list 12 left scrolling is preferably exponentially retarded. If the list 12 stops before the desired element 13 is visible, the scrolling action (step 34) can be repeated until the desired element 13, such as a name and telephone number is visible on the display 15. When required, the list 12 is stopped (step 35) by touching an element 13 or 14 of the list 12.

Below is described as an example a way to find an element 13, 14, 27 on a long list 26, when the desired element 13 initially is outside the area 15 visible on the display 22. When the list presentation mode is activated 31 but the desired element 13 is not visible, then the cylinder 11 is rotated by moving the pointing means 17, 28 up or down on the element 14, 27 along the display surface 22. The element 14, 27 moves together with the pointing means 17, 28, so that the pointing means will not move outside the element. When the pointing means 17, 28 is moved off the active area 25 of the display, the list 12, 26 is left in the moving state, or the elements in the display 15, 22 will continue scrolling. The rotation of the cylinder 12 is preferably exponentially retarding. The active area 25 of the display contains a touch sensitive list 26. The rotation is visible as a motion of the elements 27 of the list 22 and heard as a sound proportional to the speed. When the desired element 13 comes into view the list 12, 26 is stopped by touching the active area 25 of the list, preferably at the location of said ele-

ment 13, and when required the display is scrolled sideways until the desired part of the element is visible on the display 15.

Figure 4 shows some parts of the mobile station which are essential for the invention. In order to scroll the displayed information the arrangement includes a memory 42 for storing the displayed information, a display 43 for presenting the information, and means 41, 46 for scrolling said displayed information. The device of figure 2 comprises means for scrolling the list 26 by moving the pointing means 28 in the scrolling direction on the active area 25 of the display. These means for scrolling the list 26 comprise a central processing unit 41, a display control area or a reading surface 44 for detecting a touch of the pointing means 28, a pointing means 28, and a program in the memory 42 which reads the display control area 25 in order to detect a touch and the touch point of the pointing means 28, and in order to scroll the displayed information 26 on the display 22, so that the displayed information is scrolled in the movement direction of the pointing means 28 controlled by the movement of the pointing means 28.

The processor based device preferably comprises means 23, 45 to generate a sound which is proportional to the scrolling speed of said displayed information 26. These means include a speaker 23, an audio section 45, and a control program stored in the memory 42. The sound proportional to the scrolling speed of the list 26 is for instance generated by the frequency, loudness or interruptions of the sound. The data communication between the parts 41 - 45 is realized through the micro-processor bus 46.

The arrangement also includes means for displaying the elements 27, such as text and symbols, of the presented information, here the list 26, in the display 43 on the outer surface of an imaginary cylinder. These means for presenting the list 26 on the display 22 include a central processing unit 41 and a program in the memory 42 which creates a picture of a cylindrical list 26 on the display 43. The user can handle the list 26 by suitably touching the display control area 25 with a pointing means 28 in the above presented manner, and by acting on the elements 27 of the list.

Figure 5 shows a mobile station 51, in which an arrangement according to an embodiment of the invention is realized. On one side of the mobile station 51 is shown a touch surface 53 known *per se*, which is used as an alternative way to control the scrolling operation in the display 52 of the mobile station 51 by moving a pointing means on said control surface 53. Preferably the touch surface 53 operates in the same way as the active area of the display described above. The touch surface 53 operates alternatively in numerous other ways, for which there are direction arrows 54a, 54b at the ends of the touch surface 53. The direction arrows 54a, 54b represent the scrolling direction caused by a touch. Alternative ways of operation are i.a. scrolling one element at a time by touching the touch surface 53 once at a

direction arrow 54a, 54b; an accelerating scrolling by touching the touch surface 53 a longer time at a direction arrow 54a, 54b; a controlled scrolling rate by touching the touch surface 53 continuously in an area between the direction arrows 54a, 54b, whereby the place of the touch determines the scrolling speed. The scrolling rate obtains its maximum value according to the place of the touch when the touch surface 53 is touched a long time. The touch can begin at any place of the touch surface 53 when a controlled scrolling rate is desired. The scrolling is stopped when the center of the touch surface 53 is touched.

The touch surface 53 of the mobile station 51 is alternatively used, preferably on the basis of a selected parameter, as was described above in connection with figure 3 regarding the use of the active area of the display. Then the list elements are moved directly proportionally to the movement of the touch spot on the touch surface 53.

The control area 25 of the mobile station 21 is alternatively used, preferably on the basis of a selected parameter, as was presented above regarding the use of the touch surface 53 in the description of figure 5. Then the touch spot on the active area of the display 25 causes a scrolling rate which is proportional to the position of the touch spot.

The list scrolling in the display is retarded e.g. according to the equation

$$v = v_0 - \frac{t^2}{K} \quad (1)$$

where v is the scrolling speed, v_0 is the scrolling speed at the beginning, t is the time, and K is a constant. The counting of the time t starts at the moment when the scrolling is left on without user control.

Above we presented a movement only in the direction of the rotation of an imaginary cylinder, but in order to have a view of the end of a long line it is also possible to arrange a transversal movement. This transversal movement is preferably only a transition movement, without any scrolling separately left on. The transversal movement is controlled by the active area on the display, or alternatively by a separate horizontal touch surface. It is also possible to limit the movement so that a movement is possible only in a single direction at a time. Then an oblique movement of the pointing means causes a vertical or a horizontal scrolling, which is selected for instance so that a vertical or horizontal movement is selected when the oblique movement is in an angle less than 45 degrees from the vertical or horizontal, respectively.

The invention is not limited to apply only to the above presented embodiment examples, but many variations are possible within the inventive idea defined by the claims.

Claims

1. A method for scrolling information (12, 13, 14) presented on a display of a mobile station, **characterized** in that a control area of the display is touched with a pointing means (17), said pointing means (17) is moved in contact with said control area of the display, and a displayed part of the presented information (12, 13, 14) is scrolled (34) in the display (15), in a direction of said movement of said pointing means (17).
2. A method according to claim 1, **characterized** in that said displayed part of the information (12, 13, 14) presented on the display of the mobile station is left scrolling in a vertical direction, even if said pointing means (17) is removed from said control area of the display.
3. A method according to claim 2, **characterized** in that said displayed part, which is left scrolling, is arranged to scroll at a rate measured for a vertical speed of said pointing means (17) at the last moment before it was removed.
4. A method according to claim 3, **characterized** in that said displayed part is left scrolling if said speed exceeds a predetermined limit.
5. A method according to claim 2, 3 or 4, **characterized** in that said displayed part left scrolling is arranged to scroll at a rate retarding by itself.
6. A method according to claim 2, 3, 4 or 5, **characterized** in that said scrolling is stopped if said scrolling speed falls below a predetermined limit.
7. A method according to claim 2, 3, 4 or 5, **characterized** in that said displayed part of the presented information (12, 13, 14) is stopped by touching said display control area with said pointing means (17).
8. A method according to any previous claim 1 to 7, **characterized** in that a scrolling rate of said displayed part of the presented information (12, 13, 14) on the display (15) is indicated by generating a sound proportional to said scrolling rate.
9. A method according to any previous claim 1 to 8, **characterized** in that the presented information (12, 13, 14) is arranged on an outer surface of an imaginary cylinder (11) rotating in the display (15).
10. A method according to any previous claim 1 to 9, **characterized** in that said scrolling of said displayed part of the presented information (12, 13, 14), or a rotation of said imaginary cylinder (11) is arranged to be substantially continuous.

11. A method according to any previous claim 1 to 10, **characterized** in that said scrolling of said displayed part is limited to be effected only in a vertical direction. 5
12. A method according to any previous claim 1 to 11, **characterized** in that the presented information (12, 13, 14) is arranged as a list (12), the elements (13, 14) of which, such as text and symbols, are presented in the display (15). 10
13. An arrangement to scroll the information (26) presented on a display (22) of a mobile station (21), whereby the arrangement has a display (22, 43) to display information (26) and means (41, 46) to scroll the presented information (26), **characterized** in that the arrangement includes a display control area for detecting a touch of a pointing means (28), and means (41, 42, 46) to scroll a displayed part of the presented information (26) on the display (22) in a movement direction of said pointing means (28). 15
20
14. An arrangement according to claim 13, **characterized** in that said control area includes an active surface (25, 44) on the display (22, 43) for detecting a touch of said pointing means (28). 25
15. An arrangement according to claim 13, **characterized** in that said control area includes a separate touch surface (53) for detecting a touch of the pointing means (28). 30
16. An arrangement according to claim 13, 14 or 15, **characterized** in that it further includes means (23, 45) to generate a sound which is proportional to a scrolling speed of the presented information (26). 35
17. An arrangement according to any previous claim 13 to 16, **characterized** in that it further includes means to arrange the presented information (26) in a form of a cylinder rotating in the display (22), whereby information (26) elements (27), such as text and symbols, are displayed on an outer surface of a cylinder. 40
45

50

55

6

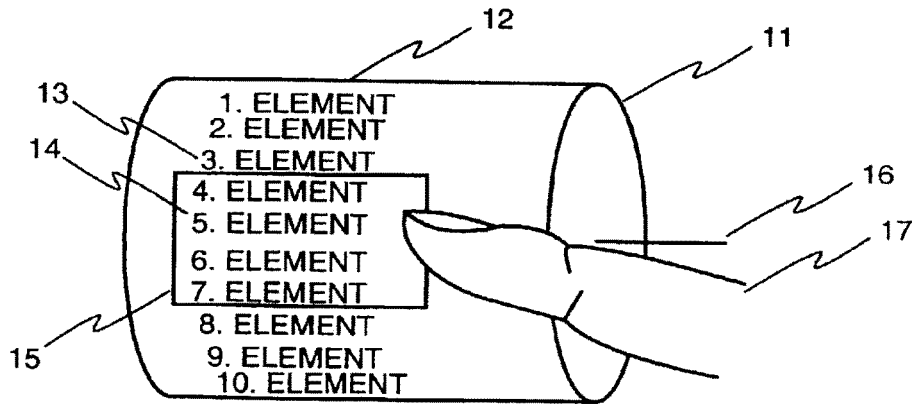


FIGURE 1

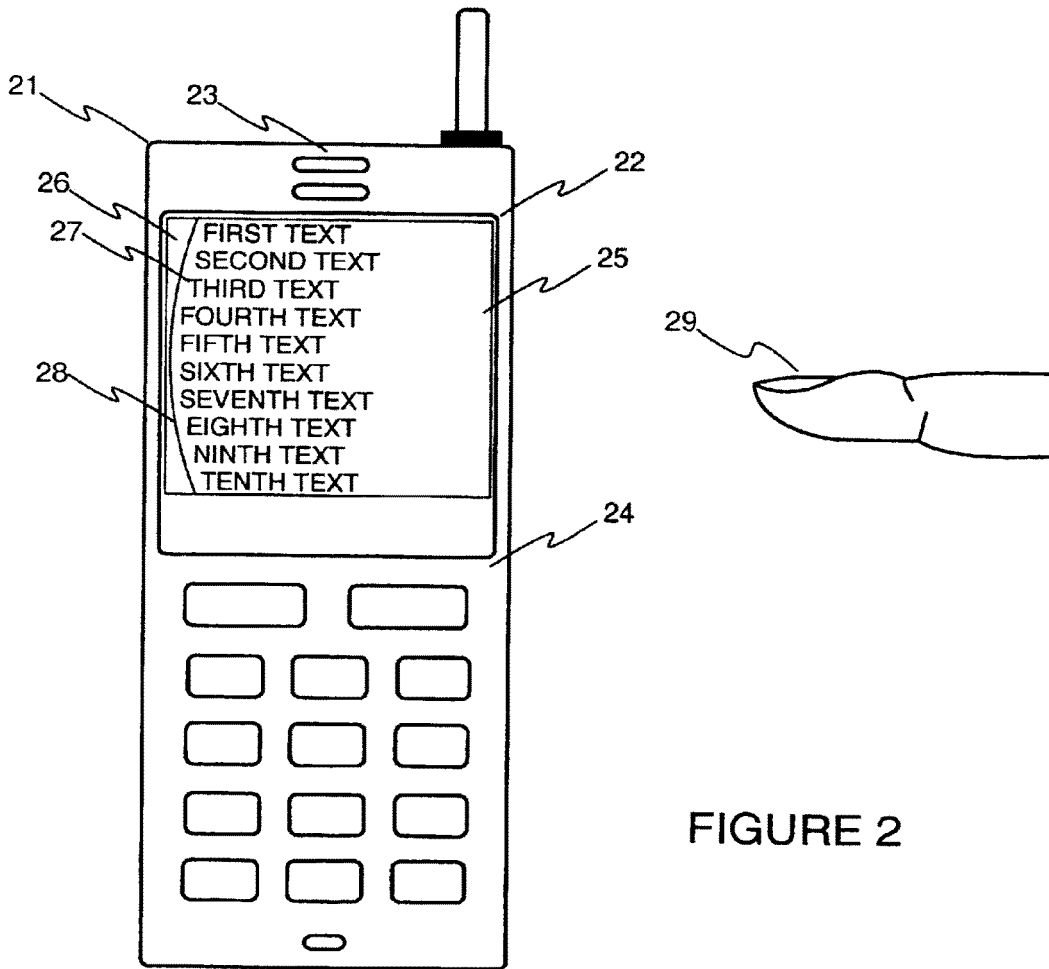


FIGURE 2

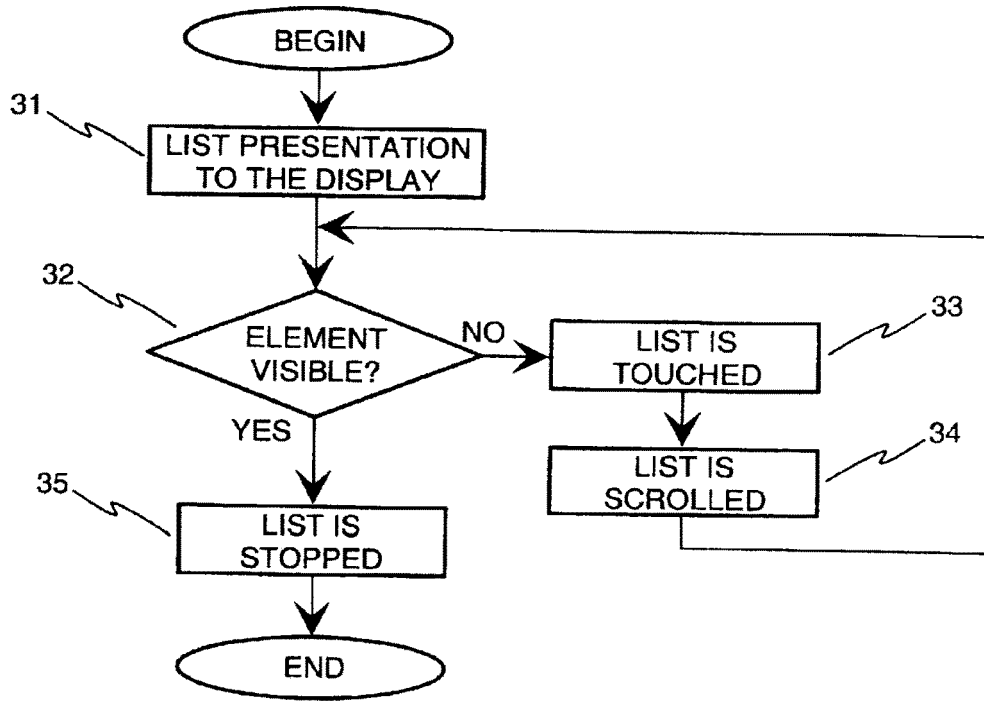


FIGURE 3

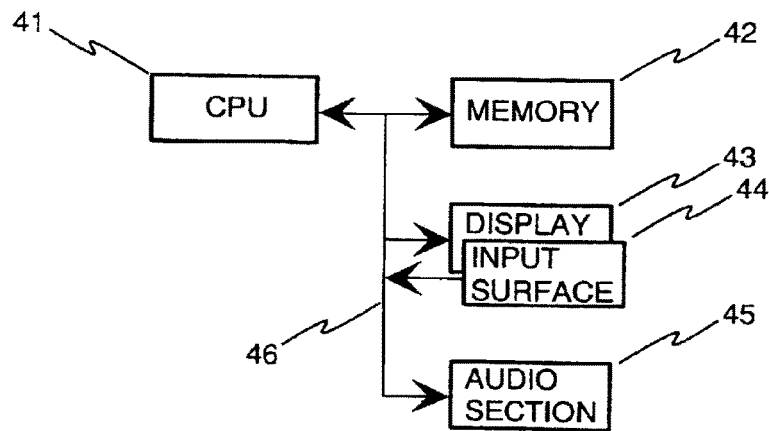


FIGURE 4

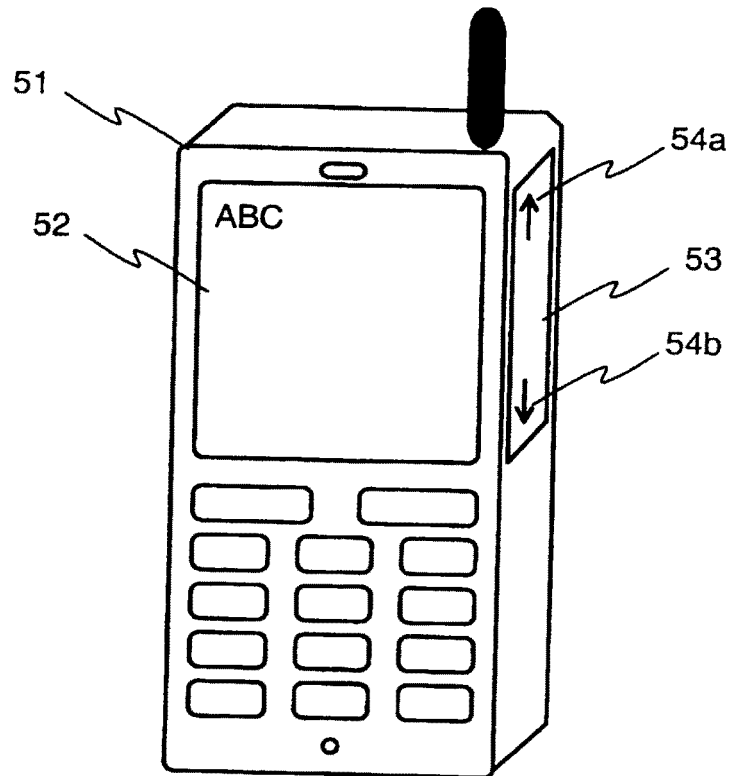


FIGURE 5

INFORMATION DISCLOSURE CITATION PTO-1449				<i>Complete If Known</i>			
				Application Number		11/956,969	
				Filing Date		December 14, 2007	
				First Named Inventor		Bas Ording	
				Art Unit		2174	
				Examiner Name		Pesin, Boris M.	
Sheet	1	of	3	Attorney Docket No.	P4304US1/63266-5054US		

U.S. PATENT DOCUMENTS							
Examiner Initials	Cite No.	Document Number	Publication Date MM-DD-YYYY	Name of Patentee or Applicant of Cited Document	Class	Subclass	Filing Date if Appropriate
		Number - Kind Code ¹					
		5,844,547	12-01-1998	Minakuchi et al.	345	173	
		5,867,158	02-02-1999	Murasaki et al.	345	341	
		6,034,688	03-07-2000	Greenwood et al.	345	353	
		6,489,951	12-03-2002	Wong et al.	345	173	
		6,567,102	05-20-2003	Kung	345	660	
		6,661,409	12-09-2003	Demartines et al.	345	173	
		6,707,449	03-16-2004	Hinckley et al.	345	173	
		6,809,724	10-26-2004	Shiraishi et al.	345	169	
		6,907,575	06-14-2005	Duarte	715	784	
		6,912,462	06-28-2005	Ogaki	701	208	
		6,972,776	12-06-2005	Davis et al.	345	684	
		6,975,306	12-13-2005	Hinckley et al.	345	173	
		7,009,599	03-07-2006	Pihlaja	345	173	
		7,046,230	05-16-2006	Zadesky et al.	345	156	
		7,075,512	07-11-2006	Fabre et al.	345	156	
		7,102,626	09-05-2006	Denny, III	345	179	
		7,154,534	12-26-2006	Seki et al.	348	207.1	
		7,155,048	12-26-2006	Ohara	382	132	
		7,181,373	02-20-2007	Le Cocq et al.	703	1	
		7,184,796	02-27-2007	Karidis et al.	455	566	
		7,240,291	07-03-2007	Card et al.	715	776	
		2003/0095135	05-22-2003	Kaasila et al.	345	613	
		2003/0095697	05-22-2003	Wood et al.	382	131	
		2004/0021676	02-05-2004	Chen et al.	345	684	
		2004/0080541	04-29-2004	Saiga et al.	345	805	
		2004/0263486	12-30-2004	Seni	345	173	
		2005/0168488	08-04-2005	Montague	345	659	
		2005/0198588	09-08-2005	Lin et al.	715	784	
		2005/0237308	10-27-2005	Autio et al.	345	173	
		2005/0270269	12-08-2005	Tokkonen	345	156	
		2005/0275618	12-15-2005	Juh et al.	345	156	
		2005/0026521	02-02-2006	Hotelling et al.	715	702	
		2006/0048073	03-02-2006	Jarrett et al.	715	784	

Examiner Signature	DB2/20768505.1	Date Considered	
---------------------------	----------------	------------------------	--

*EXAMINER: Initial if reference considered, whether or not citation is in conformance with MPEP 609. Draw line through citation if not in conformance and not considered. Include copy of this form with next communication to applicant.

¹ See Kind Codes of USPTO Patent Documents at www.uspto.gov or MPEP 901.04. ² Enter Office that issued the document, by the two-letter code (WIPO Standard ST.3). ³ For Japanese patent documents, the indication of the year of the reign of the Emperor must precede the serial number of the patent document. ⁴ Kind of document by the appropriate symbols as indicated on the document under WIPO Standard ST. 16 if possible. ⁵ Applicant is to place a check mark here if English language Translation is attached.

Burden Hour Statement: This form is estimated to take 2.0 hours to complete. Time will vary depending upon the needs of the individual case. Any comments on the amount of time you are required to complete this form should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, Washington, DC 20231. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. SEND TO: Assistant Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.

INFORMATION DISCLOSURE CITATION PTO-1449				<i>Complete If Known</i>			
				Application Number		11/956,969	
				Filing Date		December 14, 2007	
				First Named Inventor		Bas Ording	
				Art Unit		2174	
Examiner Name		Pesin, Boris M.					
Sheet	2	of	3	Attorney Docket No.	P4304US1/63266-5054US		

		2006/0055669	03-16-2006	Das	345	156	
		2006/0061551	03-23-2006	Fateh	345	158	
		2006/0077544	04-13-2006	Stark	359	448	
		2006/0082549	04-20-2006	Hoshino et al.	345	157	
		2006/0094502	05-04-2006	Katayama et al.	463	31	
		2006/0156249	07-13-2006	Blythe et al.	715	781	
		2006/0181510	08-17-2006	Faith	345	158	
		2006/0187215	08-24-2006	Rosenberg et al.	345	173	
		2006/0197753	09-07-2006	Hotelling	345	173	
		2006/0238495	10-26-2006	Davis	345	156	
		2007/0008066	01-11-2007	Fukuda	340	5.52	
		2007/0024646	02-01-2007	Saarinen et al.	345	660	
		2007/0046646	03-01-2007	Kwon et al.	345	173	
		2007/0067745	03-22-2007	Choi et al.	715	863	
		2007/0109275	05-17-2007	Chuang	345	173	
		2007/0120835	05-31-2007	Sato	345	173	
		2007/0150826	06-28-2007	Anzures et al.	715	772	
		2007/0150842	06-28-2007	Chaudhri et al.	715	863	
		2007/0152978	07-05-2007	Kocienda et al.	345	173	
		2007/0152979	07-05-2007	Jobs et al.	345	173	
		2007/0155434	07-05-2007	Jobs et al.	455	565	
		2007/0156364	07-05-2007	Rothkopf	702	117	

FOREIGN PATENT DOCUMENTS

Examiner Initials	Cite No.	Foreign Patent Document Country Code ² - Number ³ - Kind Code ⁴ (if known)	Publication Date MM-DD- YYYY	Name of Patentee or Applicant of Cited Document	Class	Subclass	Translation	
							Yes	No
		EP 0 635 779 A1	01-25-1995	Xerox Corporation	G06F	3/033		
		EP 0 880 091 A2	11-25-1998	Nokia Mobile Phones Ltd.	G06F	3/033		
		WO 02/01338 A1	01-03-2002	Intel Corporation	G06F	3/033		
		WO 03/060622 A2	07-24-2003	Koninklijke Philips Electronics N.V.	G06F			
		WO 2006/020305 A2	02-23-2006	Apple Computer, Inc.				

Examiner Signature	DB2/20768505.1	Date Considered	
---------------------------	----------------	------------------------	--

*EXAMINER: Initial if reference considered, whether or not citation is in conformance with MPEP 609. Draw line through citation if not in conformance and not considered. Include copy of this form with next communication to applicant.

¹ See Kind Codes of USPTO Patent Documents at www.uspto.gov or MPEP 901.04. ² Enter Office that issued the document, by the two-letter code (WIPO Standard ST.3). ³ For Japanese patent documents, the indication of the year of the reign of the Emperor must precede the serial number of the patent document. ⁴ Kind of document by the appropriate symbols as indicated on the document under WIPO Standard ST. 16 if possible. ⁵ Applicant is to place a check mark here if English language Translation is attached.

Burden Hour Statement: This form is estimated to take 2.0 hours to complete. Time will vary depending upon the needs of the individual case. Any comments on the amount of time you are required to complete this form should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, Washington, DC 20231. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. SEND TO: Assistant Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.

INFORMATION DISCLOSURE CITATION PTO-1449				<i>Complete If Known</i>		
				Application Number		11/956,969
				Filing Date		December 14, 2007
				First Named Inventor		Bas Ording
				Art Unit		2174
Examiner Name		Pesin, Boris M.				
Sheet	3	of	3	Attorney Docket No.	P4304US1/63266-5054US	

OTHER NON PATENT LITERATURE DOCUMENTS		
Examiner Initials	Cite No.	Include name of the author (in CAPITAL LETTERS), title of the article (when appropriate), title of the item (book, magazine, journal, serial, symposium, catalog, etc.), date, page(s), volume-issuc number(s), publisher, city and/or country where published
		IBM, "Scroll Control Box," IBM Technical Disclosure Bulletin, Vol. 38, No. 04, April 1993, pages 399-403.
		TIDWELL et al., "Magnetism," Designing Interfaces, November 2005, Section 85.
		Invitation to Pay Additional Fees for International Application No. PCT/US2008/050292, mailed July 18, 2008.

Examiner Signature	DB2/20768505.1	Date Considered	
---------------------------	----------------	------------------------	--

*EXAMINER: Initial if reference considered, whether or not citation is in conformance with MPEP 609. Draw line through citation if not in conformance and not considered. Include copy of this form with next communication to applicant.

¹ See Kind Codes of USPTO Patent Documents at www.uspto.gov or MPEP 901.04. ² Enter Office that issued the document, by the two-letter code (WIPO Standard ST.3). ³ For Japanese patent documents, the indication of the year of the reign of the Emperor must precede the serial number of the patent document. ⁴ Kind of document by the appropriate symbols as indicated on the document under WIPO Standard ST. 16 if possible. ⁵ Applicant is to place a check mark here if English language Translation is attached.

Burden Hour Statement: This form is estimated to take 2.0 hours to complete. Time will vary depending upon the needs of the individual case. Any comments on the amount of time you are required to complete this form should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, Washington, DC 20231. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. SEND TO: Assistant Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.

(19) World Intellectual Property Organization
International Bureau



(43) International Publication Date
24 July 2003 (24.07.2003)

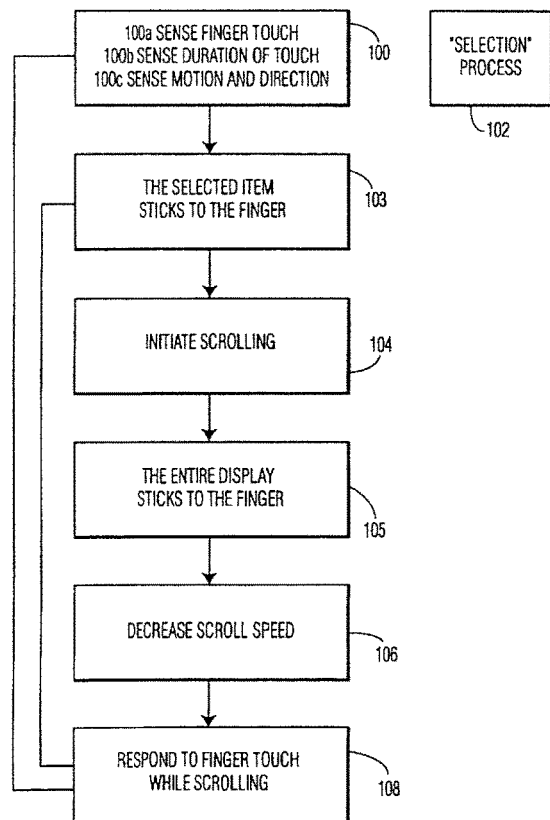
PCT

(10) International Publication Number
WO 03/060622 A2

- (51) International Patent Classification⁷: G06F
- (21) International Application Number: PCT/IB02/05422
- (22) International Filing Date:
13 December 2002 (13.12.2002)
- (25) Filing Language: English
- (26) Publication Language: English
- (30) Priority Data:
10/034,375 28 December 2001 (28.12.2001) US
- (71) Applicant: KONINKLIJKE PHILIPS ELECTRONICS N.V. [NL/NL]; Groenewoudseweg 1, NL-5621 BA Eindhoven (NL).
- (72) Inventors: ZIMMERMAN, John, Z.; Prof. Holstlaan 6, NL-5656 AA Eindhoven (NL). MARTINO, Jacquelyn, A.; Prof. Holstlaan 6, NL-5656 AA Eindhoven (NL).
- (74) Agent: UITTENBOGAARD, Frank; Internationaal Octroibureau B.V., Prof. Holstlaan 6, NL-5656 AA Eindhoven (NL).
- (81) Designated States (*national*): AE, AG, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BY, BZ, CA, CH, CN, CO, CR, CU, CZ, DE, DK, DM, DZ, EC, EE, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MA, MD, MG, MK, MN, MW, MX, MZ, NO, NZ, OM, PH, PL, PT, RO, RU, SC, SD, SE, SG, SK, SL, TJ, TM, TN, TR, TT, TZ, UA, UG, UZ, VC, VN, YU, ZA, ZM, ZW.
- (84) Designated States (*regional*): ARIPO patent (GH, GM, KE, LS, MW, MZ, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian-patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE, SI, SK, TR), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

[Continued on next page]

(54) Title: TOUCH-SCREEN IMAGE SCROLLING SYSTEM AND METHOD



(57) Abstract: Electronic image displays, of lists that extend beyond the vertical display dimension of the display screen, are displaced in the vertical direction by touching the screen with a finger and then moving the finger in the desired direction on the screen. In a natural manner, the initial speed of displacement of the displayed image corresponds to the speed of motion of the finger along the screen. When the user's finger is disengaged from the screen, the system senses the disengagement and thereafter allows the vertical displacement speed of the image to decrease at a controlled rate. When it is desired to stop the motion of the image at a given point, or to make a selection from the displayed image, the system measures the length of time that the finger is in contact with the screen and the distance that the finger is moved during that time, to determine if a selection is desired or if it is desired only to stop displacement of the image. That is, a short term contact with the screen, say 500ms or less, accompanied by little or no displacement on the screen, can be identified as an intended selection, while a longer contact with little or no accompanying displacement can be interpreted as being intended to stop the motion of the image without making a selection.



WO 03/060622 A2



Published:

— without international search report and to be republished upon receipt of that report

For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.

Touch-screen image scrolling system and method

BACKGROUND OF THE INVENTION

1. Field of the Invention

This invention relates generally to displays of information data in the form of sequential lines of symbols commonly comprising lists of words and numbers, and more specifically relates to the use and control of electronic forms of such displays.

2. Description of the Related Art

It has become well-known to display lists of words and numbers on electronic display screens for ready access by users. Often, such lists extend in length beyond the dimensions of the electronic screen, and in such cases it has further become well-known to cause the image of the list to "scroll" past the screen so that a line of text comprising words, numbers or other symbols, appears to travel from one edge of the screen to the other until a desired section of the list, or portion of a line, appears on the screen.

It is known that the systems and methods currently being used to control the scrolling motion of the screen image are subject to numerous limitations and disadvantages. For example, in one system a cursor may be positioned at one edge of the screen and then moved toward the opposite edge while holding down a selected "mouse" button, thereby engaging and "dragging" the screen image in a desired direction. It is well known that such displacement of the screen image is slow and cumbersome except for relatively slight relative movements. Another system in current use activates an automatic continuous "scrolling" motion of the image when the cursor is positioned on a specific portion of the image, while a selected mouse button is depressed. This requires holding down the selected button until the desired portion of the screen image is displayed. A related system in current use varies the speed of the scrolling motion in accordance with the position of the cursor relative to the edge of the screen. All of these cursor position-responsive control systems are subject to similar limitations of screen clutter, lack of aesthetic visual appeal, and the requirement for manipulation and handling of the mouse device.

SUMMARY OF THE INVENTION

The invention herein disclosed improves upon the scroll-like display of data on electronic display screens by making it possible for a user/viewer to access a desired portion of a long list of data and information by scrolling to the location of that portion rapidly and in a more natural manner than heretofore possible.

The present invention overcomes and avoids the limitations of known control systems for scrolling electronic displays by providing a touch-screen responsive system that imparts a scrolling motion to the displayed image in response to the motion of a finger in contact with the screen. The speed and direction of motion of the finger along the screen determines the initial speed and direction of motion for the image. After the finger separates from the screen, the image continues to move in the same direction at a gradually decreasing speed until motion is stopped manually by touching the screen without movement of the finger, or the speed decreases to zero, or to a predetermined minimum speed, or until the image reaches its "end". Alternatively, continued motion of the image may be achieved or again increased by repeating the "sweeping motion" of a the user's finger along the screen. Motion of the displayed image may be stopped manually by applying a finger to the screen without moving it along the surface of the screen for a finite period of time. If a finger is applied to the surface of the screen for a shorter period of time, for example for a period less than a minimum set time, the finger touch can be deemed to be a "selection" of an item or "thing" corresponding to the image displayed at the touched location. Still further, if the finger touch on the screen is made to move with the display, but at a slower rate than the then-current rate of movement, the display will be slowed to a rate corresponding to the motion of the finger at the movement that contact is broken.

This operation of the system of this invention is achieved by programming a microprocessor-based control system to displace the image on a screen display, such as the screen of a conventional cathode ray tube, in response to a finger touch on the screen and the direction of a finger motion along the surface of the screen at the initial speed of the finger motion. Thereafter, the speed of displacement is caused to decay at a selected rate (units of displacement per unit of time, or a function thereof), until the displacement finally stops (for example, due to having reached the end of the "scroll") or until it is stopped deliberately as explained herein.

In accordance with this invention, the scrolling motion of data on the display screen moves in a seemingly "natural" way, moving initially at a speed imparted by the

motion of the user's finger, with the speed thereafter slowing at a constant rate until it ultimately comes to rest, unless it is terminated earlier.

Moreover, if the speed of scrolling is found to be slow at a point deemed to be too far before the desired location in the scroll, the scrolling speed may be increased as many
5 times as possible by merely touching the screen again to impart "new" motion to the display.

At any desired point or time while a scrolling motion is in progress, it may be stopped entirely, again in a seemingly "natural" way, by merely touching one's finger to the screen while holding it substantially stationary for a predetermined period of time. The reason for requiring a predetermined time-period for stationary [i.e. no-motion] touch time is
10 to assure that the timing mechanisms will have sufficient time to distinguish between a touch intended to stop the scrolling motion and a touch [shorter in time] intended to "select" or "mark" a particular item that is included in the scrolled data. "Touch marking" is a well-known feature of scrolled display technology at this time, but this invention discloses its use in combination with a new, and heretofore unknown, form of scrolling motion control.

15 These and other features and advantages of this invention will be made more apparent to those having skill in this art, by reference to the following specification considered in conjunction with the accompanying drawings, in which:

BRIEF DESCRIPTION OF THE DRAWINGS

20 Figure 1 is a flow-chart representing the sequential operations of a touch-screen image scrolling system in accordance with this invention.

Figure 2 is simplified pictorial representation of a touch-screen image scrolling system in accordance with one embodiment of the invention of Fig. 1.

25 Figure 3 is a simplified block diagram of another embodiment of a touch-screen image scrolling system in accordance with Fig. 1.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

In the following description, certain specific details of the disclosed embodiment such as architecture, interfaces and techniques, etc, are set forth for purposes of
30 explanation rather than limitation, so as to provide a clear and thorough understanding of the present invention. However, it should be understood readily by those skilled in this art, that the present invention may be practiced in other embodiments which do not conform exactly to the details set forth herein, without departing significantly from the spirit and scope of this disclosure. Further, in this context, and for the purposes of brevity and clarity, detailed

descriptions of well-known apparatus, circuits and methodology have been omitted so as to avoid unnecessary detail and possible confusion.

Referring now to the block diagram of Fig. 1 of the drawings, the method of operating a touch-screen image scrolling system 10 (as shown in Fig. 1) in accordance with this invention may be seen to begin in step 100 with sensing the touch of a finger upon an electronic display screen 100a having a stationary data display, determining the period of time that the finger is in contact with the screen 100b, and determining if the finger moves or remains stationary. 100c. The technology and methodology for sensing and determining the appropriate values for information of the type herein disclosed is well-known to persons having skill in this art, and is not further described or discussed in this specification.

If no motion occurs and the touch contact continues for less than a predetermined minimum time, the touch is treated in step 100 as a "selection" of the data term touched, and the system continues with "selection" path 102. The operation of a selection path, beginning with, for example, highlighting of the term or icon touched, is well-known and is of no further concern in connection with the operation of the system of this invention. However, if the touch contact continues for more than the first predetermined minimum time, and the finger then moves after that time, the process of the invention will proceed to step 103, in which the "selected" item on the list will then "stick to the finger" so that the item can be repositioned on the list by the known process of "touch- dragging". This repositioning step can be very desirable to frequent users who may wish to cluster several preferred items in a given location. After an item has been repositioned in step 103, and finger contact with the screen is interrupted, the process will revert to "waiting" status. With advance reference to step 105, explained below, it should be noted here, that in this step it is a selected item, rather than the entire display, that "sticks to the finger."

In another feature, if no motion of the finger occurs while the screen is stationary, and the contact continues for less than a second minimum time which is less than the first minimum time by a readily measurable finite value, then step 100 ignores the contact and the system reverts to "waiting" status, awaiting further input signals.

However, if step 100 senses motion in association with the finger touch on the screen, during the finite period between the first predetermined time and the second, then the method of the invention proceeds to step 104, converting the speed and direction of motion of the touch into corresponding initial scrolling motion of the displayed data. And step 104 proceeds directly into step 106. Step 104 either proceeds to step 106, or diverges to step 105

depending upon whether the finger is removed from contact with the screen or continues in contact with the screen.

That is, if the finger touch of step 104 imparts movement to the display and the touch-contact is then broken, movement of the display continues in accordance with step 5 106. However, if contact with the screen is not broken, the method of the invention proceeds from step 104 to step 105, wherein the entire display [not just a selected item] in effect "sticks to the finger" so that the entire display can be moved up or down or back and forth, as the case may be, with the finger. If there is no finger motion at the time that finger contact with the screen is broken in step 105, the display will remain in the position it is in at that 10 time without further motion, and the system will revert again to "waiting" status. In the alternative, if finger contact in step 105 is broken while the finger is in motion, the system of the invention proceeds to step 106, as described below.

In step 106, the timer function associated with the system of the invention measures time while the scrolling action continues and the system begins decreasing the 15 scrolling speed at a controlled rate, from its initial value which is determined by the speed of the finger touch, toward zero or until the speed is reduced to any desired, predetermined minimum speed. It is assumed that most users of this system will prefer that the decrease in scrolling speed begin immediately after the start of scrolling. However, it should be recognized that the start of the decreasing speed function can, in fact, be delayed so as to 20 begin at any time after the start of the scrolling motion. Incorporating a finite-time delay into the control system for utilization of this method is a simple technique well within the knowledge of those skilled in this art.

While the slowing scrolling motion continues, and after scrolling has terminated entirely, the system continues waiting for further input signals, to control the next 25 operation of the system. However, in accordance with the invention, slowing of the scrolling speed continues until one of three events occurs: (1) slowing decreases the speed of the scroll to zero or to any preset minimum; or (2) an "end of scroll" data signal is received from the data source; or (3) a finger touch on the screen indicates that the scrolling is to be terminated. Regardless of the status of the slowing action, the method of this invention allows the system 30 to react to the next user-initiated input signal at any time, following step 106.

Step 108 shows that the method of the invention reacts to a finger touch on the screen during or after scrolling by repeating, essentially, the functions of step 100. That is, in step 108, the system senses the touch of a finger 100a on the electronic display screen, determines the period of time 100b that the finger is in contact with the screen, and

determines if the finger moves or remains stationary. 100b. If the touch is stationary and the contact continues for less than a predetermined minimum time, the finger touch is treated in step 108 as both (1) a "selection" of the data term touched, and (2) an instruction to terminate the scrolling motion. In this case, scrolling motion terminates and the system reverts to the "selection" path 102, previously mentioned. On the other hand, if the touch is stationary but the contact does not continue for more than the minimum time, the method treats the touch as an instruction to terminate the scrolling motion only, and there is no resulting "selection" of any data listing that may have been touched. When scrolling motion terminates under these circumstances, the method reverts to the state that exists before the beginning of step 100, waiting for "instructions" in the form of input signals; i.e. awaiting either selection of a displayed item or initiation of scrolling motion.

Once again it should be emphasized that the duration of contact for a stationary finger touch on the screen serves as the distinction between a "selection" touch and a "stop scrolling" touch. Although it has been stated above, that a relatively long-term finger touch while scrolling motion is taking place serves as both a "selection" and a "stop motion" signal, it will be obvious that the method could be set up easily so that a finger touch during the scrolling process would act solely as a "stop motion" signal regardless of the length of the touch; this would protect against the possibility of unintended "selections" resulting from inadvertently long touches that were intended only to "stop" the scrolling.

In contrast to stationary touching in step 108, if the system senses motion of the finger touch on the screen, the method reverts to step 104, again converting the speed and direction of motion of the touch into scrolling motion of the displayed data and restarting the scrolling process. As before, step 104 then proceeds directly into step 106.

In the embodiment of the system of this invention illustrated in Fig. 2, the system is shown to comprise a simple personal computer apparatus having a display screen 10, a central processing unit 12 and a keyboard 14 for inputting manual instruction to the processing unit 12. In accordance with convention, it will be understood that processing unit 12 includes an internal electronic memory unit (not shown) of conventional design and capabilities. Accordingly, for the purposes of this disclosure, the internal memory unit may be assumed to be the source of a scrollable data display capable of appearing on display screen 10 which is accessible to a hand or stylus device, here stylistically represented by the outline of a hand 16.

In use, the computer is set up in well-known manner to display the scrollable data on screen 10, and a hand/finger or stylus 16 is touched to the screen and moved down

along the screen to impart an initial downward "scrolling" motion to the data display. Software in the computer interactively responds to the contact with the screen to create the desired displacement motion of the display and the internal timer facility now inherent in such computer apparatus, in cooperation with the programming of processing unit 12
5 responds to the start of motion by gradually decreasing the speed of displacement, as explained previously herein. When a desired point in the display is seen or approached, the user may apply a hand or stylus 16 to the screen to terminate the scrolling motion. Because the scrolling motion does not involve any moving parts with real or simulated mass, it is possible to stop the motion of the display instantly, without any difficulty or concern for
10 inertial force consequences.

Accordingly, it will now be understood that the system and method of this invention facilitates a rapid, convenient and natural-feeling approach to accessing a scroll-like display of data on a computer screen.

In the embodiment represented in Fig. 3, the system of this invention is shown
15 to comprise the essential elements of the computer apparatus of Fig. 2 without having the configuration of a computer. That is, the basic components of the system of this invention are here shown to comprise a microprocessor 42 which is in turn coupled to a keyboard 44, a timer means 43 and a display screen 40. Each of these components functions in the same manner as its counterparts in the embodiment of Fig. 2, with microprocessor 42 and the associated timer
20 means 43 together, here serving the same function as central processing unit 12 in Fig. 2.

Although a preferred embodiment of the invention has been illustrated and described, those having skill in this art will recognize that various other forms and embodiments now may be visualized readily without departing significantly from the spirit and scope of the invention disclosed herein and set forth in the accompanying claims.
25

CLAIMS:

1. An improved touch-screen image scrolling system, comprising:
an electronic image display screen 40 (10);
a microprocessor 42 (12) coupled to said display screen 40 (10) to display
information thereon and to receive interactive signals therefrom;
5 timer means 43 (12) associated with said microprocessor to provide timing
capacity therefor;
a source 45 (12) of scroll format data capable of display on said display screen
40 (10);
a keyboard 44 (14) coupled to said microprocessor 42 (12) to provide input
10 control signals thereto;
finger touch program instructions associated with said microprocessor 42 (12)
for sensing the speed, direction and time duration of a finger touch contact with said display
screen 40 (10):
scrolling motion program instructions associated with said microprocessor 42
15 (12) responsive to said duration of said finger touch contact such that, when said duration
exceeds a first given preset minimum time and is accompanied by motion along the surface
of said screen followed by separation of said finger touch from said screen, a scroll format
display on said screen 40 (10) is caused to begin to scroll in said sensed direction and at said
sensed initial speed;
20 time decay program instructions associated with said microprocessor 42 (12)
for reducing the rate of scrolling displacement on said display screen 10 at a given rate until
motion is terminated;
stopping motion program instructions associated with said microprocessor 42
(12) for terminating scrolling displacement of the image on said screen upon first occurrence
25 of any signal in the group of signals comprising:
(a) a substantially stationary finger touch on the screen enduring for a
period longer than a preset minimum time, and
(b) an end-of-scroll signal received from said scroll format data source
45.

2. The improved touch-screen image scrolling system of claim 1, wherein said scrolling motion program instructions further comprise instructions to move said display in correspondence with movement of the finger touch, in response to movement following a touch having a stationary duration greater than said first preset given minimum time and less
5 than a second given preset minimum time.

3. The improved touch-screen image scrolling system of claim 1, wherein said scrolling motion program instructions further comprise instructions to move a touch-selected item relative to the stationary display in correspondence with movement of said finger touch,
10 in response to motion following a touch having a stationary duration greater than said second given preset minimum time.

4. The improved touch-screen image scrolling system of Claim 1, wherein said group of signals for terminating scrolling displacement of the image on said display screen
15 further comprises

(a) a signal indicating that the rate of scrolling displacement on said screen has decayed to a value below a predetermined given value.

5. The improved touch-screen image scrolling system of Claim 1, wherein said
20 microprocessor 42 (12), and said timer means 43 (12) together comprise a processing unit of a conventional computer.

6. The improved touch-screen image scrolling system of Claim 5, wherein said source 44 of scroll format data capable of display on said display screen 40 (10) comprises
25 part of the memory of said conventional computer.

7. An improved method of controlling the scroll-like display of data on an electronic display screen, said method comprising the steps of:

100b sensing the duration of finger touch contact time with an electronic
30 display screen having scrollable data displayed thereon;

100c sensing the speed and direction of motion of said finger touch contact with said display screen;

104 initiating scrolling motion of said scrollable data on said display screen in said sensed direction and at said sensed speed;

106 slowing the speed of said scrolling motion from the initiated speed thereof, at a predetermined rate; and

terminating said scrolling motion when one of the conditions comprising the following group of conditions is sensed:

- 5 (a) a substantially stationary finger touch having a finite duration is sensed;
- (b) an end-of-scroll signal is sensed.

8. The improved method of controlling the scroll-like display of data on an
10 electronic display screen, in accordance with Claim 7, wherein said group of conditions to be sensed for terminating said scrolling motion further comprises: the speed of said scrolling motion on said screen slows to a value below a predetermined given value.

9. The improved method of controlling the scroll-like display of data on an
15 electronic display screen, in accordance with claim 7, wherein said method comprises the further step of sensing a finger touch on said screen having a duration greater than said first given preset minimum time and less than a second given preset minimum time which is greater than said first given time and then moving said display in correspondence with movement of the finger touch.

20

10. The improved method of controlling the scroll-like display of data on an
electronic display screen, in accordance with claim 7, wherein said method comprises the further step of 103 sensing a stationary finger touch on said screen having a duration greater than a second preset given minimum time which is greater than said first given preset time
25 and then moving a touch-selected item relative to the stationary display in correspondence with movement of the finger touch.

1/2

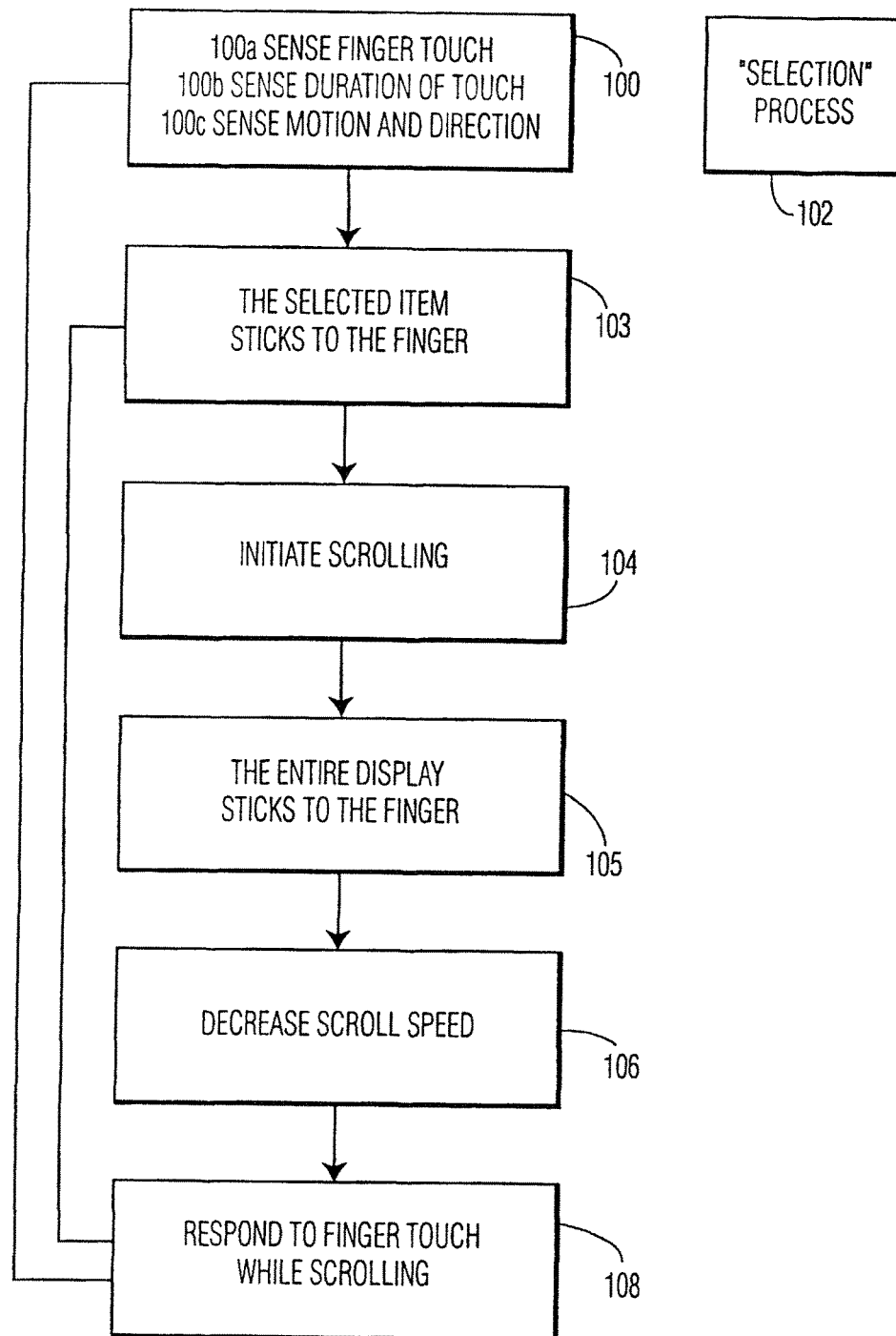


FIG. 1

2/2

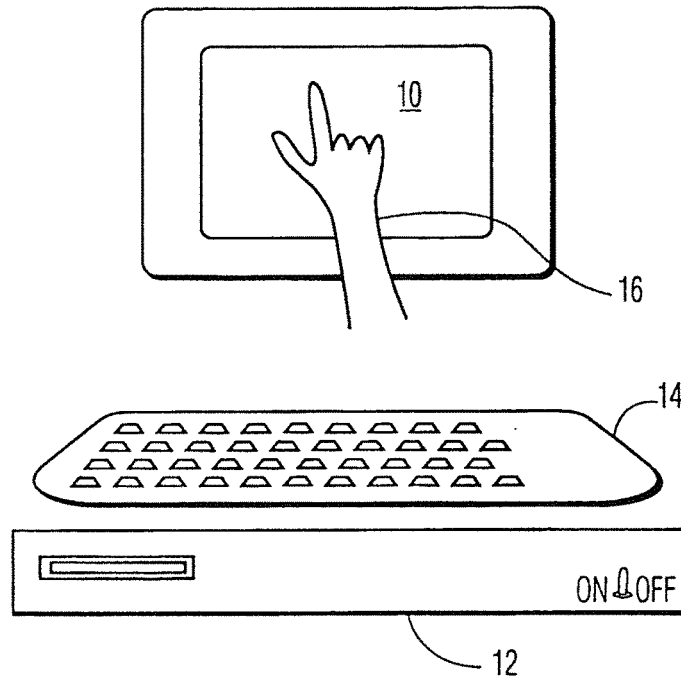


FIG. 2

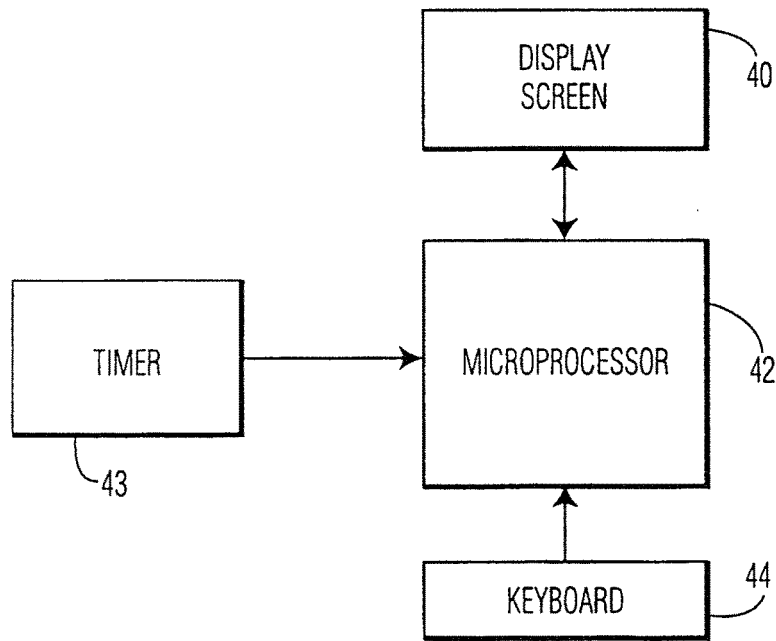


FIG. 3

(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(19) World Intellectual Property Organization
International Bureau



(43) International Publication Date
24 July 2003 (24.07.2003)

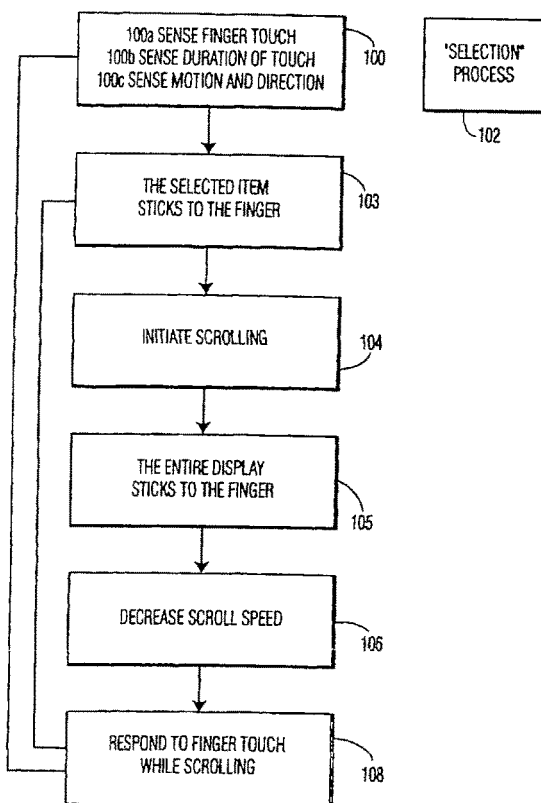
PCT

(10) International Publication Number
WO 03/060622 A3

- (51) International Patent Classification⁷: G06F 3/033
- (21) International Application Number: PCT/IB02/05422
- (22) International Filing Date:
13 December 2002 (13.12.2002)
- (25) Filing Language: English
- (26) Publication Language: English
- (30) Priority Data:
10/034,375 28 December 2001 (28.12.2001) US
- (71) Applicant: KONINKLIJKE PHILIPS ELECTRONICS N.V. [NL/NL]; Groenewoudseweg 1, NL-5621 BA Eindhoven (NL).
- (72) Inventors: ZIMMERMAN, John, Z.; Prof. Holstlaan 6, NL-5656 AA Eindhoven (NL). MARTINO, Jacquelyn, A.; Prof. Holstlaan 6, NL-5656 AA Eindhoven (NL).
- (74) Agent: UITTENBOGAARD, Frank; Internationaal Octrooibureau B.V., Prof. Holstlaan 6, NL-5656 AA Eindhoven (NL).
- (81) Designated States (*national*): AE, AG, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BY, BZ, CA, CH, CN, CO, CR, CU, CZ, DE, DK, DM, DZ, EC, EE, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MA, MD, MG, MK, MN, MW, MX, MZ, NO, NZ, OM, PH, PL, PT, RO, RU, SC, SD, SE, SG, SK, SL, TJ, TM, TN, TR, TT, TZ, UA, UG, UZ, VC, VN, YU, ZA, ZM, ZW.
- (84) Designated States (*regional*): ARIPO patent (GH, GM, KE, LS, MW, MZ, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE, SI, SK, TR), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

[Continued on next page]

(54) Title: TOUCH-SCREEN IMAGE SCROLLING SYSTEM AND METHOD



(57) Abstract: Electronic image displays, of lists that extend beyond the vertical display dimension of the display screen, are displaced in the vertical direction by touching the screen with a finger and then moving the finger in the desired direction on the screen. In a natural manner, the initial speed of displacement of the displayed image corresponds to the speed of motion of the finger along the screen. When the user's finger is disengaged from the screen, the system senses the disengagement and thereafter allows the vertical displacement speed of the image to decrease at a controlled rate. When it is desired to stop the motion of the image at a given point, or to make a selection from the displayed image, the system measures the length of time that the finger is in contact with the screen and the distance that the finger is moved during that time, to determine if a selection is desired or if it is desired only to stop displacement of the image. That is, a short term contact with the screen, say 500ms or less, accompanied by little or no displacement on the screen, can be identified as an intended selection, while a longer contact with little or no accompanying displacement can be interpreted as being intended to stop the motion of the image without making a selection.

WO 03/060622 A3



Published:

— *with international search report*

(88) Date of publication of the international search report:

20 November 2003

For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.

INTERNATIONAL SEARCH REPORT

Intern: application No
PCT/1B 02/05422A. CLASSIFICATION OF SUBJECT MATTER
IPC 7 G06F3/033

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 7 G06F

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)
EPO-Internal, WPI Data, PAJ

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	US 4 954 967 A (TAKAHASHI HIROSHI) 4 September 1990 (1990-09-04) column 2, line 44 - line 51; figures 6A,7 column 3, line 3 - line 64; claims 1,4,5,8,15	1-10
Y	WO 99 57630 A (SCIENTIFIC ATLANTA) 11 November 1999 (1999-11-11) page 5, line 23 - line 31 page 7, line 14 - line 20 page 8, line 23 - page 10, line 2; claims 1,2,6,8,11	1-10

 Further documents are listed in the continuation of box C. Patent family members are listed in annex.

* Special categories of cited documents:

- *A* document defining the general state of the art which is not considered to be of particular relevance
- *E* earlier document but published on or after the international filing date
- *L* document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
- *O* document referring to an oral disclosure, use, exhibition or other means
- *P* document published prior to the international filing date but later than the priority date claimed

- *T* later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
- *X* document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
- *Y* document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.
- *&* document member of the same patent family

Date of the actual completion of the international search

5 August 2003

Date of mailing of the international search report

19/08/2003

Name and mailing address of the ISA
European Patent Office, P.B. 5818 Patentlaan 2
NL - 2280 HV Rijswijk
Tel. (+31-70) 340-2040, Tx. 31 651 epo nl,
Fax: (+31-70) 340-3016

Authorized officer

Alonso y Goicolea, L

INTERNATIONAL SEARCH REPORT

Information on patent family members

Intern .pplication No

PCT/IB 02/05422

Patent document cited in search report		Publication date	Patent family member(s)		Publication date
US 4954967	A	04-09-1990	JP	1683073 C	31-07-1992
			JP	3049119 B	26-07-1991
			JP	60066298 A	16-04-1985
<hr/>					
WO 9957630	A	11-11-1999	WO	9957630 A1	11-11-1999
<hr/>					

WO2006020305

Publication Title:

GESTURES FOR TOUCH SENSITIVE INPUT DEVICES

Abstract:

1485 Abstract of WO2006020305

Methods and systems for processing touch inputs are disclosed. The invention in one respect includes reading data from a multipoint sensing device such as a multipoint touch screen where the data pertains to touch input with respect to the multipoint sensing device, and identifying at least one multipoint gesture based on the data from the multipoint sensing device.

Data supplied from the esp@cenet database - Worldwide

Courtesy of <http://v3.espacenet.com>

(19) World Intellectual Property Organization
International Bureau



(43) International Publication Date
23 February 2006 (23.02.2006)

PCT

(10) International Publication Number
WO 2006/020305 A2

(51) International Patent Classification: **Not classified**

(21) International Application Number:
PCT/US2005/025657

(22) International Filing Date: 19 July 2005 (19.07.2005)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:
60/592,483 30 July 2004 (30.07.2004) US
10/903,964 30 July 2004 (30.07.2004) US

(71) Applicant (for all designated States except US): **APPLE COMPUTER, INC.** [US/US]; 1 Infinite Loop, Cupertino, California 95014 (US).

(72) Inventors; and

(75) Inventors/Applicants (for US only): **HOTELLING, Steve** [US/US]; 1351 Hidden Mine Road, San Jose, California 95120 (US). **STRICKON, Joshua, A.** [US/US]; 333 Santana Row #212, San Jose, California 95128 (US). **HUPPI, Brian, Q.** [US/US]; 101#2 28th Street, San Francisco, California 94131 (US). **CHAUDHRI, Imran** [US/US]; 2713 Sacramento Street, No. 3, San Francisco,

California 94115 (US). **CHRISTIE, Greg** [US/US]; 1112 Kelly Drive, San Jose, California 95129 (US). **ORDING, Bas** [NL/US]; 1119 Dolores Street, #4, San Francisco, California 94110 (US). **KERR, Duncan, Robert** [GB/US]; 2600 18th Street, #15, San Francisco, California 94110 (US). **IVE, Jonathan, P.** [GB/US]; 196 Twin Peaks Blvd, San Francisco, California 94114 (US).

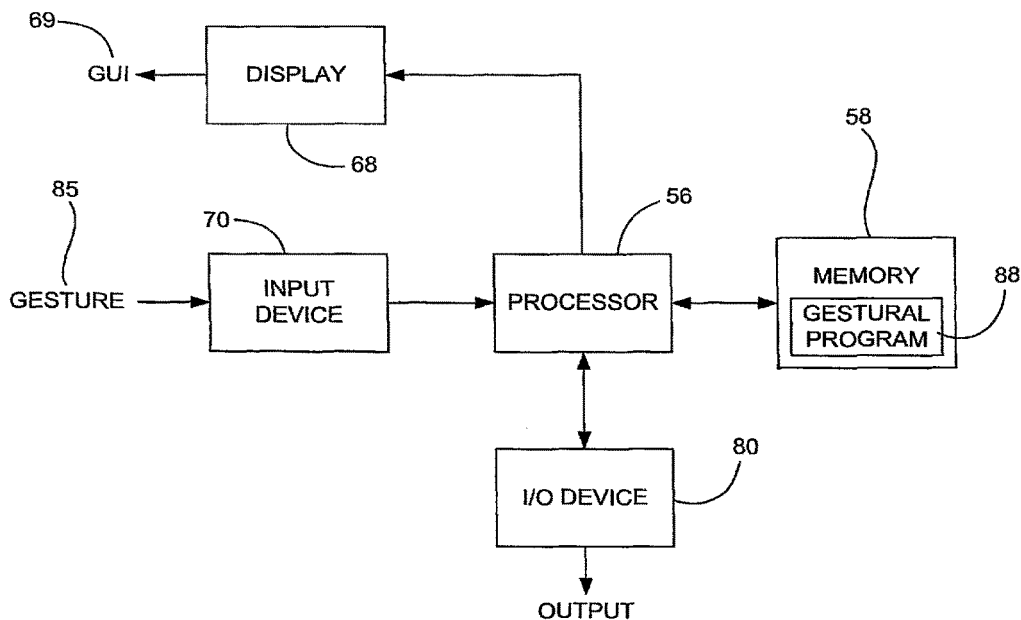
(74) Agent: **HOELLWARTH, Quin, C.**; Beyer Weaver & Thomas, LLP, P. O. BOX 70250, Oakland, California 94612-0250 (US).

(81) Designated States (unless otherwise indicated, for every kind of national protection available): AE, AG, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BW, BY, BZ, CA, CH, CN, CO, CR, CU, CZ, DE, DK, DM, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KM, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MA, MD, MG, MK, MN, MW, MX, MZ, NA, NG, NI, NO, NZ, OM, PG, PH, PL, PT, RO, RU, SC, SD, SE, SG, SK, SL, SM, SY, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, YU, ZA, ZM, ZW.

(84) Designated States (unless otherwise indicated, for every kind of regional protection available): ARIPO (BW, GH, GM, KE, LS, MW, MZ, NA, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM),

[Continued on next page]

(54) Title: GESTURES FOR TOUCH SENSITIVE INPUT DEVICES



(57) Abstract: Methods and systems for processing touch inputs are disclosed. The invention in one respect includes reading data from a multipoint sensing device such as a multipoint touch screen where the data pertains to touch input with respect to the multipoint sensing device, and identifying at least one multipoint gesture based on the data from the multipoint sensing device.

WO 2006/020305 A2



European (AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HU, IE, IS, IT, LT, LU, LV, MC, NL, PL, PT, RO, SE, SI, SK, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.

Published:

- *without international search report and to be republished upon receipt of that report*

GESTURES FOR TOUCH SENSITIVE INPUT DEVICES

BACKGROUND OF THE INVENTION

1. Field of the Invention

5 The present invention relates generally to gesturing associated with touch sensitive devices.

2. Description of the Related Art

There exist today many styles of input devices for performing operations in a computer system. The operations generally correspond to moving a cursor and making selections on a display screen. The operations may also include paging, scrolling, panning, zooming, etc. By way of example, the input devices may include 10 buttons, switches, keyboards, mice, trackballs, touch pads, joy sticks, touch screens and the like. Each of these devices has advantages and disadvantages that are taken into account when designing the computer system.

Buttons and switches are generally mechanical in nature and provide limited 15 control with regards to the movement of the cursor and making selections. For example, they are generally dedicated to moving the cursor in a specific direction (e.g., arrow keys) or to making specific selections (e.g., enter, delete, number, etc.).

In mice, the movement of the input pointer corresponds to the relative movements of the mouse as the user moves the mouse along a surface. In trackballs, 20 the movement of the input pointer corresponds to the relative movements of a ball as the user moves the ball within a housing. Mice and trackballs also include one or more buttons for making selections. Mice may also include scroll wheels that allow a user to move through the GUI by simply rolling the wheel forward or backward.

With touch pads, the movement of the input pointer corresponds to the 25 relative movements of the user's finger (or stylus) as the finger is moved along a surface of the touch pad. Touch screens, on the other hand, are a type of display screen that has a touch-sensitive transparent panel covering the screen. When using a touch screen, a user makes a selection on the display screen by pointing directly to GUI objects on the screen (usually with a stylus or finger).

30

In order to provide additionally functionality, gestures have been implemented with some of these input devices. By way of example, in touch pads, selections may be made when one or more taps are detected on the surface of the touch pad. In some cases, any portion of the touch pad may be tapped, and in other cases a dedicated

portion of the touch pad may be tapped. In addition to selections, scrolling may be initiated by using finger motion at the edge of the touch pad.

U.S. Patent 5,612,719 and 5,590,219, assigned to Apple Computer, Inc. describe some other uses of gesturing. 5,612, 719 discloses an onscreen button that is responsive to at least two different button gestures made on the screen on or near the
5 button. 5,590, 219 discloses a method for recognizing an ellipse-type gesture input on a display screen of a computer system.

In recent times, more advanced gestures have been implemented. For example, scrolling may be initiated by placing four fingers on the touch pad so that
10 the scrolling gesture is recognized and thereafter moving these fingers on the touch pad to perform scrolling events. The methods for implementing these advanced gestures, however, has several drawbacks. By way of example, once the gesture is set, it cannot be changed until the user resets the gesture state. In touch pads, for example, if four fingers equals scrolling, and the user puts a thumb down after the
15 four fingers are recognized, any action associated with the new gesture including four fingers and the thumb will not be performed until the entire hand is lifted off the touch pad and put back down again (e.g., reset). Simply put, the user cannot change gesture states midstream. Along a similar vein, only one gesture may be performed at any given time. That is, multiple gestures cannot be performed simultaneously.

20 Based on the above, there is a need for improvements in the way gestures are performed on touch sensitive devices.

SUMMARY OF THE INVENTION

The invention relates, in one embodiment, to a computer implemented method for processing touch inputs. The method includes reading data from a multipoint
25 touch screen. The data pertains to touch input with respect to the touch screen. The method also includes identifying at least one multipoint gesture based on the data from the multipoint touch screen.

The invention relates, in another embodiment to a gestural method. The method includes detecting multiple touches at different points on a touch sensitive
30 surface at the same time. The method also includes segregating the multiple touches into at least two separate gestural inputs occurring simultaneously. Each gestural input has a different function such as zooming, panning, rotating and the like.

The invention relates, in another embodiment to a gestural method. The method includes concurrently detecting a plurality of gestures that are concurrently

performed with reference to a touch sensing device. The method also includes producing different commands for each of the gestures that have been detected.

The invention relates, in another embodiment to a gestural method. The method includes displaying a graphical image on a display screen. The method also includes detecting a plurality of touches at the same time on a touch sensitive device. The method further includes linking the detected multiple touches to the graphical image presented on the display screen.

The invention relates, in another embodiment to a method of invoking a user interface element on a display via a multipoint touch screen of a computing system. The method includes detecting and analyzing the simultaneous presence of two or more objects in contact with the multipoint touch screen. The method also includes selecting a user interface tool, from a plurality of available tools, to display on a display for interaction by a user of the computing system based at least in part the analyzing. The method further includes controlling the interface tool based at least in part on the further movement of the objects in relation to the multipoint touch screen.

The invention relates, in another embodiment, to a touch-based method. The method includes detecting a user input that occurs over a multipoint sensing device. The user input includes one or more inputs. Each input has a unique identifier. The method also includes, during the user input, classifying the user input as a tracking or selecting input when the user input includes one unique identifier or a gesture input when the user input includes at least two unique identifiers. The method further includes performing tracking or selecting during the user input when the user input is classified as a tracking or selecting input. The method additionally includes performing one or more control actions during the user input when the user input is classified as a gesturing input. The control actions being based at least in part on changes that occur between the at least two unique identifiers.

The invention relates, in another embodiment, to a touch-based method. The method includes outputting a GUI on a display. The method also includes detecting a user input on a touch sensitive device. The method further includes analyzing the user input for characteristics indicative of tracking, selecting or a gesturing. The method additionally includes categorizing the user input as a tracking, selecting or gesturing input. The method further includes performing tracking or selecting in the GUI when the user input is categorized as a tracking or selecting input. Moreover, the method includes performing control actions in the GUI when the user input is

categorized as a gesturing input, the actions being based on the particular gesturing input.

The invention relates, in another embodiment, to a touch-based method. The method includes capturing an initial touch image. The method also includes
5 determining the touch mode based on the touch image. The method further includes capturing the next touch image. The method further includes determining if the touch mode changed between the initial and next touch images. The method additionally includes, if the touch mode changed, setting the next touch image as the initial touch image and determining the touch mode based on the new initial touch image.
10 Moreover, the method includes, if the touch mode stayed the same, comparing the touch images and performing a control function based on the comparison.

The invention relates, in another embodiment, to a computer implemented method for processing touch inputs. The method includes reading data from a touch screen. The data pertaining to touch input with respect to the touch screen, and the
15 touch screen having a multipoint capability. The method also includes converting the data to a collection of features. The method further includes classifying the features and grouping the features into one or more feature groups. The method additionally includes calculating key parameters of the feature groups and associating the feature groups to user interface elements on a display.

20 The invention relates, in another embodiment, to a computer implemented method. The method includes outputting a graphical image. The method also includes receiving a multitouch gesture input over the graphical image. The method further includes changing the graphical image based on and in unison with multitouch gesture input.

25 The invention relates, in another embodiment, to a touch based method. The method includes receiving a gestural input over a first region. The method also includes generating a first command when the gestural input is received over the first region. The method further includes receiving the same gestural input over a second region. The method additionally includes generating a second command when the
30 same gestural input is received over the second region. The second command being different than the first command.

The invention relates, in another embodiment, to a method for recognizing multiple gesture inputs. The method includes receiving a multitouch gestural stroke on a touch sensitive surface. The multitouch gestural stroke maintaining continuous

contact on the touch sensitive surface. The method also includes recognizing a first gesture input during the multitouch gestural stroke. The method further includes recognizing a second gesture input during the multitouch gestural stroke.

5 The invention relates, in another embodiment, to a computer implemented method. The method includes detecting a plurality of touches on a touch sensing device. The method also includes forming one or more touch groups with the plurality of touches. The method further includes monitoring the movement of and within each of the touch groups. The method additionally includes generating control signals when the touches within the touch groups are moved or when the touch
10 groups are moved in their entirety.

It should be noted that in each of the embodiments described above, the methods may be implemented using a touch based input device such as a touch screen or touch pad, more particularly a multipoint touch based input device, and even more particularly a multipoint touch screen. It should also be noted that the gestures,
15 gesture modes, gestural inputs, etc. may correspond to any of those described below in the detailed description. For example, the gestures may be associated with *zooming, panning, scrolling, rotating, enlarging, floating controls, zooming targets, paging, inertia, keyboarding, wheeling, and/or the like.*

BRIEF DESCRIPTION OF THE DRAWINGS

20 The invention will be readily understood by the following detailed description in conjunction with the accompanying drawings, wherein like reference numerals designate like structural elements, and in which:

Fig. 1 is a block diagram of a computer system, in accordance with one embodiment of the present invention.

25 Fig. 2 is a multipoint processing method, in accordance with one embodiment of the present invention.

Figs. 3A and B illustrate an image, in accordance with one embodiment of the present invention.

30 Fig. 4 illustrates a group of features, in accordance with one embodiment of the present invention.

Fig. 5 is a parameter calculation method, in accordance with one embodiment of the present invention.

Figs. 6A-6H illustrate a rotate gesture, in accordance with one embodiment of the present invention.

Fig. 7 is a diagram of a touch-based method, in accordance with one embodiment of the present invention.

Fig. 8 is a diagram of a touch-based method, in accordance with one embodiment of the present invention.

5 Fig. 9 is a diagram of a touch-based method, in accordance with one embodiment of the present invention.

Fig. 10 is a diagram of a zoom gesture method, in accordance with one embodiment of the present invention.

10 Figs. 11A-11J illustrates a zooming sequence, in accordance with one embodiment of the present invention.

Fig. 12 is a diagram of a pan method, in accordance with one embodiment of the present invention.

Figs. 13A-13D illustrate a panning sequence, in accordance with one embodiment of the present invention.

15 Fig. 14 is a diagram of a rotate method, in accordance with one embodiment of the present invention.

Figs. 15A-15C illustrate a rotating sequence, in accordance with one embodiment of the present invention.

20 Fig. 16 is a diagram of a GUI operational method, in accordance with one embodiment of the present invention.

Figs. 17A-17E illustrate a floating control sequence, in accordance with one embodiment of the present invention.

Fig. 18 is a diagram of a GUI operational method, in accordance with one embodiment of the present invention.

25 Figs. 19A-19D illustrate a zooming target sequence, in accordance with one embodiment of the present invention.

Fig. 20 is a diagram of a GUI operational method, in accordance with one embodiment of the present invention.

30 Figs. 21A-21E illustrate a page turning sequence, in accordance with one embodiment of the present invention.

Fig. 22 is a diagram of a GUI operational method, in accordance with one embodiment of the present invention.

Figs. 23A-23D illustrate an inertia sequence, in accordance with one embodiment of the present invention.

Fig. 24 is a diagram of a GUI operational method, in accordance with one embodiment of the present invention.

Figs. 25A-25D illustrates a keyboard sequence, in accordance with one embodiment of the present invention.

5 Fig. 26 is a diagram of a GUI operational method, in accordance with one embodiment of the present invention.

Figs. 27A-27D illustrates a scroll wheel sequence, in accordance with one embodiment of the present invention.

DETAILED DESCRIPTION OF THE INVENTION

10 The invention generally pertains to gestures and methods of implementing gestures with touch sensitive devices. Examples of touch sensitive devices include touch screens and touch pads. One aspect of the invention relates to recognizing at least two simultaneously occurring gestures. Another aspect of the invention relates to displaying a graphical image and linking different touches that occur to the
15 graphical image. Another aspect of the invention relates to immediately recognizing gestures so that actions associated with the gestures can be implemented at the same time. Another aspect of the invention relates to changing a displayed image based on and in unison with a gestural input, i.e., the displayed image continuously changes with changes in the gestural input such that the displayed image continuously follows
20 the gestural input. Another aspect of the invention relates to implementing an input mode based on the number of fingers (or other object) in contact with the input device. Another aspect of the invention relates to providing region sensitivity where gestures mean different things when implemented over different areas of the input device. Another aspect of the invention relates to changing an input while making
25 continuous contact with the touch sensitive surface of the touch sensitive device.

These and other aspects of the invention are discussed below with reference to Figs. 1-27. However, those skilled in the art will readily appreciate that the detailed description given herein with respect to these figures is for explanatory purposes as
30 the invention extends beyond these limited embodiments.

Fig. 1 is a block diagram of an exemplary computer system 50, in accordance with one embodiment of the present invention. The computer system 50 may correspond to a personal computer system, such as a desktops, laptops, tablets or

handheld computer. The computer system may also correspond to a computing device, such as a cell phone, PDA, dedicated media player, consumer electronic device, and the like.

5 The exemplary computer system 50 shown in Fig. 1 includes a processor 56 configured to execute instructions and to carry out operations associated with the computer system 50. For example, using instructions retrieved for example from memory, the processor 56 may control the reception and manipulation of input and output data between components of the computing system 50. The processor 56 can
10 be implemented on a single-chip, multiple chips or multiple electrical components. For example, various architectures can be used for the processor 56, including dedicated or embedded processor, single purpose processor, controller, ASIC, and so forth.

15 In most cases, the processor 56 together with an operating system operates to execute computer code and produce and use data. Operating systems are generally well known and will not be described in greater detail. By way of example, the operating system may correspond to OS/2, DOS, Unix, Linux, Palm OS, and the like. The operating system can also be a special purpose operating system, such as may be
20 used for limited purpose appliance-type computing devices. The operating system, other computer code and data may reside within a memory block 58 that is operatively coupled to the processor 56. Memory block 58 generally provides a place to store computer code and data that are used by the computer system 50. By way of example, the memory block 58 may include Read-Only Memory (ROM), Random-
25 Access Memory (RAM), hard disk drive and/or the like. The information could also reside on a removable storage medium and loaded or installed onto the computer system 50 when needed. Removable storage mediums include, for example, CD-ROM, PC-CARD, memory card, floppy disk, magnetic tape, and a network component.

30

 The computer system 50 also includes a display device 68 that is operatively coupled to the processor 56. The display device 68 may be a liquid crystal display (LCD) (e.g., active matrix, passive matrix and the like). Alternatively, the display device 68 may be a monitor such as a monochrome display, color graphics adapter

(CGA) display, enhanced graphics adapter (EGA) display, variable-graphics-array (VGA) display, super VGA display, cathode ray tube (CRT), and the like. The display device may also correspond to a plasma display or a display implemented with electronic inks.

5

The display device 68 is generally configured to display a graphical user interface (GUI) 69 that provides an easy to use interface between a user of the computer system and the operating system or application running thereon. Generally speaking, the GUI 69 represents, programs, files and operational options with
10 graphical images. The graphical images may include windows, fields, dialog boxes, menus, icons, buttons, cursors, scroll bars, etc. Such images may be arranged in predefined layouts, or may be created dynamically to serve the specific actions being taken by a user. During operation, the user can select and activate various graphical images in order to initiate functions and tasks associated therewith. By way of
15 example, a user may select a button that opens, closes, minimizes, or maximizes a window, or an icon that launches a particular program. The GUI 69 can additionally or alternatively display information, such as non interactive text and graphics, for the user on the display device 68.

20 The computer system 50 also includes an input device 70 that is operatively coupled to the processor 56. The input device 70 is configured to transfer data from the outside world into the computer system 50. The input device 70 may for example be used to perform tracking and to make selections with respect to the GUI 69 on the display 68. The input device 70 may also be used to issue commands in the computer
25 system 50. The input device 70 may include a touch sensing device configured to receive input from a user's touch and to send this information to the processor 56. By way of example, the touch-sensing device may correspond to a touchpad or a touch screen. In many cases, the touch-sensing device recognizes touches, as well as the position and magnitude of touches on a touch sensitive surface. The touch sensing
30 means reports the touches to the processor 56 and the processor 56 interprets the touches in accordance with its programming. For example, the processor 56 may initiate a task in accordance with a particular touch. A dedicated processor can be used to process touches locally and reduce demand for the main processor of the computer system. The touch sensing device may be based on sensing technologies

including but not limited to capacitive sensing, resistive sensing, surface acoustic wave sensing, pressure sensing, optical sensing, and/or the like. Furthermore, the touch sensing means may be based on single point sensing or multipoint sensing. Single point sensing is capable of only distinguishing a single touch, while multipoint
5 sensing is capable of distinguishing multiple touches that occur at the same time.

The input device 70 may be a touch screen that is positioned over or in front of the display 68. The touch screen 70 may be integrated with the display device 68 or it may be a separate component. The touch screen 70 has several advantages over
10 other input technologies such as touchpads, mice, etc. For one, the touch screen 70 is positioned in front of the display 68 and therefore the user can manipulate the GUI 69 directly. For example, the user can simply place their finger over an object to be controlled. In touch pads, there is no one-to-one relationship such as this. With touchpads, the touchpad is placed away from the display typically in a different plane.
15 For example, the display is typically located in a vertical plane and the touchpad is typically located in a horizontal plane. This makes its use less intuitive, and therefore more difficult when compared to touch screens. In addition to being a touch screen, the input device 70 can be a multipoint input device. Multipoint input devices have advantages over conventional singlepoint devices in that they can distinguish more
20 than one object (finger). Singlepoint devices are simply incapable of distinguishing multiple objects. By way of example, a multipoint touch screen, which can be used herein, is shown and described in greater detail in copending and commonly assigned U.S. Patent Application No.: 10/840,862, which is hereby incorporated herein by reference.

25

The computer system 50 also includes capabilities for coupling to one or more I/O devices 80. By way of example, the I/O devices 80 may correspond to keyboards, printers, scanners, cameras, speakers, and/or the like. The I/O devices 80 may be integrated with the computer system 50 or they may be separate components (e.g.,
30 peripheral devices). In some cases, the I/O devices 80 may be connected to the computer system 50 through wired connections (e.g., cables/ports). In other cases, the I/O devices 80 may be connected to the computer system 80 through wireless connections. By way of example, the data link may correspond to PS/2, USB, IR, RF, Bluetooth or the like.

In accordance with one embodiment of the present invention, the computer system 50 is designed to recognize gestures 85 applied to the input device 70 and to control aspects of the computer system 50 based on the gestures 85. In some cases, a gesture is defined as a stylized interaction with an input device that is mapped to one or more specific computing operations. The gestures 85 may be made through various hand, and more particularly finger motions. Alternatively or additionally, the gestures may be made with a stylus. In all of these cases, the input device 70 receives the gestures 85 and the processor 56 executes instructions to carry out operations associated with the gestures 85. In addition, the memory block 58 may include a gesture operational program 88, which may be part of the operating system or a separate application. The gestural operation program 88 generally includes a set of instructions that recognizes the occurrence of gestures 85 and informs one or more software agents of the gestures 85 and/or what action(s) to take in response to the gestures 85.

When a user performs one or more gestures, the input device 70 relays gesture information to the processor 56. Using instructions from memory 58, and more particularly, the gestural operational program 88, the processor 56 interprets the gestures 85 and controls different components of the computer system 50, such as memory 58, a display 68 and I/O devices 80, based on the gestures 85. The gestures 85 may be identified as commands for performing actions in applications stored in the memory 58, modifying GUI objects shown on the display 68, modifying data stored in memory 58, and/or for performing actions in I/O devices 80. By way of example, the commands may be associated with zooming, panning, scrolling, paging, rotating, sizing, and the like. As further examples, the commands may also be associated with launching a particular program, opening a file or document, viewing a menu, making a selection, executing instructions, logging onto the computer system, permitting authorized individuals access to restricted areas of the computer system, loading a user profile associated with a user's preferred arrangement of the computer desktop, and/or the like.

A wide range of different gestures can be utilized. By way of example, the gestures may be single point or multipoint gestures; static or dynamic gestures;

continuous or segmented gestures; and/or the like. Single point gestures are those gestures that are performed with a single contact point, e.g., the gesture is performed with a single touch as for example from a single finger, a palm or a stylus. Multipoint gestures are those gestures that can be performed with multiple points, e.g., the
5 gesture is performed with multiple touches as for example from multiple fingers, fingers and palms, a finger and a stylus, multiple styli and/or any combination thereof. Static gestures are those gestures that do not include motion, and dynamic gestures are those gestures that do include motion. Continuous gestures are those gestures that are performed in a single stroke, and segmented gestures are those
10 gestures that are performed in a sequence of distinct steps or strokes.

In one embodiment, the computer system 50 is configured to register multiple gestures at the same time, i.e., multiple gestures can be performed simultaneously. By way of example, a zoom gesture may be performed at the same time as a rotate
15 gesture, or a rotate gesture may be performed at the same time as a pan gesture. In one particular implementation, zoom, rotate and pan gestures can all occur simultaneously in order to perform zooming, rotating and panning at the same time.

In another embodiment, the system is configured to immediately recognize the
20 gestures so that actions associated with the gestures can be implemented at the same time as the gesture, i.e., the gesture and action simultaneously occur side by side rather than being a two-step process. By way of example, during a scrolling gesture, the screen moves with the finger motion.

In another embodiment, an object presented on a display 68 continuously
25 follows the gesture occurring on a touch screen. There is a one to one relationship between the gesture being performed and the objects shown on the display 68. For example, as the gesture is performed, modifications simultaneously occur to the objects located underneath the gesture. For example, during a zooming gesture, the
30 fingers may spread apart or close together in order to cause the object shown on the display 68 to zoom in during the spreading and zoom out during the closing. During this operation, the computer system 50 recognizes the user input as a zoom gesture, determines what action should be taken, and outputs control data to the appropriate device, in this case the display 68.

In another embodiment, the computer system 50 provides region sensitivity where gestures mean different things when implemented over different areas of the input device 68. For example, a rotation gesture over a volume knob causes volume
5 increase/decrease, whereas a rotation gesture over a photo causes rotation of the photo.

In another embodiment, the number of fingers in contact with the touch screen may indicate an input mode. For example, a single touch as for example by a single
10 finger may indicate the desire to perform tracking, i.e., pointer or cursor movements, or selections, whereas multiple touches as for example by a group of fingers may indicate the desire to perform gesturing. The number of fingers for implementing gesturing may be widely varied. By way of example, two fingers may indicate a first gesture mode, three fingers may indicate a third gesture mode, etc. Alternatively, any
15 number of fingers, i.e., more than one, may be used for the same gesture mode, which can include one or more gesture controls. The orientation of the fingers may similarly be used to denote the desired mode. The profile of the finger may be detected to permit different modal operations based on whether the user has used his thumb or index finger, for example.

20

In another embodiment, an input can be changed while making a continuous stroke on the input device without stopping the stroke (e.g., lifting off the touch sensitive surface). In one implementation, the user can switch from a tracking (or selection) mode to gesturing mode while a stroke is being made. For example,
25 tracking or selections may be associated with a single finger and gesturing may be associated with multiple fingers; therefore, the user can toggle between tracking/selection and gesturing by picking up and placing down a second finger on the touch screen. In another implementation, the user can switch from one gesture mode to another gesture mode while a stroke is being made. For example, zooming
30 may be associated with spreading a pair of fingers and rotating may be associated with rotating the pair of fingers; therefore, the user can toggle between zooming and rotating by alternating the movement of their fingers between spreading and rotating. In yet another implementation, the number of gesture inputs can be changed while a stroke is being made (e.g., added or subtracted). For example, during zooming where

the fingers are spread apart, the user may further rotate their fingers to initiate both zooming and rotation. Furthermore during zooming and rotation, the user can stop spreading their fingers so that only rotation occurs. In other words, the gesture inputs can be continuously input, either simultaneously or consecutively.

5

In one particular embodiment, a single finger initiates tracking (or selection) and two or more fingers in close proximity to one another initiates scrolling or panning. Two fingers is generally preferred so as to provide easy toggling between one and two fingers, i.e., the user can switch between modes very easily by simply picking or placing an additional finger. This has the advantage of being more
10 intuitive than other forms of mode toggling. During tracking, cursor movement is controlled by the user moving a single finger on the touch sensitive surface of a touch sensing device. The sensor arrangement of the touch sensing device interprets the finger motion and generates signals for producing corresponding movement of the
15 cursor on the display. During scrolling, screen movement is controlled by the user moving dual fingers on the touch sensitive surface of the touch sensing device. When the combined fingers are moved in the vertical direction, the motion is interpreted as a vertical scroll event, and when the combined fingers are moved in the horizontal direction, the motion is interpreted as a horizontal scroll event. The same can be said
20 for panning although panning can occur in all directions rather than just the horizontal and vertical directions.

The term “scrolling” as used herein generally pertains to moving displayed data or images (e.g., text or graphics) across a viewing area on a display screen so
25 that a new set of data (e.g., line of text or graphics) is brought into view in the viewing area. In most cases, once the viewing area is full, each new set of data appears at the edge of the viewing area and all other sets of data move over one position. That is, the new set of data appears for each set of data that moves out of the viewing area. In essence, the scrolling function allows a user to view consecutive
30 sets of data currently outside of the viewing area. The viewing area may be the entire viewing area of the display screen or it may only be a portion of the display screen (e.g., a window frame).

As mentioned above, scrolling may be implemented vertically (up or down) or horizontally (left or right). In the case of vertical scrolling, when a user scrolls down, each new set of data appears at the bottom of the viewing area and all other sets of data move up one position. If the viewing area is full, the top set of data moves out of the viewing area. Similarly, when a user scrolls up, each new set of data appears at the top of the viewing area and all other sets of data move down one position. If the viewing area is full, the bottom set of data moves out of the viewing area.

By way of example, the display screen, during operation, may display a list of media items (e.g., songs). A user is able to linearly scroll through the list of media items by moving his or her finger across a touch screen. As the finger moves across the touch screen, the displayed items from the list of media items are varied such that the user is able to effectively scroll through the list of media items. In most cases, the user is able to accelerate their traversal of the list of media items by moving his or her finger at greater speeds. Some embodiments, which may be related to the above example, are described in greater detail below. See for example Figs. 6, 23, 27.

Fig. 2 is a multipoint processing method 100, in accordance with one embodiment of the present invention. The multipoint processing method 100 may for example be performed in the system shown in Fig. 1. The multipoint processing method 100 generally begins at block 102 where images are read from a multipoint input device, and more particularly a multipoint touch screen. By way of example, the multipoint touch screen may generally correspond to the multipoint touch screen disclosed in copending U.S. Patent Application No.: 10/840,862, which is hereby incorporated herein by reference. Although the term "image" is used it should be noted that the data may come in other forms. In most cases, the image read from the touch screen provides magnitude (Z) as a function of position (x and y) for each sensing point or pixel of the touch screen. The magnitude may, for example, be reflect the capacitance measured at each point.

30

Following block 102, multipoint processing method 100 proceeds to block 104 where the image is converted into a collection or list of features. Each feature represents a distinct input such as a touch. In most cases, each feature includes its own unique identifier (ID), x coordinate, y coordinate, Z magnitude, angle θ , area A ,

and the like. By way of example, Figs. 3A and 3B illustrate a particular image 120 in time. In image 120, there are two features 122 based on two distinct touches. The touches may for example be formed from a pair of fingers touching the touch screen. As shown, each feature 122 includes unique identifier (ID), x coordinate, y coordinate, Z magnitude, angle θ , and area A. More particularly, the first feature 122A is represented by $ID_1, x_1, y_1, Z_1, \theta_1, A_1$ and the second feature 122B is represented by $ID_2, x_2, y_2, Z_2, \theta_2, A_2$. This data may be outputted for example using a multitouch protocol.

10 The conversion from data or images to features may be accomplished using methods described in copending U.S. Patent Application No.: 10/840,862 which is hereby incorporated herein by reference. As disclosed therein, the raw data is received. The raw data is typically in a digitized form, and includes values for each node of the touch screen. The values may be between 0 and 256 where 0 equates to
15 no touch pressure and 256 equates to full touch pressure. Thereafter, the raw data is filtered to reduce noise. Once filtered, gradient data, which indicates the topology of each group of connected points, is generated. Thereafter, the boundaries for touch regions are calculated based on the gradient data, i.e., a determination is made as to which points are grouped together to form each touch region. By way of example, a
20 watershed algorithm may be used. Once the boundaries are determined, the data for each of the touch regions are calculated (e.g., x, y, Z, θ , A).

Following block 104, multipoint processing method 100 proceeds to block 106 where feature classification and groupings are performed. During classification,
25 the identity of each of the features is determined. For example, the features may be classified as a particular finger, thumb, palm or other object. Once classified, the features may be grouped. The manner in which the groups are formed can widely varied. In most cases, the features are grouped based on some criteria (e.g., they carry a similar attribute). For example, the two features shown in Figs. 3A and 3B
30 may be grouped together because each of these features is located in proximity to each other or because they are from the same hand. The grouping may include some level of filtering to filter out features that are not part of the touch event. In filtering, one or more features may be rejected because they either meet some predefined criteria or because they do not meet some criteria. By way of example, one of the

features may be classified as a thumb located at the edge of a tablet PC. Because the thumb is being used to hold the device rather than being used to perform a task, the feature generated therefrom is rejected, i.e., is not considered part of the touch event being processed.

5

Following block 106, the multipoint processing method 100 proceeds to block 108 where key parameters for the feature groups are calculated. The key parameters may include distance between features, x/y centroid of all features, feature rotation, total pressure of the group (e.g., pressure at centroid), and the like. As shown in Fig. 4, the calculation may include finding the centroid C, drawing a virtual line 130 to each feature from the centroid C, defining the distance D for each virtual line (D_1 and D_2), and then averaging the distances D_1 and D_2 . Once the parameters are calculated, the parameter values are reported. The parameter values are typically reported with a group identifier (GID) and number of features within each group (in this case three). In most cases, both initial and current parameter values are reported. The initial parameter values may be based on set down, i.e., when the user sets their fingers on the touch screen, and the current values may be based on any point within a stroke occurring after set down. As should be appreciated, blocks 102-108 are repetitively performed during a user stroke thereby generating a plurality of sequentially configured signals. The initial and current parameters can be compared in later steps to perform actions in the system.

Following block 108, the process flow proceeds to block 110 where the group is or associated to a user interface (UI) element. UI elements are buttons boxes, lists, sliders, wheels, knobs, etc. Each UI element represents a component or control of the user interface. The application behind the UI element(s) has access to the parameter data calculated in block 108. In one implementation, the application ranks the relevance of the touch data to the UI element corresponding there to. The ranking may be based on some predetermine criteria. The ranking may include producing a figure of merit, and whichever UI element has the highest figure of merit, giving it sole access to the group. There may even be some degree of hysteresis as well (once one of the UI elements claims control of that group, the group sticks with the UI element until another UI element has a much higher ranking). By way of example,

the ranking may include determining proximity of the centroid (or features) to the GUI object associated with the UI element.

Following block 110, the multipoint processing method 100 proceeds to
5 blocks 112 and 114. The blocks 112 and 114 can be performed approximately at the
same time. From the user perspective, in one embodiment, the blocks 112 and 114
appear to be performed concurrently. In block 112, one or more actions are
performed based on differences between initial and current parameter values as well
as the UI element to which they are associated. In block 114, user feedback
10 pertaining to the one ore more action being performed is provided. By way of
example, user feedback may include display, audio, tactile feedback and/or the like.

Fig. 5 is a parameter calculation method 150, in accordance with one
embodiment of the present invention. The parameter calculation method 150 may,
15 for example, correspond to block 108 shown in Fig. 2. The parameter calculation
method 150 generally begins at block 152 where a group of features is received.
Following block 152, the parameter calculation method 150 proceeds to block 154
where a determination is made as to whether or not the number of features in the
group of features has changed. For example, the number of features may have
20 changed due to the user picking up or placing an additional finger. Different fingers
may be needed to perform different controls (e.g., tracking, gesturing). If the number
of features has changed, the parameter calculation method 150 proceeds to block 156
where the initial parameter values are calculated. If the number stays the same, the
parameter calculation method 150 proceeds to block 158 where the current parameter
25 values are calculated. Thereafter, the parameter calculation method 150 proceeds to
block 150 where the initial and current parameter values are reported. By way of
example, the initial parameter values may contain the average initial distance between
points (or Distance (AVG) initial) and the current parameter values may contain the
average current distance between points (or Distance (AVG) current). These may be
30 compared in subsequent steps in order to control various aspects of a computer
system.

The above methods and techniques can be used to implement any number of
GUI interface objects and actions. For example, gestures can be created to detect and

effect a user command to resize a window, scroll a display, rotate an object, zoom in or out of a displayed view, delete or insert text or other objects, etc. Gestures can also be used to invoke and manipulate virtual control interfaces, such as volume knobs, switches, sliders, handles, knobs, doors, and other widgets that may be created to
5 facilitate human interaction with the computing system.

To cite an example using the above methodologies, and referring to Figs. 6A-6H, a rotate gesture for controlling a virtual volume knob 170 on a GUI interface 172 of a display 174 of a tablet PC 175 will be described. In order to actuate the knob
10 170, the user places their fingers 176 on a multipoint touch screen 178. The virtual control knob may already be displayed, or the particular number, orientation or profile of the fingers at set down, or the movement of the fingers immediately thereafter, or some combination of these and other characteristics of the user's interaction may invoke the virtual control knob to be displayed. In either case, the
15 computing system associates a finger group to the virtual control knob and makes a determination that the user intends to use the virtual volume knob. This association may also be based in part on the mode or current state of the computing device at the time of the input. For example, the same gesture may be interpreted alternatively as a volume knob gesture if a song is currently playing on the computing device, or as a
20 rotate command if an object editing application is being executed. Other user feedback may be provided, including for example audible or tactile feedback.

Once knob 170 is displayed as shown in Fig. 6A, the user's fingers 176 can be positioned around the knob 170 similar to if it were an actual knob or dial, and
25 thereafter can be rotated around the knob 170 in order to simulate turning the knob 170. Again, audible feedback in the form of a clicking sound or tactile feedback in the form of vibration, for example, may be provided as the knob 170 is "rotated." The user may also use their other hand to hold the tablet PC 175.

30 As shown in Fig. 6B, the multipoint touch screen 178 detects at least a pair of images. In particular, a first image 180 is created at set down, and at least one other image 182 is created when the fingers 176 are rotated. Although only two images are shown, in most cases there would be many more images that incrementally occur between these two images. Each image represents a profile of the fingers in contact

with the touch screen at a particular instant in time. These images can also be referred to as touch images. It will be understood that the term “image” does not mean that the profile is displayed on the screen 178 (but rather imaged by the touch sensing device). It should also be noted that although the term “image” is used, the data may be in other forms representative of the touch plane at various times.

As shown in Fig. 6C, each of the images 180 and 182 is converted to a collection of features 184. Each feature 184 is associated with a particular touch as for example from the tips each of the fingers 176 surrounding the knob 170 as well as the thumb of the other hand 177 used to hold the tablet PC 175.

As shown in Fig. 6D, the features 184 are classified, i.e., each finger/thumb is identified, and grouped for each of the images 180 and 182. In this particular case, the features 184A associated with the knob 170 are grouped together to form group 188 and the feature 184B associated with the thumb is filtered out. In alternative arrangements, the thumb feature 184B may be treated as a separate feature by itself (or in another group), for example, to alter the input or operational mode of the system or to implement another gesture, for example, a slider gesture associated with an equalizer slider displayed on the screen in the area of the thumb (or other finger).

As shown in Fig. 6E, the key parameters of the feature group 188 are calculated for each image 180 and 182. The key parameters associated with the first image 180 represent the initial state and the key parameters of the second image 182 represent the current state.

Also as shown in Fig. 6E, the knob 170 is the UI element associated with the feature group 188 because of its proximity to the knob 170. Thereafter, as shown in Fig. 6F, the key parameter values of the feature group 188 from each image 180 and 182 are compared to determine the rotation vector, i.e., the group of features rotated five (5) degrees clockwise from the initial to current state. In Fig. 6F, the initial feature group (image 180) is shown in dashed lines while the current feature group (image 182) is shown in solid lines.

As shown in Fig. 6G, based on the rotation vector the speaker 192 of the tablet PC 175 increases (or decreases) its output in accordance with the amount of rotation of the fingers 176, i.e., increase the volume by 5% based on rotation of 5 degrees. The display 174 of the tablet PC can also adjust the rotation of the knob 170 in accordance with the amount of rotation of the fingers 176, i.e., the position of the knob 170 rotates five (5) degrees. In most cases, the rotation of the knob occurs simultaneously with the rotation of the fingers, i.e., for every degree of finger rotation the knob rotates a degree. In essence, the virtual control knob follows the gesture occurring on the screen. Still further, an audio unit 194 of the tablet PC may provide a clicking sound for each unit of rotation, e.g., provide five clicks based on rotation of five degrees. Still yet further, a haptics unit 196 of the tablet PC 175 may provide a certain amount of vibration or other tactile feedback for each click thereby simulating an actual knob.

It should be noted that additional gestures can be performed simultaneously with the virtual control knob gesture. For example, more than one virtual control knob can be controlled at the same time using both hands, i.e., one hand for each virtual control knob. Alternatively or additionally, one or more slider bars can be controlled at the same time as the virtual control knob, i.e., one hand operates the virtual control knob, while at least one finger and maybe more than one finger of the opposite hand operates at least one slider and maybe more than one slider bar, e.g., slider bar for each finger.

It should also be noted that although the embodiment is described using a virtual control knob, in another embodiment, the UI element can be a virtual scroll wheel. As an example, the virtual scroll wheel can mimic an actual scroll wheel such as those described in U.S. Patent Publication Nos: 2003/0076303A1, 2003/0076301A1, 2003/0095096A1, which are all herein incorporated by reference. For example, when the user places their finger on the surface of the virtual scroll wheel and makes a swirling, rotational or tangential gesture motion, a scrolling action can be performed with respect to a list of items displayed in a window.

Fig. 7 is a diagram of a touch-based method 200 in accordance with one embodiment of the present invention. The method generally begins at block 202

where a user input that occurs over a multipoint sensing device is detected. The user input includes one or more touch inputs, with each touch input having a unique identifier. Following block 202, the touch-based method 200 proceeds to block 204 where the user input is classified as a tracking or selection input when the user input includes a single unique identifier (one touch input), or is classified as a gesture input when the user input includes at least two unique identifiers (more than one touch input). If the user input is classified as a tracking input, the touch-based method 200 proceeds to block 206 where tracking is performed corresponding to the user input. If the user input is classified as a gesture input, the touch-based method 200 proceeds to block 208 where one or more gesture control actions are performed corresponding to the user input. The gesture control actions are based at least in part on changes that occur with or between the at least two unique identifiers.

Fig. 8 is a diagram of a touch-based method 250 in accordance with one embodiment of the present invention. The touch-based method 250 generally begins at block 252 where an initial image is captured during an input stroke on a touch sensitive surface. Following block 252, the touch-based method 250 proceeds to block 254 where the touch mode is determined based on the initial image. For example, if the initial image includes a single unique identifier then the touch mode may correspond to a tracking or selection mode. On the other hand, if the image includes more than one unique identifier, then the touch mode may correspond to a gesture mode. Following block 254, the touch-based method 250 proceeds to block 256 where a next image is captured during the input stroke on the touch sensitive surface. Images are typically captured sequentially during the stroke and thus there may be a plurality of images associated with the stroke. Following block 256, touch-based method 250 proceeds to block 258 where a determination is made as to whether the touch mode changed between capture of the initial image and capture of the next image. If the touch mode changed, the touch-based method 250 proceeds to block 260 where the next image is set as the initial image and thereafter the touch mode is again determined at block 254 based on the new initial image. If the touch mode stayed the same, the touch-based method 250 proceeds to block 262 where the initial and next images are compared and one or more control signals are generated based on the comparison.

Fig. 9 is a diagram of a touch-based method 300 in accordance with one embodiment of the present invention. The touch-based method 300 begins at block 302 where a GUI object is output. For example, a processor may instruct a display to display a particular GUI object. Following block 302, the touch-based method 300 proceeds to block 304 where a gesture input is received over the GUI object. For instance, a user may set or move their fingers in a gestural way on the surface of the touch screen and while over the displayed GUI object. The gestural input may include one or more single gestures that occur consecutively or multiple gestures that occur simultaneously. Each of the gestures generally has a particular sequence, motion, or orientation associated therewith. For example, a gesture may include spreading fingers apart or closing fingers together, rotating the fingers, translating the fingers, and/or the like.

Following block 304 the touch-based method 300 proceeds to block 306 where the GUI object is modified based on and in unison with the gesture input. By modified, it is meant that the GUI object changes according to the particular gesture or gestures being performed. By in unison, it is meant that the changes occur approximately while the gesture or gestures are being performed. In most cases, there is a one to one relationship between the gesture(s) and the changes occurring at the GUI object and they occur substantially simultaneously. In essence, the GUI object follows the motion of the fingers. For example, spreading of the fingers may simultaneously enlarge the object, closing of the fingers may simultaneously reduce the GUI object, rotating the fingers may simultaneously rotate the object, translating the fingers may allow simultaneous panning or scrolling of the GUI object.

In one embodiment, block 306 may include determining which GUI object is associated with the gesture being performed, and thereafter locking the displayed object to the fingers disposed over it such that the GUI object changes in accordance with the gestural input. By locking or associating the fingers to the GUI object, the GUI object can continuously adjust itself in accordance to what the fingers are doing on the touch screen. Often the determination and locking occurs at set down, i.e., when the finger is positioned on the touch screen.

Fig. 10 is a diagram of a zoom gesture method 350, in accordance with one embodiment of the present invention. The zoom gesture may be performed on a multipoint touch screen. The zoom gesture method 350 generally begins at block 352 where the presence of at least a first finger and a second finger are detected on a touch sensitive surface at the same time. The presence of at least two fingers is configured to indicate that the touch is a gestural touch rather than a tracking touch based on one finger. In some cases, the presence of only two fingers indicates that the touch is a gestural touch. In other cases, any number of more than two fingers indicates that the touch is a gestural touch. In fact, the gestural touch may be configured to operate whether two, three, four or more fingers are touching, and even if the numbers change during the gesture, i.e., only need a minimum of two fingers at any time during the gesture.

Following block 352, the zoom gesture method 350 proceeds to block 354 where the distance between at least the two fingers is compared. The distance may be from finger to finger or from each finger to some other reference point as for example the centroid. If the distance between the two fingers increases (spread apart), a zoom-in signal is generated as shown in block 356. If the distance between two fingers decreases (close together), a zoom-out signal is generated as shown in block 358. In most cases, the set down of the fingers will associate or lock the fingers to a particular GUI object being displayed. For example, the touch sensitive surface can be a touch screen, and the GUI object can be displayed on the touch screen. This typically occurs when at least one of the fingers is positioned over the GUI object. As a result, when the fingers are moved apart, the zoom-in signal can be used to increase the size of the embedded features in the GUI object and when the fingers are pinched together, the zoom-out signal can be used to decrease the size of embedded features in the object. The zooming typically occurs within a predefined boundary such as the periphery of the display, the periphery of a window, the edge of the GUI object, and/or the like. The embedded features may be formed on a plurality of layers, each of which represents a different level of zoom. In most cases, the amount of zooming varies according to the distance between the two objects. Furthermore, the zooming typically can occur substantially simultaneously with the motion of the objects. For instance, as the fingers spread apart or closes together, the object zooms in or zooms out at the same time. Although this methodology is directed at zooming, it should be

noted that it may also be used for enlarging or reducing. The zoom gesture method 350 may be particularly useful in graphical programs such as publishing, photo, and drawing programs. Moreover, zooming may be used to control a peripheral device such as a camera, i.e., when the finger is spread apart, the camera zooms out and
5 when the fingers are closed the camera zooms in.

Figs. 11A-11J illustrate a zooming sequence using the method described above. Fig. 11A illustrates a display presenting a GUI object 364 in the form of a map of North America with embedded levels which can be zoomed. In some cases, as
10 shown, the GUI object is positioned inside a window that forms a boundary of the GUI object 364. Fig. 11B illustrates a user positioning their fingers 366 over a region of North America 368, particularly the United States 370 and more particularly California 372. In order to zoom in on California 372, the user starts to spread their fingers 366 apart as shown in Fig. 11C. As the fingers 366 spread apart further
15 (distance increases), the map zooms in further on Northern California 374, then to a particular region of Northern California 374, then to the Bay area 376, then to the peninsula 378 (e.g., the area between San Francisco and San Jose Area), and then to the city of San Carlos 380 located between San Francisco and San Jose as illustrated in Figs. 11D-11H. In order to zoom out of San Carlos 380 and back to North
20 America 368, the fingers 366 are closed back together following the sequence described above, but in reverse.

Fig. 12 is a diagram of a pan method 400, in accordance with one embodiment of the present invention. The pan gesture may be performed on a multipoint touch
25 screen. The pan method 400 generally begins at block 402 where the presence of at least a first object and a second object are detected on a touch sensitive surface at the same time. The presence of at least two fingers is configured to indicate that the touch is a gestural touch rather than a tracking touch based on one finger. In some cases, the presence of only two fingers indicates that the touch is a gestural touch. In
30 other cases, any number of more than two fingers indicates that the touch is a gestural touch. In fact, the gestural touch may be configured to operate whether two, three, four or more fingers are touching, and even if the numbers change during the gesture, i.e., only need a minimum of two fingers. Following block 402, the pan method 400 proceeds to block 404 where the position of the two objects when the objects are

moved together across the touch screen is monitored. Following block 404, the pan method 400 proceeds to block 406 where a pan signal is generated when the position of the two objects changes relative to an initial position. In most cases, the set down of the fingers will associate or lock the fingers to a particular GUI object displayed on the touch screen. Typically, when at least one of the fingers is positioned over the image on the GUI object. As a result, when the fingers are moved together across the touch screen, the pan signal can be used to translate the image in the direction of the fingers. In most cases, the amount of panning varies according to the distance the two objects move. Furthermore, the panning typically can occur substantially simultaneously with the motion of the objects. For instance, as the fingers move, the object moves with the fingers at the same time.

Figs. 13A-13D illustrate a panning sequence based on the pan method 400 described above. Using the map of Fig. 11, Fig. 13A illustrates a user positioning their fingers 366 over the map. Upon set down, the fingers 366 are locked to the map. As shown in Fig. 13B, when the fingers 366 are moved vertically up, the entire map 364 is moved up thereby causing previously seen portions of map 364 to be placed outside the viewing area and unseen portions of the map 364 to be placed inside the viewing area. As shown in Fig. 13C, when the fingers 366 are moved horizontally sideways, the entire map 364 is moved sideways thereby causing previously seen portions of map 364 to be placed outside the viewing area and unseen portions of the map to be placed inside the viewing area. As shown in Fig. 13D, when the fingers 366 are moved diagonally, the entire map 364 is moved diagonally thereby causing previously seen portions of map 364 to be placed outside the viewing area and unseen portions of the map to be placed inside the viewing area. As should be appreciated, the motion of the map 364 follows the motion of the fingers 366. This process is similar to sliding a piece of paper along a table. The pressure the fingers exert on the paper locks the paper to the fingers and when the fingers are slid across the table, the piece of paper moves with them.

30

Fig. 14 is a diagram of a rotate method 450, in accordance with one embodiment of the present invention. The rotate gesture may be performed on a multipoint touch screen. The rotate method 450 generally begins at block 452 where the presence of a first object and a second object are detected at the same time. The

presence of at least two fingers is configured to indicate that the touch is a gestural touch rather than a tracking touch based on one finger. In some cases, the presence of only two fingers indicates that the touch is a gestural touch. In other cases, any number of more than two fingers indicates that the touch is a gestural touch. In fact, 5 the gestural touch may be configured to operate whether two, three, four or more fingers are touching, and even if the numbers change during the gesture, i.e., only need a minimum of two fingers.

Following block 452, the rotate method 450 proceeds to block 454 where the 10 angle of each of the finger is set. The angles are typically determined relative to a reference point. Following block 454, rotate method 450 proceeds to block 456 where a rotate signal is generated when the angle of at least one of the objects changes relative to the reference point. In most cases, the set down of the fingers will associate or lock the fingers to a particular GUI object displayed on the touch screen. 15 Typically, when at least one of the fingers is positioned over the image on the GUI object, the GUI object will be associated with or locked to the fingers. As a result, when the fingers are rotated, the rotate signal can be used to rotate the object in the direction of finger rotation (e.g., clockwise, counterclockwise). In most cases, the amount of object rotation varies according to the amount of finger rotation, i.e., if the 20 fingers move 5 degrees then so will the object. Furthermore, the rotation typically can occur substantially simultaneously with the motion of the fingers. For instance, as the fingers rotate, the object rotates with the fingers at the same time.

Figs. 15A-15C illustrate a rotating sequence based on the method described 25 above. Using the map of Fig. 11, Fig. 15A illustrates a user positioning their fingers 366 over the map 364. Upon set down, the fingers 366 are locked to the map 364. As shown in Fig. 15B, when the fingers 366 are rotated in a clockwise direction, the entire map 364 is rotated in the clockwise direction in accordance with the rotating fingers 366. As shown in Fig. 15C, when the fingers 366 are rotated in a 30 counterclockwise direction, the entire map 364 is rotated in the counter clockwise direction in accordance with the rotating fingers 366.

It should be noted that the methods described in Figs. 10-15 can be implemented during the same gestural stroke. That is, zooming, rotating and panning

can all be performed during the gestural stroke, which may include spreading, rotating and sliding fingers. For example, upon set down with at least two fingers, the displayed object (map) is associated or locked to the two fingers. In order to zoom, the user can spread or close their fingers. In order to rotate, the user can rotate their fingers. In order to pan, the user can slid their fingers. Each of these actions can occur simultaneously in a continuous motion. For example, the user can spread and close their fingers while rotating and sliding them across the touch screen. Alternatively, the user can segment each of these motions without having to reset the gestural stroke. For example, the user can first spread their fingers, then rotate their fingers, then close their fingers, then slide their fingers and so on.

Fig. 16 is a diagram of a GUI operational method 500, in accordance with one embodiment of the present invention. The GUI operational method 500 is configured for initiating floating controls in a GUI. The GUI operational method 500 generally begins at block 502 where the presence of an object such as a finger or thumb is detected. This may for example be accomplished using a touch screen. Following block 502, the GUI operational method 500 proceeds to block 504 where the object is recognized (the identity of the object is found). The object may be recognized among a plurality of objects. For example, see block 104 of Fig. 2 above.

Following block 504, the GUI operational method 500 proceeds to block 506 where an image in the vicinity of the object is generated. The image is typically based on the recognized object . The image may include windows, fields, dialog boxes, menus, icons, buttons, cursors, scroll bars, etc. In some cases, the user can select and activate the image (or features embedded therein) in order to initiate functions and tasks. By way of example, the image may be a user interface element or a group of user interface elements (e.g., one or more buttons that open, close, minimize, or maximize a window). The image may also be one or more icons that launch a particular program or files that open when selected. The image may additionally correspond to non interactive text and graphics. In most cases, the image is displayed as long as the object is detected or it may be displayed for some preset amount of time, i.e., after a period of time it times out and is removed.

In one particular embodiment, the image includes one or more control options that can be selected by the user. The control options may include one or more control buttons for implementing various tasks. For example, the control option box may include music listening control buttons as for example, play, pause, seek and menu.

5

Figs. 17A-17E illustrate a floating control sequence using the method described above. As shown in Fig. 17A, a user 510 is using a tablet PC 512 and therefore is holding the tablet PC 512 with one hand 514 while navigating (e.g., tracking, gesturing) with the other hand 516. As shown in Fig. 17B, which is a close up of the user holding the tablet PC 512, a portion of the thumb of the holding hand 514 is positioned over the touch screen 520. As shown in Fig. 17C, the tablet PC 512 recognizes the thumb and displays a control box 522 adjacent the thumb. The control box 522 includes various buttons 524, which can be selected by the user's thumb to initiate tasks in the tablet PC 512. As shown in Fig. 17D, while holding the tablet PC 15 512, the thumb is extended over one of the buttons 524 and subsequently tapped thereby selecting the task associated with the button 524. By way of example, the task may be associated with launching a program or gaining access to a network or changing the mode of operation of the device. The control box 522 and buttons 524 may be used to change the input mode of the touch screen 520 so that, for example, 20 the identical gesture made with the fingers of the user's other hand may have multiple meanings depending on which of buttons 524 is selected. As shown in Fig. 17E, when the thumb is moved away from the touch screen 520, the control box 522 may time out and disappear. Alternatively, the control box may be closed using conventional close icons or buttons.

25

Fig. 18 is a diagram of a GUI operational method 550, in accordance with one embodiment of the present invention. The GUI operational method 550 is configured for initiating zooming targets. The GUI operational method 550 generally begins at block 552 where a control box GUI element is displayed. The control box contains 30 one or more control buttons, which are somewhat close together, and which can be used to perform actions. The control box may, for example, include control buttons such as maximize, minimize, close, and the like. Following block 552, the GUI operational method 550 proceeds to block 554 where the control box is enlarged, or at least one of the control buttons is enlarged for a period of time when the presence of

an object over the control box or one of the control buttons is detected. In the case where the control box is enlarged each of the control buttons is enlarged thereby making selection thereof much easier. In the case where only the control button is enlarged, the user would decide whether this is the correct button and if so select the enlarged control button, or restart the process so that the appropriate control button is presented. In most cases, the size of the control buttons corresponds to the size of the finger so that they may be easily selected by the object. Following block 554, the GUI operational method 550 proceeds to block 556 where a control signal associated with the selected control button is generated when the presence of the object over one of the enlarged control buttons is detected.

Figs. 19A-19D illustrate a zooming target sequence using the GUI operational method 550 described above. As shown in Fig. 19A, a user 510 places their finger 576 over a control box 578. Because the buttons 580 of the control box 578 included therein are smaller than the finger 576 and located close together, it is difficult for the user 510 to make a selection directly without possibly pressing an undesirable button 580, e.g., a button adjacent the desired button. By way of example, the finger 576 may cover two or more of the buttons 580. As shown in Fig. 19B, at least a portion of the control box 578 is enlarged including the buttons 580 included therein when the user places their thumb over the control box. As shown in Fig. 19C, once the control box has reached its enlarged state, the user can select one of the enlarged buttons, which is now closer to the size of the thumb. By way of example, the user may tap on the desired control button. As shown in Fig. 19D, the control box reduces to its initial size after the button is selected or after a predetermined time period in which no selection was made (e.g., times out) or when the user moves their finger away from the control box.

Fig. 20 is a diagram of a GUI operational method 600, in accordance with one embodiment of the present invention. The GUI operational method 600 is configured for initiating a page turn. The GUI operational method 600 generally begins at block 602 where a page from a multitude of pages is displayed in a GUI. By way of example, the pages may be associated with an electronic book. Following block 602, the GUI operational method 600 proceeds to block 604 where the presence of an object (or objects) in a predetermined region over the page is detected. The