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(54) **METHOD AND APPARATUS FOR ACCELERATED SCROLLING**

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See application file for complete search history.

(56) **References Cited**

U.S. PATENT DOCUMENTS

1,061,578	A	5/1913	Wischhusen et al.
2,798,907	A	7/1957	Schneider
2,903,229	A	9/1959	Landge
2,945,111	A	7/1960	McCormick
3,005,055	A	10/1961	Mattke
3,965,399	A	6/1976	Walker et al.
4,103,252	A	7/1978	Bobick
4,110,749	A	8/1978	Janko et al.
4,121,204	A	10/1978	Welch et al.
4,129,747	A	12/1978	Pepper, Jr.
4,158,216	A	6/1979	Bigelow
4,246,452	A	1/1981	Chandler

(Continued)

FOREIGN PATENT DOCUMENTS

DE 3615742 11/1987

(Continued)

OTHER PUBLICATIONS

"About Quicktip®" www.logicad3d.com/docs/qt.html, downloaded Apr. 8, 2002.

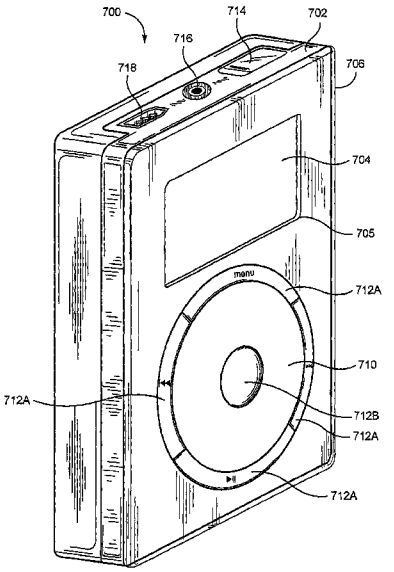
(Continued)

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(57) **ABSTRACT**

Improved approaches for users to with graphical user interfaces of computing devices are disclosed. A rotational user action supplied by a user via a user input device can provide accelerated scrolling. The accelerated nature of the scrolling enables users to scroll or traverse a lengthy data set (e.g., list of items) faster and with greater ease. The amount of acceleration provided can be performed in successive stages, and/or performed based on the speed of the rotational user action. In one embodiment, the rotational user action is transformed into linear action with respect to a graphical user interface. The resulting acceleration effect causes the linear action to be enhanced such that a lengthy data set is able to be rapidly traversed.

40 Claims, 15 Drawing Sheets



U.S. PATENT DOCUMENTS

4,264,903	A		4/1981	Bigelow
4,293,734	A		10/1981	Pepper, Jr.
4,380,007	A		4/1983	Steinegger
4,380,040	A		4/1983	Posset
4,475,008	A		10/1984	Doi et al.
4,570,149	A		2/1986	Thornburg et al.
4,587,378	A		5/1986	Moore
4,644,100	A		2/1987	Brenner et al.
4,719,524	A	*	1/1988	Morishima et al. 360/73.05
4,734,034	A		3/1988	Maness et al.
4,736,191	A	*	4/1988	Matzke et al. 341/20
4,739,299	A		4/1988	Eventoff et al.
4,752,655	A		6/1988	Tajiri et al.
4,755,765	A		7/1988	Ferland
4,764,717	A		8/1988	Tucker et al.
4,798,919	A		1/1989	Miessler et al.
4,810,992	A		3/1989	Eventoff
4,831,359	A		5/1989	Newell
4,849,852	A		7/1989	Mullins
4,856,993	A		8/1989	Maness et al.
4,866,602	A		9/1989	Hall
4,897,511	A		1/1990	Itaya et al.
4,914,624	A		4/1990	Dunthorn
4,917,516	A		4/1990	Retter
4,951,036	A		8/1990	Grueter et al.
4,990,900	A		2/1991	Kikuchi
5,008,497	A		4/1991	Asher
5,036,321	A		7/1991	Leach et al.
5,125,077	A		6/1992	Hall
5,159,159	A		10/1992	Asher
5,179,648	A	*	1/1993	Hauck 345/684
5,186,646	A		2/1993	Pederson
5,231,326	A		7/1993	Echols
5,237,311	A		8/1993	Mailey et al.
5,305,017	A		4/1994	Gerpheide
D349,280	S		8/1994	Kaneko
5,339,213	A		8/1994	Ocallaghan
5,367,199	A		11/1994	Lefkowitz et al.
5,374,787	A		12/1994	Miller et al.
5,404,152	A		4/1995	Nagai
5,408,621	A		4/1995	Ben-Arie
5,414,445	A		5/1995	Kaneko et al.
5,416,498	A		5/1995	Grant
5,424,756	A		6/1995	Ho et al.
5,432,531	A		7/1995	Calder et al.
5,438,331	A		8/1995	Gilligan et al.
D362,431	S		9/1995	Kaneko et al.
5,450,075	A		9/1995	Waddington
5,453,761	A		9/1995	Tanaka
5,473,343	A		12/1995	Kimmich et al.
5,473,344	A		12/1995	Bacon et al.
5,479,192	A		12/1995	Carroll, Jr. et al.
5,495,566	A	*	2/1996	Kwatinetz 345/785
5,508,703	A		4/1996	Okamura et al.
5,543,588	A		8/1996	Bisset et al.
5,559,301	A		9/1996	Bryan, Jr. et al.
5,559,943	A		9/1996	Cyr et al.
5,561,445	A		10/1996	Miwa et al.
5,564,112	A		10/1996	Hayes et al.
5,565,887	A		10/1996	McCambridge et al.
5,578,817	A		11/1996	Bidiville et al.
5,581,670	A		12/1996	Bier et al.
5,585,823	A		12/1996	Duchon et al.
5,589,893	A		12/1996	Gaughan et al.
5,596,347	A		1/1997	Robertson et al.
5,598,183	A		1/1997	Robertson et al.
5,611,040	A		3/1997	Brewer et al.
5,611,060	A		3/1997	Belfiore et al.
5,613,137	A		3/1997	Bertram et al.
5,617,114	A		4/1997	Bier et al.
5,627,531	A		5/1997	Posso et al.
5,632,679	A		5/1997	Tremmel
5,640,258	A		6/1997	Kurashima et al.
D382,550	S		8/1997	Kaneko et al.
5,657,012	A		8/1997	Tait
D385,542	S		10/1997	Kaneko et al.
5,689,285	A		11/1997	Asher
5,726,687	A		3/1998	Belfiore et al.
5,729,219	A		3/1998	Armstrong et al.
5,730,165	A		3/1998	Philipp
5,748,185	A		5/1998	Stephan et al.
5,751,274	A		5/1998	Davis
5,754,890	A		5/1998	Holmdahl et al.
5,777,605	A		7/1998	Yoshinobu et al.
5,786,818	A		7/1998	Brewer et al.
5,790,769	A		8/1998	Buxton et al.
5,805,144	A		9/1998	Scholder et al.
5,808,602	A		9/1998	Sellers
5,825,353	A		10/1998	Will
5,828,364	A		10/1998	Siddiqui
5,838,304	A		11/1998	Hall
5,841,423	A		11/1998	Carroll, Jr. et al.
D402,281	S		12/1998	Ledbetter et al.
5,850,213	A		12/1998	Imai et al.
5,856,822	A		1/1999	Du et al.
5,859,629	A		1/1999	Tognazzini
5,875,311	A		2/1999	Bertram et al.
5,883,619	A		3/1999	Ho et al.
5,889,236	A		3/1999	Gillespie et al.
5,903,229	A		5/1999	Kishi
5,907,152	A		5/1999	Dandliker et al.
5,907,318	A		5/1999	Medina
5,909,211	A		6/1999	Combs et al.
5,914,706	A		6/1999	Kono
5,923,388	A		7/1999	Kurashima et al.
5,943,044	A		8/1999	Martinelli et al.
5,956,019	A		9/1999	Bang et al.
5,959,611	A		9/1999	Smailagic et al.
5,973,668	A		10/1999	Watanabe
6,000,000	A		12/1999	Hawkins et al.
6,002,389	A		12/1999	Kasser
6,005,299	A		12/1999	Hengst
6,025,832	A		2/2000	Sudo et al.
6,031,518	A		2/2000	Adams et al.
6,034,672	A		3/2000	Gaultier et al.
6,057,829	A		5/2000	Silfvast
6,075,533	A		6/2000	Chang
6,084,574	A		7/2000	Bidiville
6,097,372	A		8/2000	Suzuki
6,124,587	A		9/2000	Bidiville
6,128,006	A		10/2000	Rosenberg et al.
6,163,312	A		12/2000	Furuya
6,166,721	A		12/2000	Kuroiwa et al.
6,179,496	B1		1/2001	Chou
6,181,322	B1		1/2001	Nanavati
6,188,393	B1		2/2001	Shu
6,191,774	B1		2/2001	Schena et al.
6,198,473	B1		3/2001	Armstrong
6,211,861	B1		4/2001	Rosenberg et al.
6,219,038	B1		4/2001	Cho
D442,592	S		5/2001	Ledbetter et al.
6,225,976	B1		5/2001	Yates et al.
6,225,980	B1		5/2001	Weiss et al.
6,226,534	B1	*	5/2001	Aizawa 455/566
D443,616	S		6/2001	Fisher et al.
6,243,078	B1		6/2001	Rosenberg
6,256,011	B1		7/2001	Culver
6,262,717	B1		7/2001	Donohue et al.
6,266,050	B1		7/2001	Oh et al.
6,297,795	B1	*	10/2001	Kato et al. 345/684
6,323,845	B1		11/2001	Robbins
6,340,800	B1		1/2002	Zhai et al.
D454,568	S		3/2002	Andre et al.
6,373,470	B1		4/2002	Andre et al.

6,377,530	B1	4/2002	Burrows	
6,429,852	B1	8/2002	Adams et al.	
6,473,069	B1	10/2002	Gerpheide	
6,492,979	B1	12/2002	Kent et al.	
6,496,181	B1	12/2002	Bomer	
6,497,412	B1 *	12/2002	Bramm	273/430
6,587,091	B2	7/2003	Serpa	
6,636,197	B1	10/2003	Goldenberg et al.	
6,639,584	B1 *	10/2003	Li	345/173
6,650,975	B2	11/2003	Ruffner	
6,677,927	B1	1/2004	Bruck et al.	
6,686,904	B1 *	2/2004	Sherman et al.	345/168
6,703,550	B2	3/2004	Chu	
6,724,817	B1 *	4/2004	Simpson et al.	375/240.07
6,727,889	B2	4/2004	Shaw	
6,738,045	B2 *	5/2004	Hinckley et al.	345/163
6,750,803	B2	6/2004	Yates et al.	
6,791,533	B2	9/2004	Su	
6,795,057	B2	9/2004	Gordon	
6,844,872	B1	1/2005	Farag et al.	
6,978,127	B1	12/2005	Bulthuis et al.	
2001/0011991	A1	8/2001	Wang et al.	
2001/0043545	A1	11/2001	Aratani	
2001/0050673	A1	12/2001	Davenport	
2001/0051046	A1	12/2001	Watanabe et al.	
2002/0030665	A1	3/2002	Ano	
2002/0033848	A1 *	3/2002	Sciammarella et al.	345/838
2002/0045960	A1 *	4/2002	Phillips et al.	700/94
2002/0089545	A1 *	7/2002	Levi Montalcini	345/784
2002/0118169	A1	8/2002	Hinckley et al.	
2002/0154090	A1	10/2002	Lin	
2002/0158844	A1	10/2002	McLoone et al.	
2002/0164156	A1	11/2002	Bilbrey	
2002/0180701	A1	12/2002	Hayama et al.	
2003/0043121	A1	3/2003	Chen	
2003/0050092	A1 *	3/2003	Yun	455/556
2003/0076303	A1	4/2003	Huppi	
2003/0076306	A1	4/2003	Zadesky et al.	
2003/0095096	A1	5/2003	Robbin et al.	
2003/0098851	A1	5/2003	Brink	
2003/0184517	A1	10/2003	Senzui et al.	
2004/0239622	A1	12/2004	Proctor et al.	
2004/0252109	A1	12/2004	Trent, Jr. et al.	

FOREIGN PATENT DOCUMENTS

DE	19722636		12/1998
DE	10022537		11/2000
EP	0 498 540	A2	1/1992
EP	0674288	A1	9/1995
EP	0 731 407	A1	9/1996
EP	0 551 778	B1	1/1997
EP	0551778	B1	1/1997
EP	0 880 091	A2	11/1998
EP	1 026 713	A1	8/2000
EP	1 162 826		12/2001
FR	2 686 440	A1	7/1993
JP	57-95722		6/1982
JP	57 97626		6/1982
JP	05-36623		5/1983
JP	05-233141		9/1983
JP	61-117619		6/1986
JP	61-124009		6/1986
JP	63-20411		1/1988
JP	63-106826		5/1988
JP	63-181022		7/1988
JP	63-298518		12/1988
JP	04-32920		2/1992
JP	5-041135		2/1993
JP	5-101741		4/1993
JP	05080938	A	4/1993
JP	5-189110		7/1993
JP	5-205565		8/1993
JP	5-211021		8/1993
JP	5-217464		8/1993
JP	05-262276		10/1993
JP	5-265656		10/1993
JP	5-274956		10/1993
JP	05-289811		11/1993
JP	5-298955		11/1993
JP	5-325723		12/1993
JP	06-20570		1/1994
JP	06-208433		2/1994
JP	6-084428		3/1994
JP	6-089636		3/1994
JP	6-96639		4/1994
JP	06-096639		4/1994
JP	06-111685		4/1994
JP	6-111695		4/1994
JP	06-111695		4/1994
JP	6-139879		5/1994
JP	06-187078		7/1994
JP	6-267382		9/1994
JP	06-283993		10/1994
JP	6-333459		12/1994
JP	7-107574		4/1995
JP	07-107574		4/1995
JP	07-107574	A	4/1995
JP	07-41882		7/1995
JP	7-41882		7/1995
JP	7-201249		8/1995
JP	07-201256		8/1995
JP	07-253838		10/1995
JP	07-261899		10/1995
JP	7-261899		10/1995
JP	7-261922		10/1995
JP	07-296670		11/1995
JP	07/319001		12/1995
JP	08-016292		1/1996
JP	8-115158		5/1996
JP	08-115158		5/1996
JP	8-203387		8/1996
JP	8-293226		11/1996
JP	8-298045		11/1996
JP	08-299541		11/1996
JP	8-316664		11/1996
JP	09-128148		5/1997
JP	9-218747		8/1997
JP	9-230993		9/1997
JP	09-230993		9/1997
JP	9-231858		9/1997
JP	09-233161		9/1997
JP	9-251347		9/1997
JP	9-258895		10/1997
JP	9-288926		11/1997
JP	10-074429		3/1998
JP	10-198507		7/1998
JP	10-227878		8/1998
JP	10-326149		12/1998
JP	11-184607		7/1999
JP	11-194863		7/1999
JP	11-194872		7/1999
JP	11-194882		7/1999
JP	11-194883		7/1999
JP	11-194891		7/1999
JP	11-195353		7/1999
JP	11-203045		7/1999
JP	11-272378		10/1999
JP	2000-215549		8/2000
JP	2000-267786		9/2000
JP	2000-353045		12/2000
JP	2001-11769		1/2001
JP	2001-22508		1/2001
JP	03-57617		6/2001
JP	2002-215311		8/2002
JP	2003280807		10/2003

JP	2005-251218	9/2005
JP	2005-285140	10/2005
JP	2005-293606	10/2005
JP	2006-004453	1/2006
JP	2006-178962	7/2006
JP	3852854	9/2006
JP	3852854	12/2006
JP	2007-123473	5/2007
KR	1998-71394	10/1998
KR	1999-50198	7/1999
KR	2000-8579	2/2000
TW	431607	4/2001
WO	WO94/17494	8/1994
WO	WO98/14863	4/1998
WO	WO99/49443	9/1999

OTHER PUBLICATIONS

"Neuros MP3 Digital Audio Computer", www.neurosaudio.com., downloaded Apr. 9, 2003.

"OEM Touchpad Modules" website www.glidepoint.com/sales/modules.index.shtml, downloaded Feb. 13, 2002.

"Product Overview—ErgoCommander®", www.logicad3d.com/products/ErgoCommander.htm, downloaded Apr. 8, 2002.

"Product Overview—SpaceMouse® Classic", www.logicad3d.com/products/Classic.htm, downloaded Apr. 8, 2002.

"Synaptics Tough Pad Interfacing Guide" Second Edition, Mar. 25, 1998, Synaptics, Inc. San Jose, CA, pp. 1 to 90.

Chapweske, Adam, "PS/2 Mouse/Keyboard Protocol", 1999, http://panda.cs.ndsu.nodak.edu/~achapwes/PICmicro/PS2/ps2.htm.

Fiore, Andrew, "Zen Touchpad", Cornell University, May 2000.

Gadgetboy, "Point and click with the latest mice", CNETAsia Product Review, www.asia.cnet.com/reviews...are/gadgetboy/0,39001770,38023590,00.htm, downloaded Dec. 5, 2001.

Tessler et al. "Touchpads Three new input devices", website www.macworld.com/1996/02/review/1806.html, downloaded Feb. 13, 2002.

"Der Klangmeister," Connect Magazine, Aug. 1998.

Photographs of Innovations 2000 Best of Show award presented at the 2000 International CES Innovations 2000 Design & Engineering Showcase, 1 pg.

BeoCom 6000, Sales Training Brochure, date unknown.

Letter re: Bang & Olufsen A/S, by David Safran, Nixon Peabody, LLP, May 21, 2004.

Marriott et al., U.S. Appl. No. 10/722,948, filed Nov. 25, 2003.

U.S. Appl. No. 10/060,712 filed Jan. 29, 2002.

U.S. Appl. No. 10/209,537 filed Jul. 30, 2002.

"Apple Unveils Optical Mouse and New Pro Keyboard," Press Release, Jul. 19, 2000.

"System Service and Troubleshooting Manual," www.dsplib.com/intv/Master, downloaded Dec. 11, 2002.

Kevin DeMeyer, "Crystal Optical Mouse," Feb. 14, 2002, Heatseekerz, Web-Article 19.

Communication pursuant to Article 96(2) EPC for corresponding EP Application No. 02 776 261.6 dated Apr. 13, 2006.

Notification of Reasons for Rejection for corresponding Japanese Application No. 2003-538879 dated Sep. 12, 2006, with translation.

Notification of Provision Rejection for corresponding Korean Application No. 10-2004-7005119 dated Aug. 29, 2006, with translation.

David H. Ahl, "Controller Update", Creative Computing vol. 9, No. 12, Dec. 1983.

"Atari VCS/2600 Peripherals", www.classicgaming.com/gamingmuseum/2600p.html, downloaded Feb. 28, 2007, pp. 1-15.

Notification of Final Rejection for corresponding Korean Application No. 10-2004-7005119 dated Aug. 31, 2007 with translation.

"Apple Presents iPod Ultra-Portable MP3 Music Player Puts 1,000 Songs in Your Pocket", Press Release, Oct. 23, 2001, 3 pgs.

Communication pursuant to Article 96(2) EPC for corresponding EP Application No. 02 776 261.6 dated Jun. 28, 2007.

U.S. Appl. No. 11/610,181, entitled "Method and Apparatus for Accelerated Scrolling", filed Dec. 13, 2006.

U.S. Appl. No. 11/610,190, entitled "Method and Apparatus for Accelerated Scrolling", filed Dec. 13, 2006.

U.S. Appl. No. 10/259,159, entitled "Method and Apparatus for Use of Rotational User Inputs", filed Sep. 26, 2002.

U.S. Appl. No. 11/610,376, entitled "Method and Apparatus for Use of Rotational User Inputs", filed Dec. 13, 2006.

U.S. Appl. No. 11/610,384, entitled "Method and Apparatus for Use of Rotational User Inputs", filed Dec. 13, 2006.

"Alps Electric introduces the GlidePoint Wave Keyboard; combines a gently curved design with Alps' advanced GlidePoint Technology", Business Wire (Oct. 21, 1996).

Alps Electric Ships GlidePoint Keyboard for the Macintosh; Includes a GlidePoint Touchpad, Erase-Eaze Backspace Key and Countoured Wrist Rest, Business Wire, (Jul. 1, 1996).

"APS show guide to exhibitors", Physics Today, 49(3) (Mar. 1996).

"Design News literature plus", Design News, 51(24) (Dec. 18, 1995).

"Manufactures", Laser Focus World, Buyers Guide '96, 31(12) (Dec. 1995).

"National Design Engineering Show", Design News, 52(5) (Mar. 4, 1996).

"Preview of exhibitor booths at the Philadelphia show", Air Conditioning Heating & News, 200(2) (Jan. 13, 1997).

"Product news", Design News, 53(11) (Jun. 9, 1997).

"Product news", Design News, 53(9) (May 5, 1997).

Bartimo, Jim, "The Portables: Traveling Quickly", Computerworld (Nov. 14, 1983).

Brink et al., "Pumped-up portables", U.S. News & World Report, 116(21) (May 30, 1994).

Brown et al., "Windows on Tablets as a Means of Achieving Virtual Input Devices", Human-Computer Interaction — INTERACT '90 (1990).

Buxton et al., "Issues and Techniques in Touch-Sensitive Tablet Input", Computer Graphics, 19(3), Proceedings of SIGGRAPH '85 (1985).

Chen et al., "A Study in Interactive 3-D Rotation Using 2-D Control Devices", Computer Graphics 22(4) (Aug. 1988).

Evans et al., "Tablet-based Valuators that Provide One, Two, or Three Degrees of Freedom", Computer Graphics 15(3) (Aug. 1981).

Jesitus, John , "Broken promises?", Industry Week/IW, 246(20) (Nov. 3, 1997).

Nass, Richard, "Touchpad input device goes digital to give portable systems a desktop "mouse-like" feel", Electronic Design, 44(18) (Sep. 3, 1996).

Perenson, Melissa, "New & Improved: Touchpad Redux", PC Magazine (Sep. 10, 1996).

Petruzzellis, "Force-Sensing Resistors" Electronics Now, 64(3) (Mar. 1993).

Sony presents "Choice Without Compromise" at IBC '97 M2 PRESSWIRE (Jul. 24, 1997).

Spiwak, Marc, "A Great New Wireless Keyboard", Popular Electronics, 14(12) (Dec. 1997).

Spiwak, Marc, "A Pair of Unusual Controllers", Popular Electronics 14(4) (Apr. 1997).

Tessler, Franklin, "Point Pad", Macworld 12(10) (Oct. 1995).

Tessler, Franklin, "Smart Input: How to Chose from the New Generation of Innovative Input Devices", Macworld 13(5) (May 1996).

Tessler, Franklin, "Touchpads", Macworld 13(2) (Feb. 1996).

Soderholm, Lars G., "Sensing Systems for 'Touch and Feel'", Design News (May 8, 1989), pp. 72-76.

Baig, E.C., "Your PC Just Might Need a Mouse", U.S. News & World Report 108(22) (Jun. 4, 1990).

Mims, Forrest M., III, "A Few Quick Pointers; Mouses, Touch Screens, Touch Pads, Light Pads, and The Like Can Make Your System Easier to Use", Computers & Electronics (22) (May 1984).

Petersen, Marty, "Koala Pad Touch Tablet & Micro Illustrator Software", InfoWorld (Oct. 10, 1983).

"Triax Custom Controllers due; Video Game Controllers", HFD-The Weekly Home Furnishing Newspaper, (67)(1) (Jan. 4, 1993).

Kobayashi (1996) "Design of Dynamic Soundscape: Mapping Time to Space for Audio Browsing with Simultaneous Listening," Thesis submitted to Program in Media Arts and Sciences at the Massachusetts Institute of Technology, (58 pages).
Kobayashi et al. (1997) "Dynamic Soundscape: Mapping Time to Space for Audio Browsing," Computer Human Interaction, pp. 194-201.
Kobayashi et al. "Development of the Touch Switches with the Click Response," Koukuu Denshi Gihou No. 17: pp. 44-48 (1994-3) (published by the Japan Aviation Electronics Industry, Ltd.); Translation of Summary.

* cited by examiner

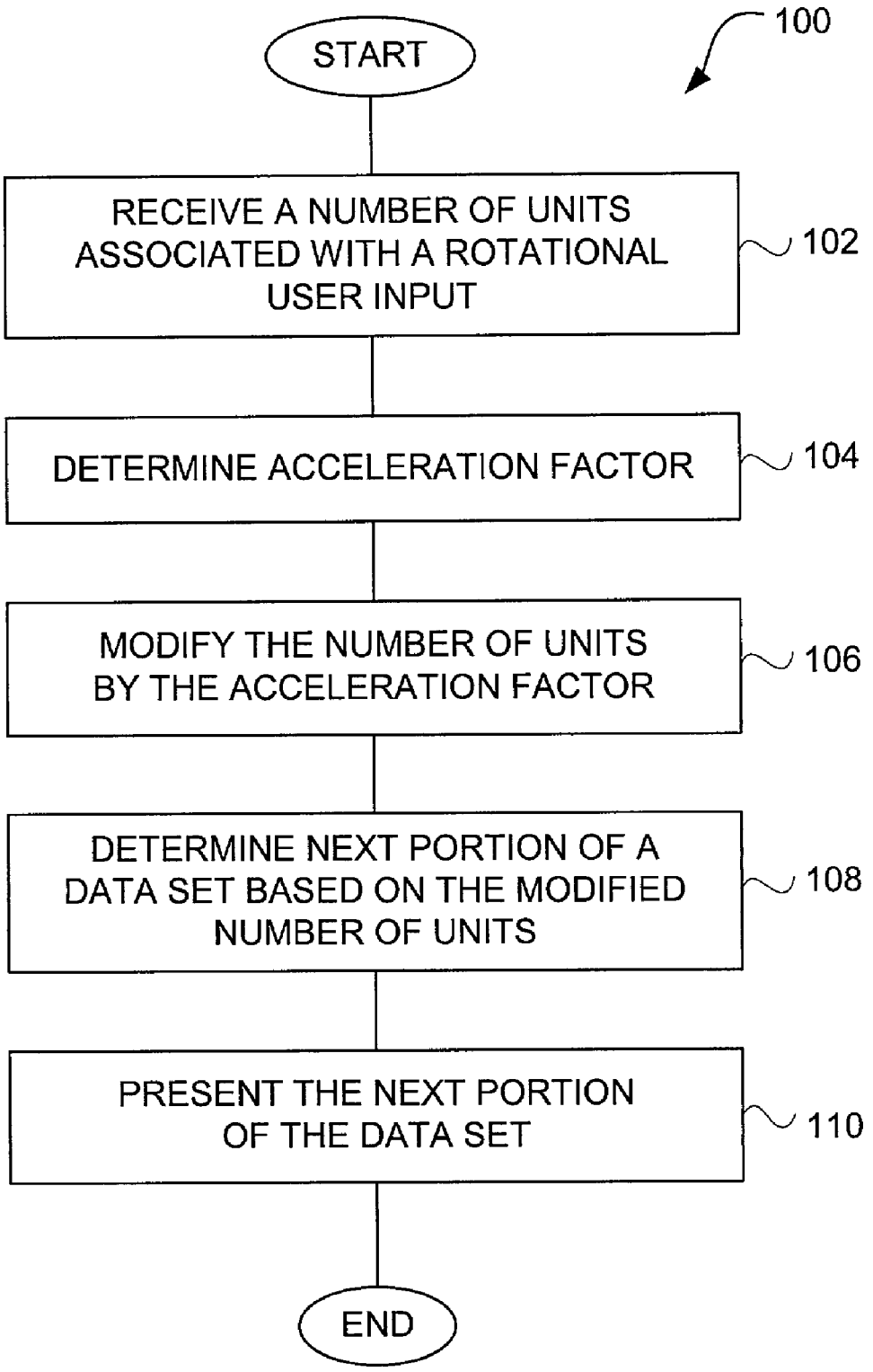

100
START
RECEIVE A NUMBER OF UNITS ASSOCIATED WITH A ROTATIONAL USER INPUT
102
DETERMINE ACCELERATION FACTOR
104
MODIFY THE NUMBER OF UNITS BY THE ACCELERATION FACTOR
106
DETERMINE NEXT PORTION OF A DATA SET BASED ON THE MODIFIED NUMBER OF UNITS
108
PRESENT THE NEXT PORTION OF THE DATA SET
110
END

FIG. 1

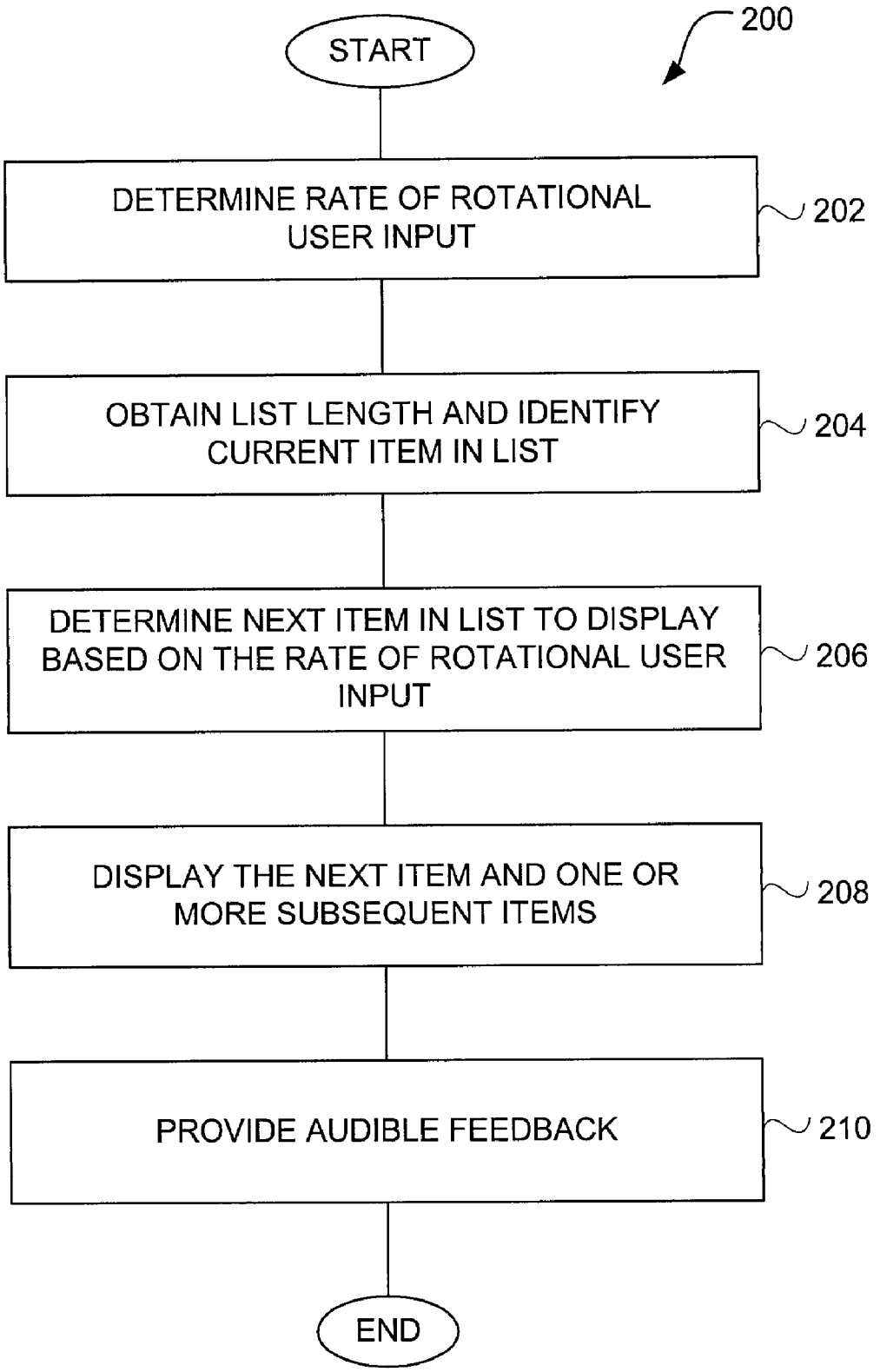

200
START
DETERMINE RATE OF ROTATIONAL USER INPUT
202
OBTAIN LIST LENGTH AND IDENTIFY CURRENT ITEM IN LIST
204
DETERMINE NEXT ITEM IN LIST TO DISPLAY BASED ON THE RATE OF ROTATIONAL USER INPUT
206
DISPLAY THE NEXT ITEM AND ONE OR MORE SUBSEQUENT ITEMS
208
PROVIDE AUDIBLE FEEDBACK
210
END

FIG. 2

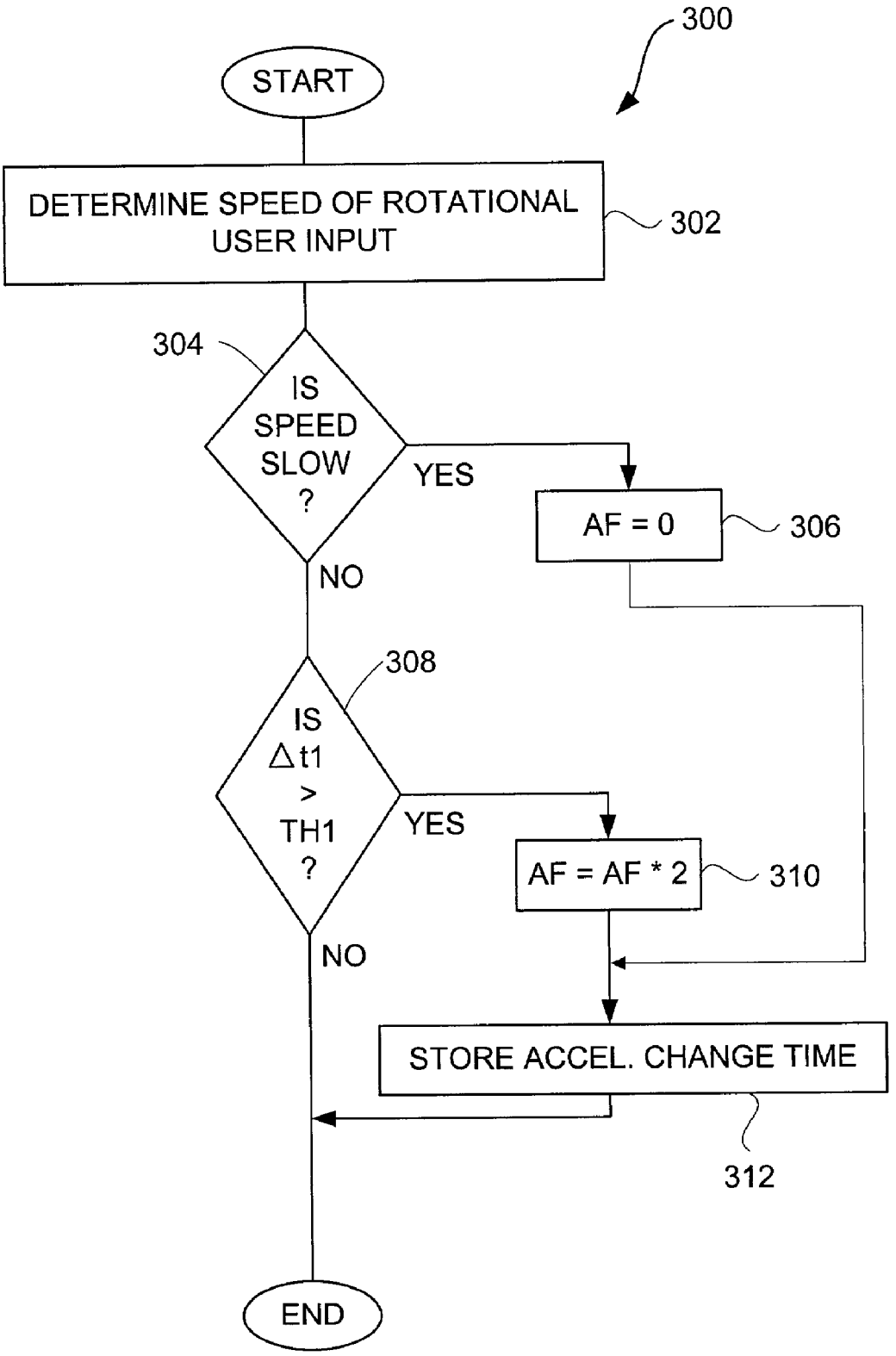

300
START
DETERMINE SPEED OF ROTATIONAL USER INPUT
302
304
IS SPEED SLOW ?
YES
AF = 0
306
NO
308
IS Δt1 > TH1 ?
YES
AF = AF * 2
310
NO
STORE ACCEL. CHANGE TIME
312
END

FIG. 3

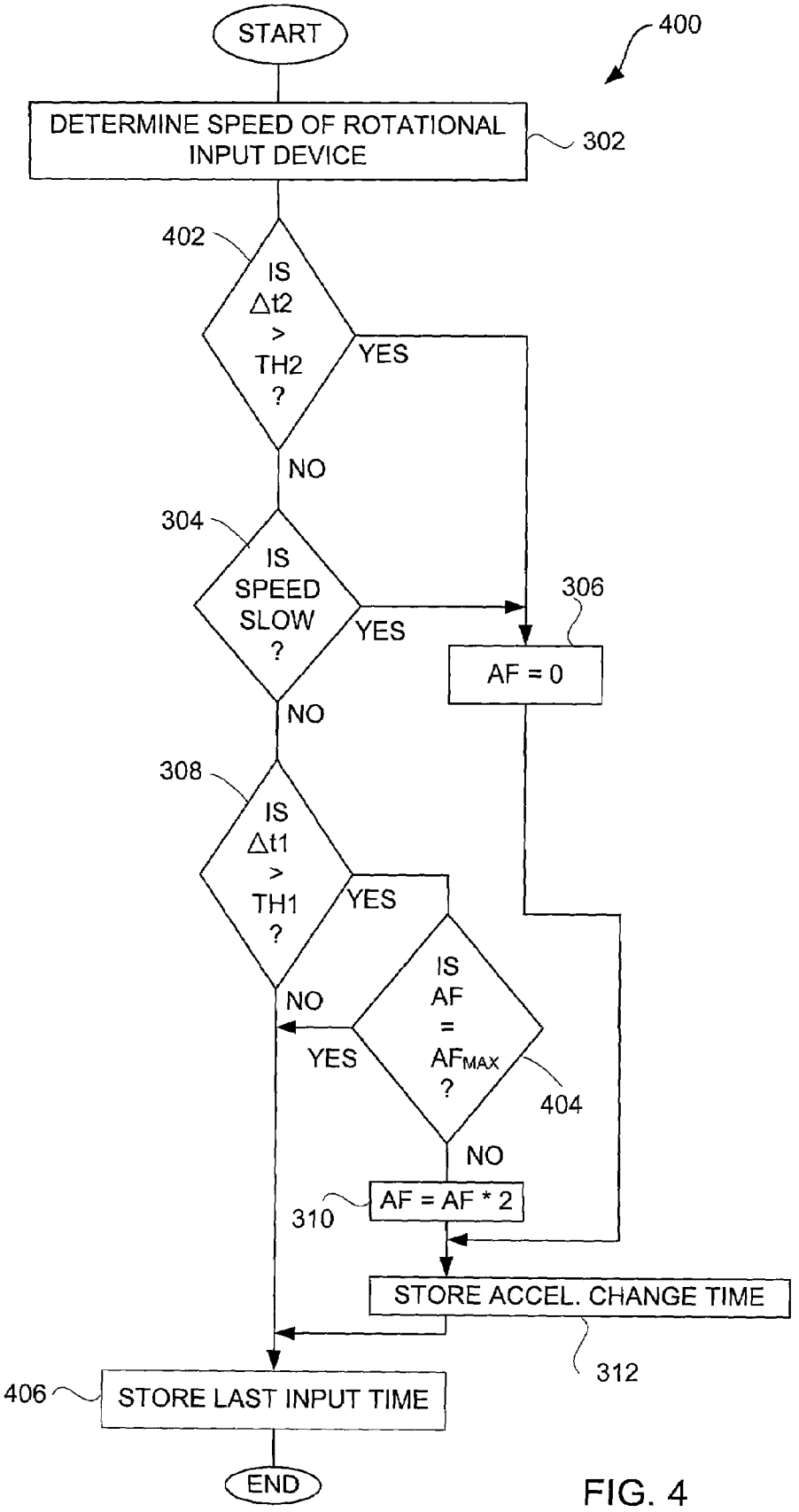

START
400
DETERMINE SPEED OF ROTATIONAL INPUT DEVICE
302
402
IS Δt2 > TH2 ?
YES
NO
304
IS SPEED SLOW ?
YES
306
AF = 0
NO
308
IS Δt1 > TH1 ?
YES
NO
IS AF = AFMAX ?
YES
404
NO
310
AF = AF * 2
STORE ACCEL. CHANGE TIME
312
406
STORE LAST INPUT TIME
END

FIG. 4

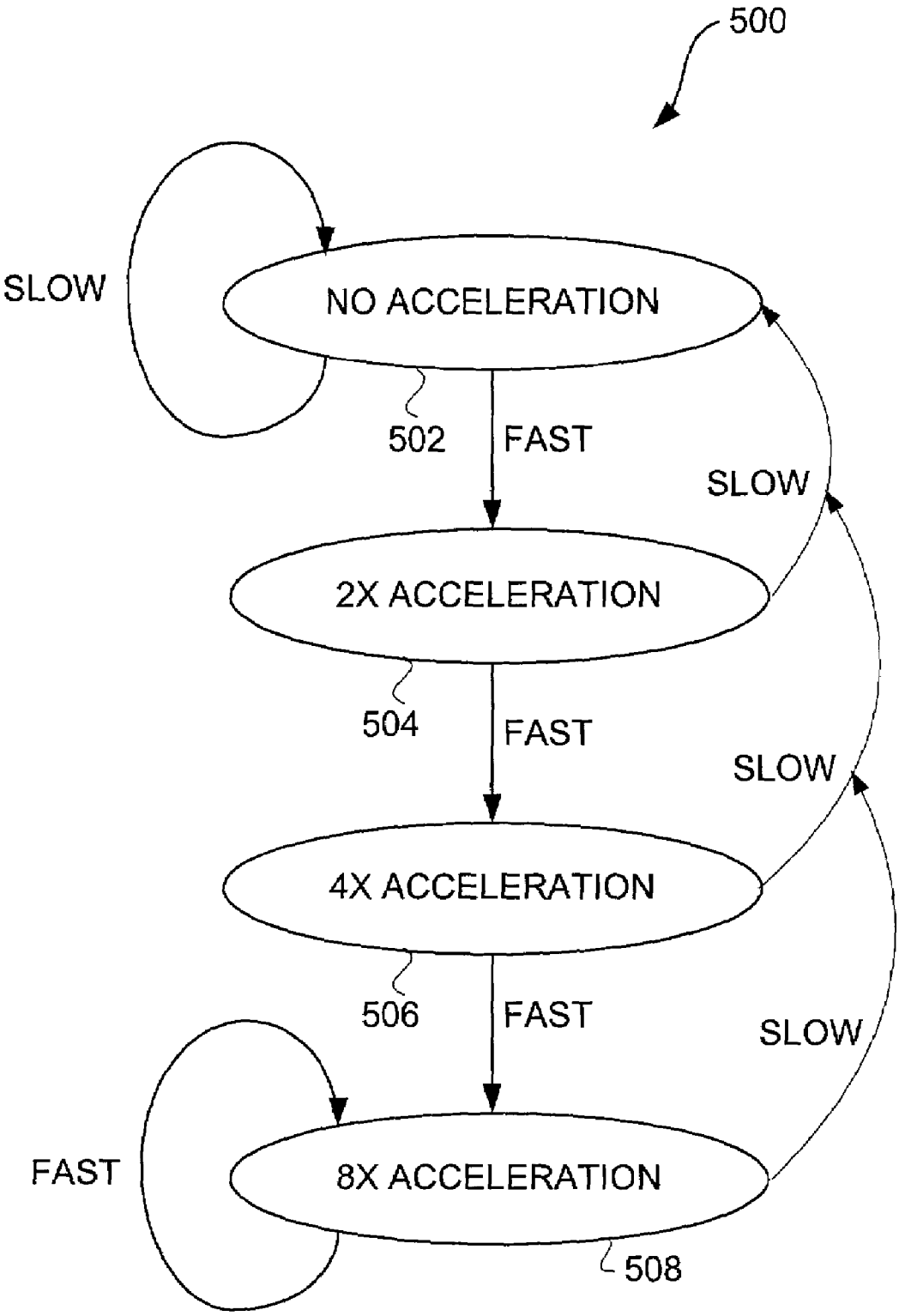

500
SLOW
NO ACCELERATION
502
FAST
SLOW
2X ACCELERATION
504
FAST
SLOW
4X ACCELERATION
506
FAST
SLOW
FAST
8X ACCELERATION
508

FIG. 5

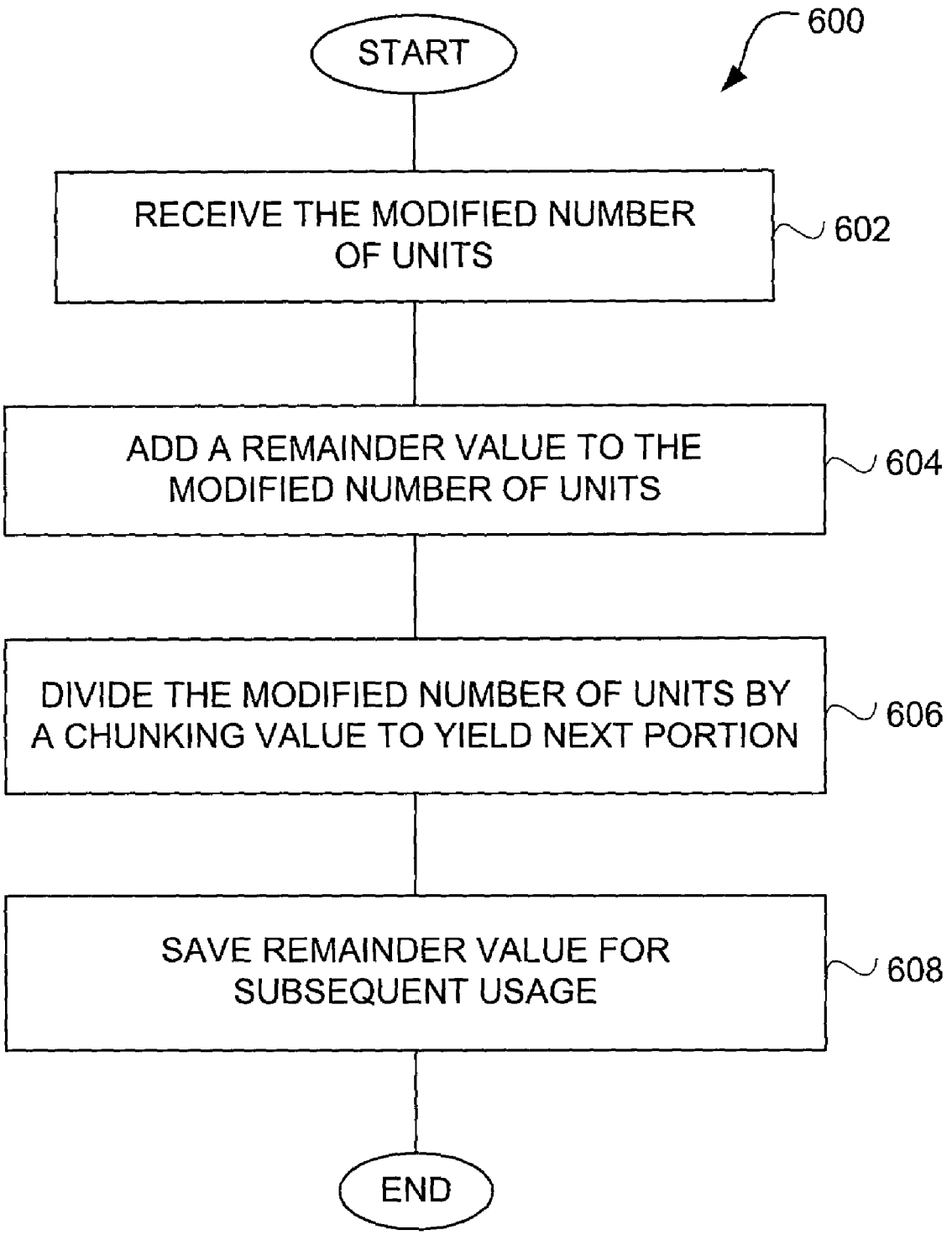

600
START
RECEIVE THE MODIFIED NUMBER OF UNITS
602
ADD A REMAINDER VALUE TO THE MODIFIED NUMBER OF UNITS
604
DIVIDE THE MODIFIED NUMBER OF UNITS BY A CHUNKING VALUE TO YIELD NEXT PORTION
606
SAVE REMAINDER VALUE FOR SUBSEQUENT USAGE
608
END

FIG. 6

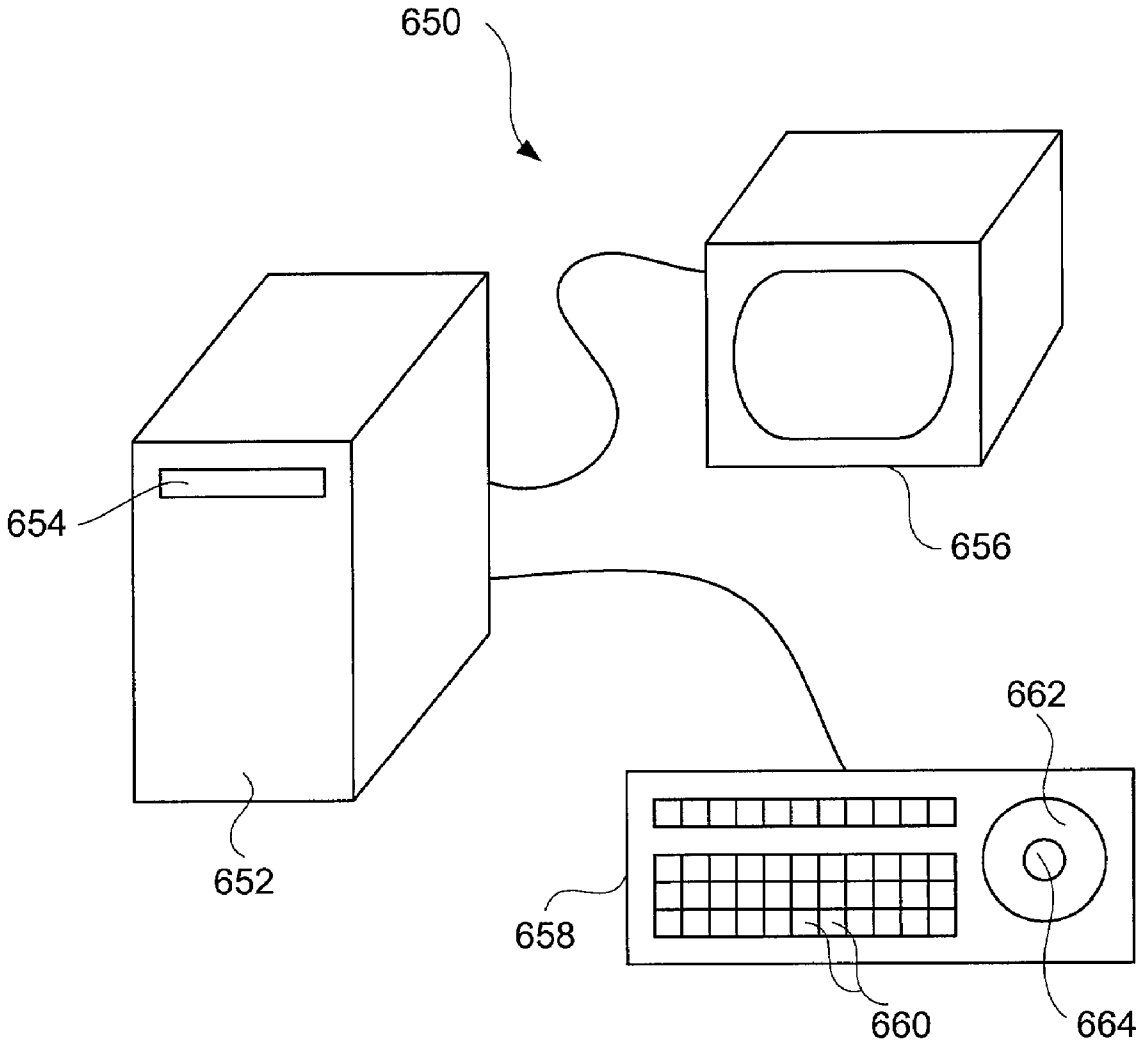


FIG. 7A

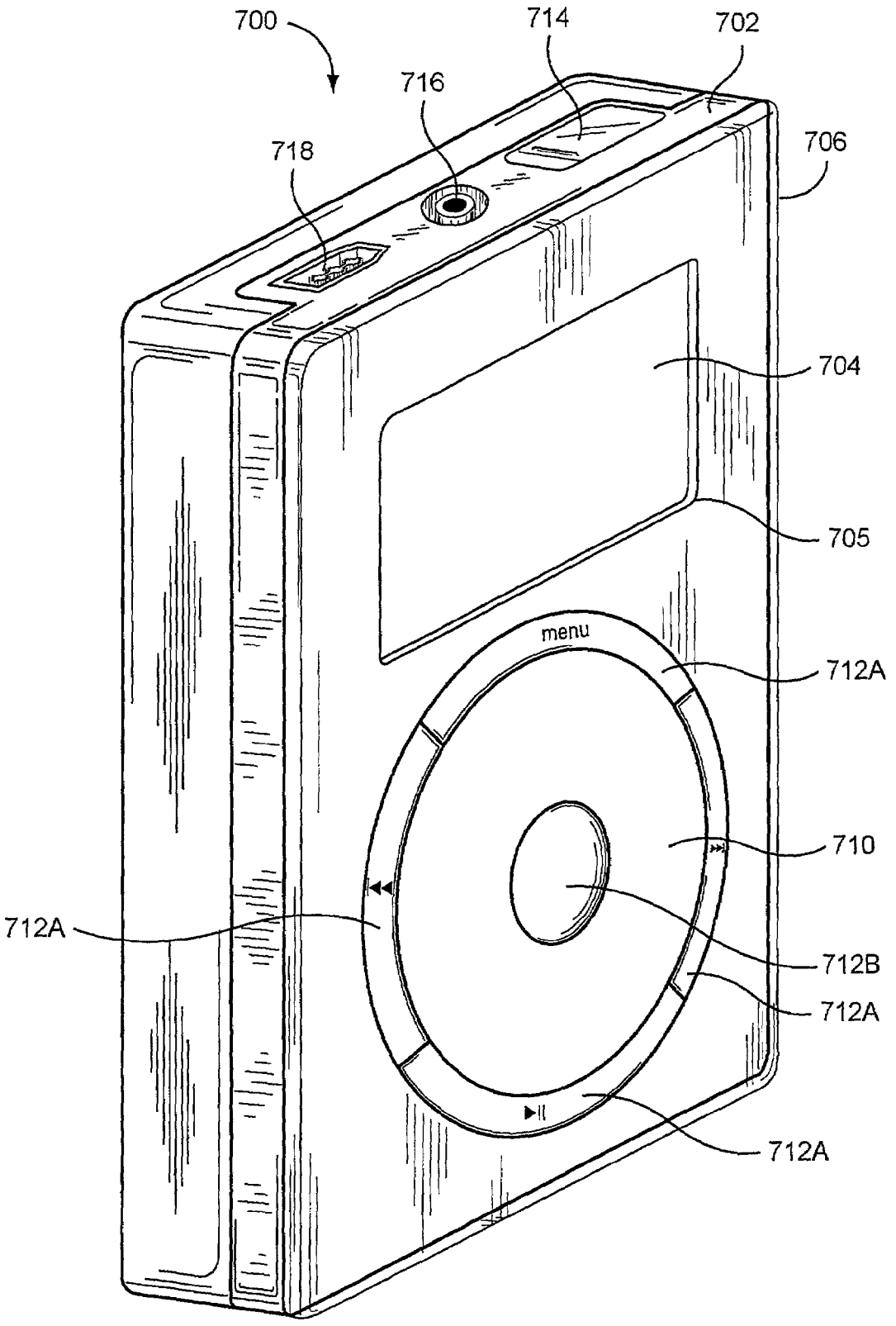

700
714
702
716
718
706
704
705
menu
712A
710
712A
712B
712A
712A

FIG. 7B

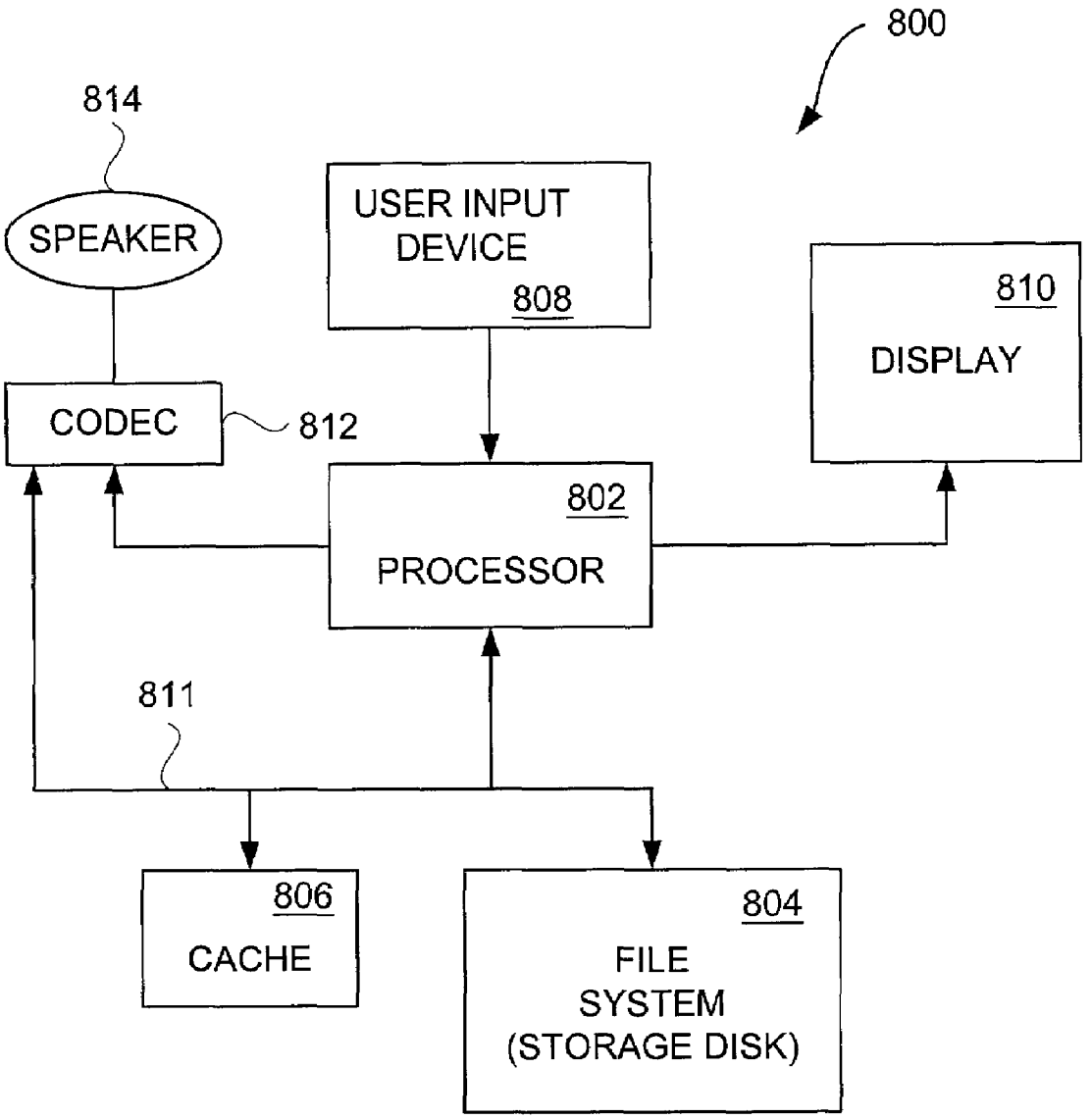

800
814
SPEAKER
USER INPUT DEVICE
808
810
DISPLAY
CODEC
812
802
PROCESSOR
811
806
CACHE
804
FILE SYSTEM (STORAGE DISK)

FIG. 8A

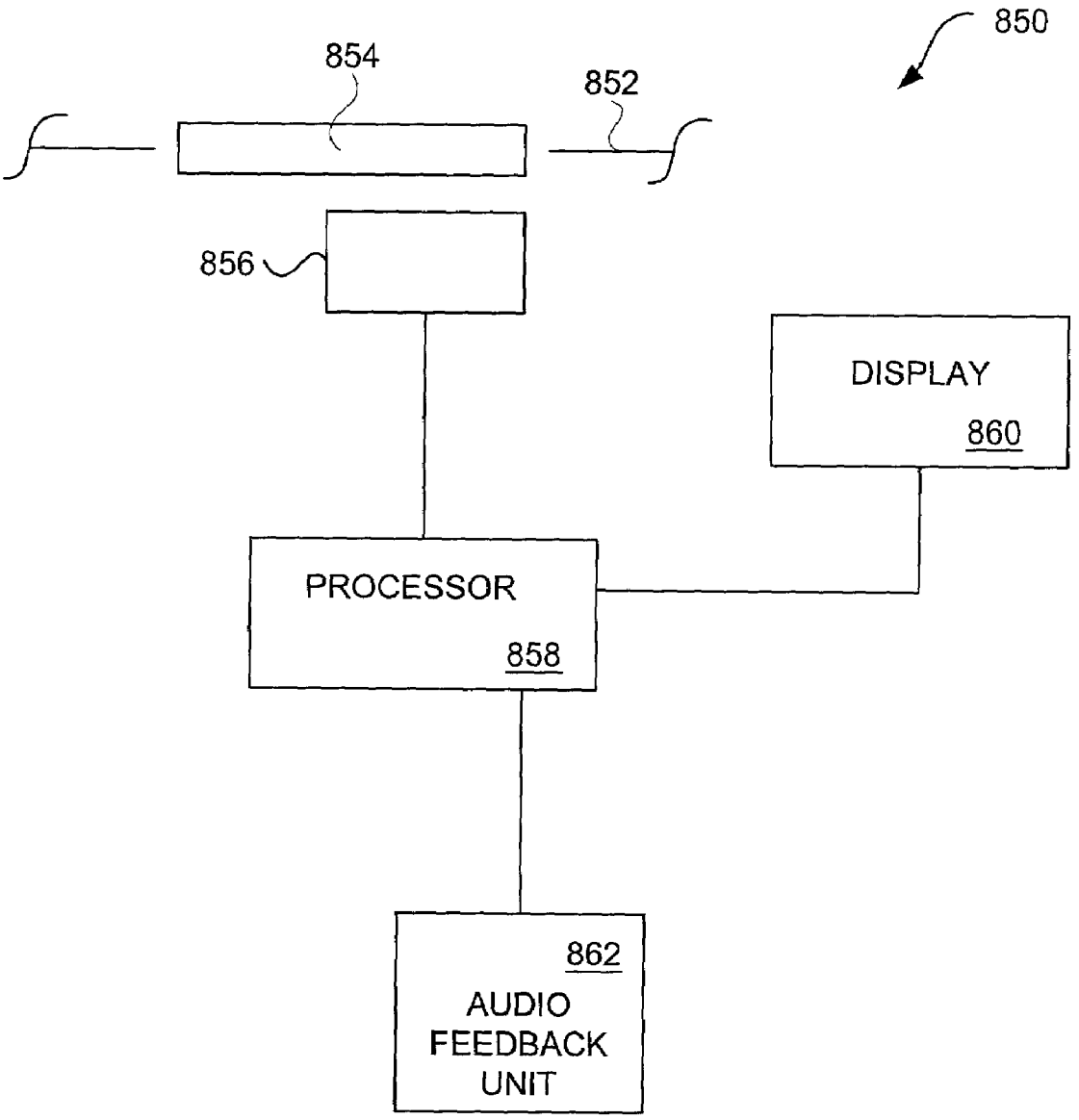

850
854
852
856
DISPLAY
860
PROCESSOR
858
862
AUDIO
FEEDBACK
UNIT

FIG. 8B

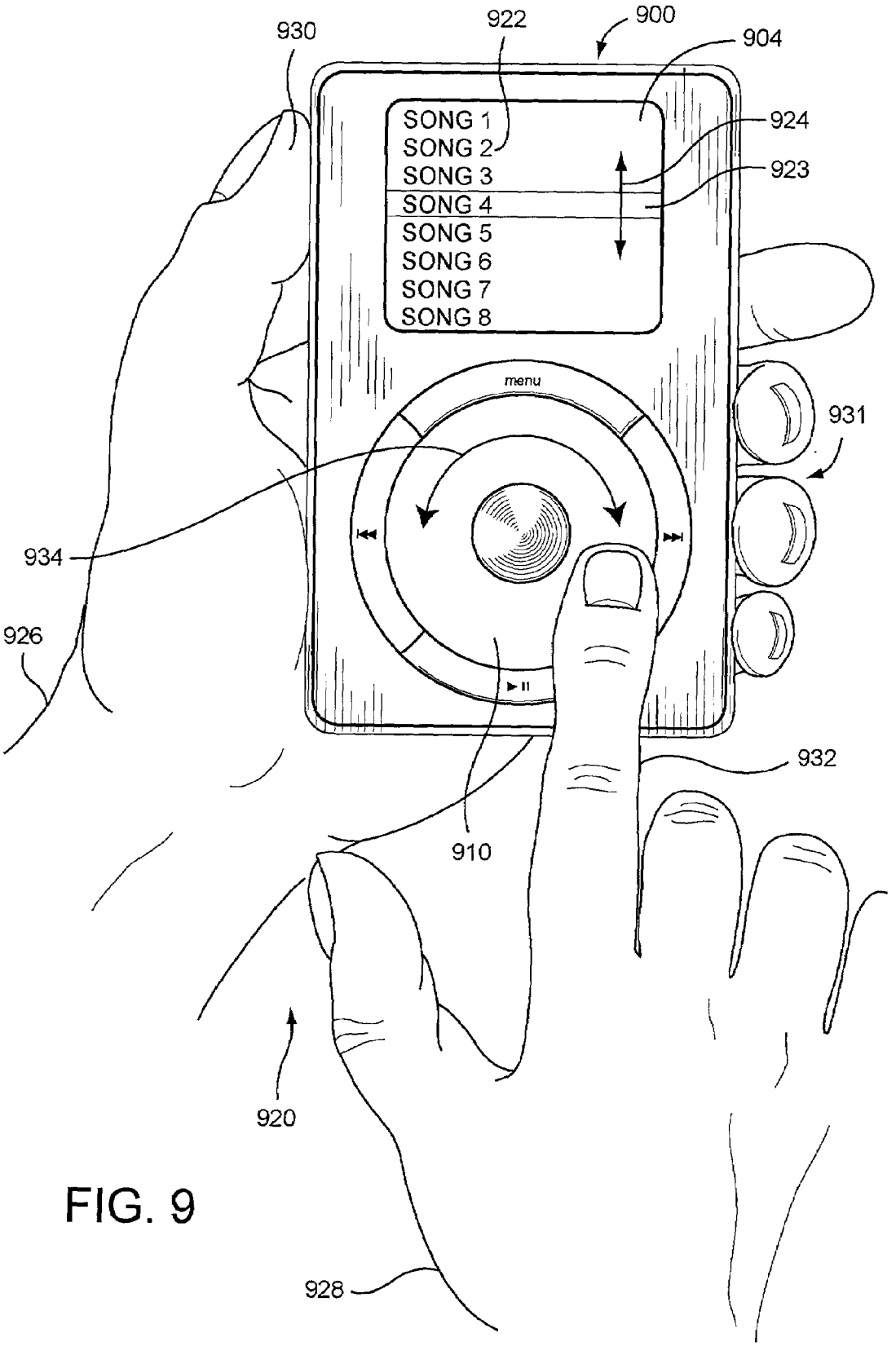

930
922
900
904
924
923
SONG 1
SONG 2
SONG 3
SONG 4
SONG 5
SONG 6
SONG 7
SONG 8
menu
931
934
926
932
910
920
928

FIG. 9

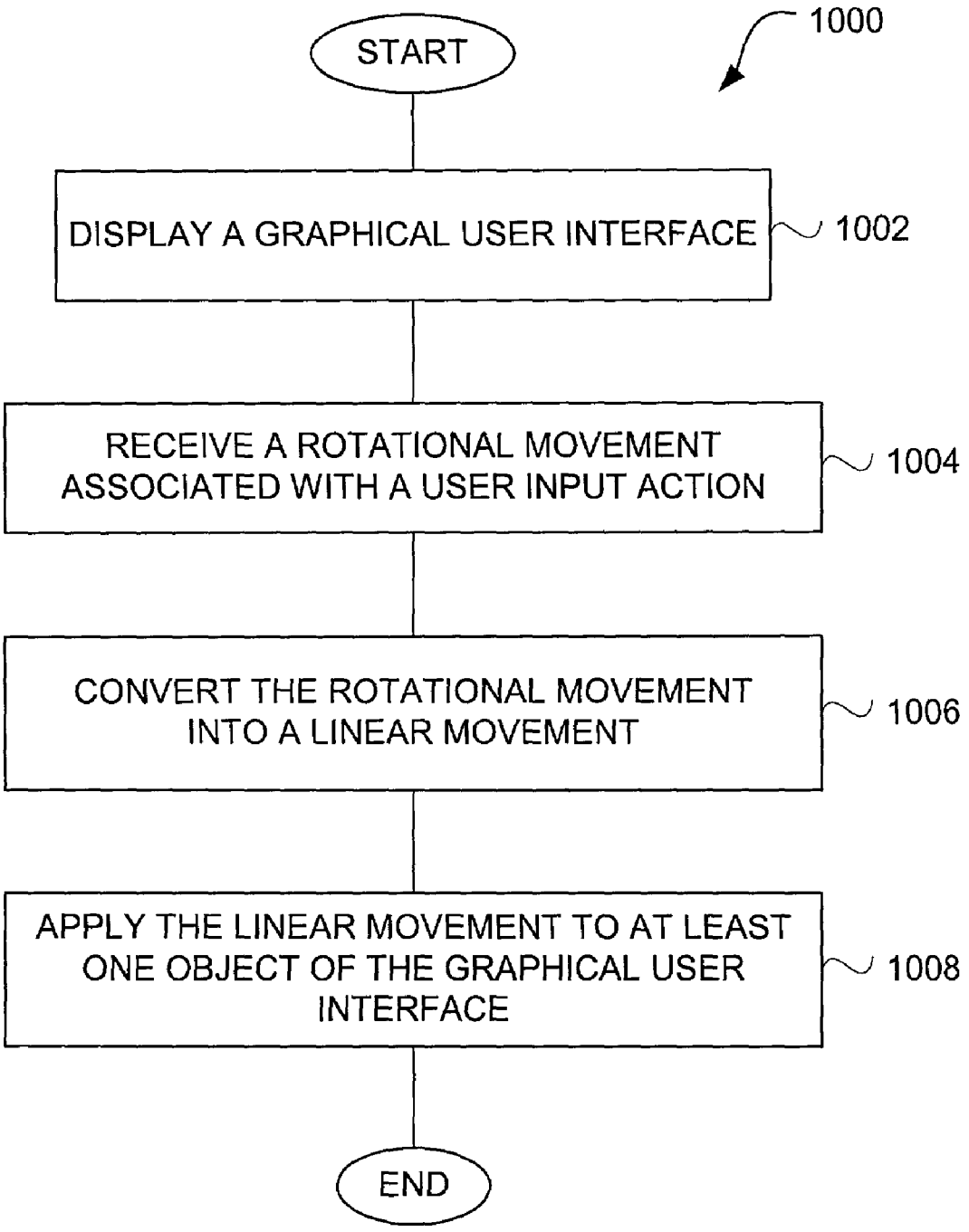

1000
START
DISPLAY A GRAPHICAL USER INTERFACE
1002
RECEIVE A ROTATIONAL MOVEMENT ASSOCIATED WITH A USER INPUT ACTION
1004
CONVERT THE ROTATIONAL MOVEMENT INTO A LINEAR MOVEMENT
1006
APPLY THE LINEAR MOVEMENT TO AT LEAST ONE OBJECT OF THE GRAPHICAL USER INTERFACE
1008
END

FIG. 10A

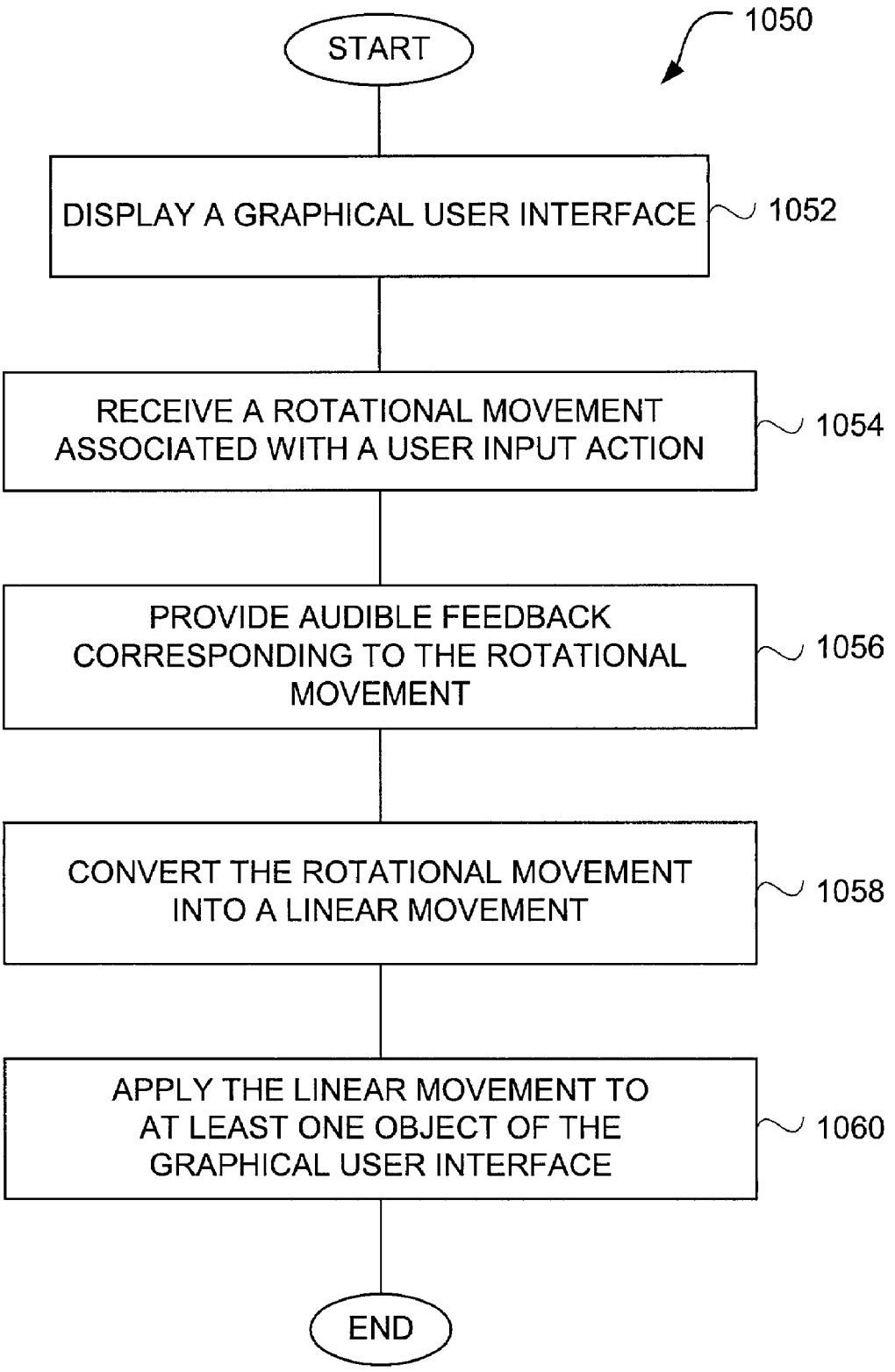

START
1050
DISPLAY A GRAPHICAL USER INTERFACE
1052
RECEIVE A ROTATIONAL MOVEMENT ASSOCIATED WITH A USER INPUT ACTION
1054
PROVIDE AUDIBLE FEEDBACK CORRESPONDING TO THE ROTATIONAL MOVEMENT
1056
CONVERT THE ROTATIONAL MOVEMENT INTO A LINEAR MOVEMENT
1058
APPLY THE LINEAR MOVEMENT TO AT LEAST ONE OBJECT OF THE GRAPHICAL USER INTERFACE
1060
END

FIG. 10B

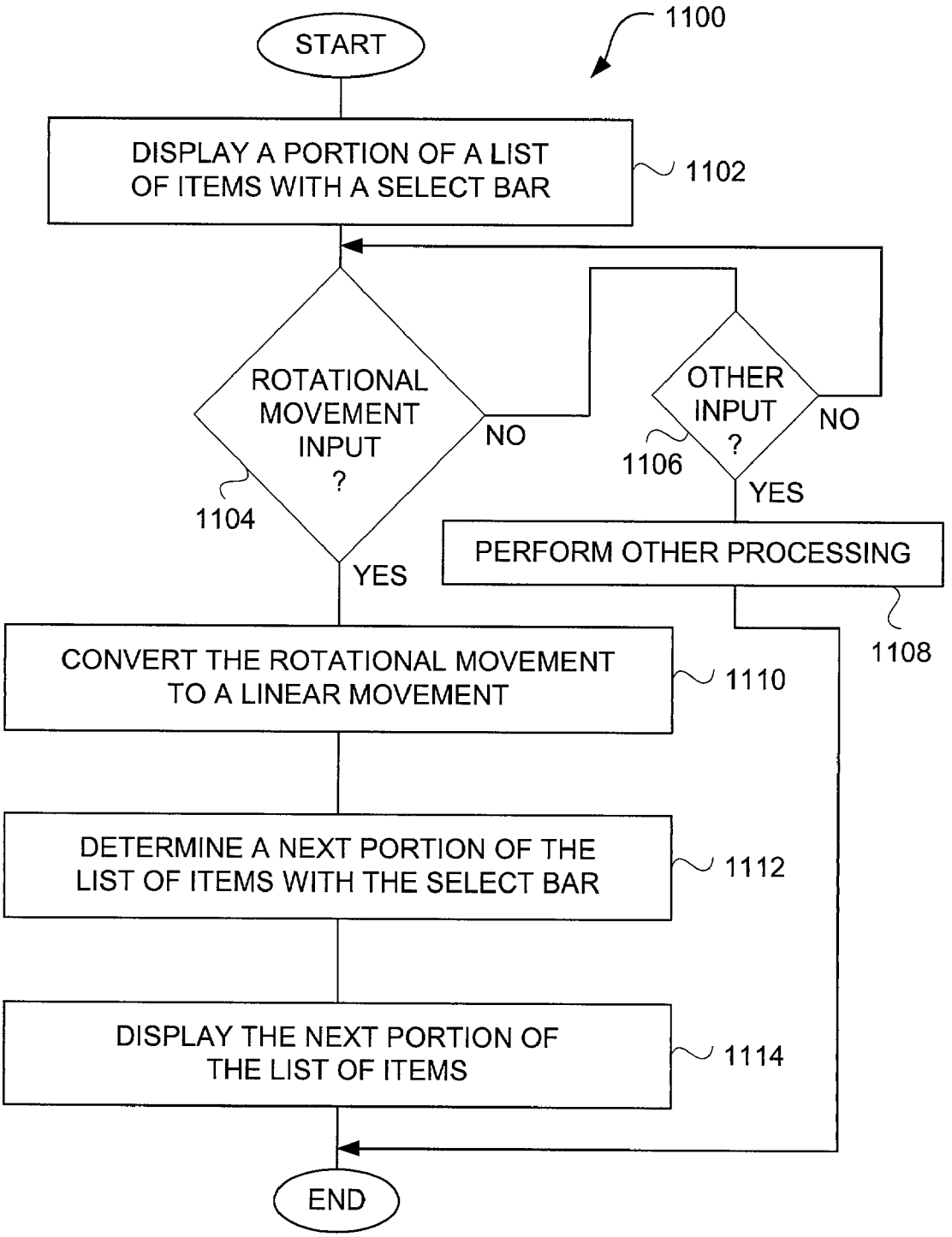

1100
START
DISPLAY A PORTION OF A LIST OF ITEMS WITH A SELECT BAR
1102
ROTATIONAL MOVEMENT INPUT ?
1104
NO
OTHER INPUT ?
1106
NO
YES
PERFORM OTHER PROCESSING
1108
YES
CONVERT THE ROTATIONAL MOVEMENT TO A LINEAR MOVEMENT
1110
DETERMINE A NEXT PORTION OF THE LIST OF ITEMS WITH THE SELECT BAR
1112
DISPLAY THE NEXT PORTION OF THE LIST OF ITEMS
1114
END

FIG. 11

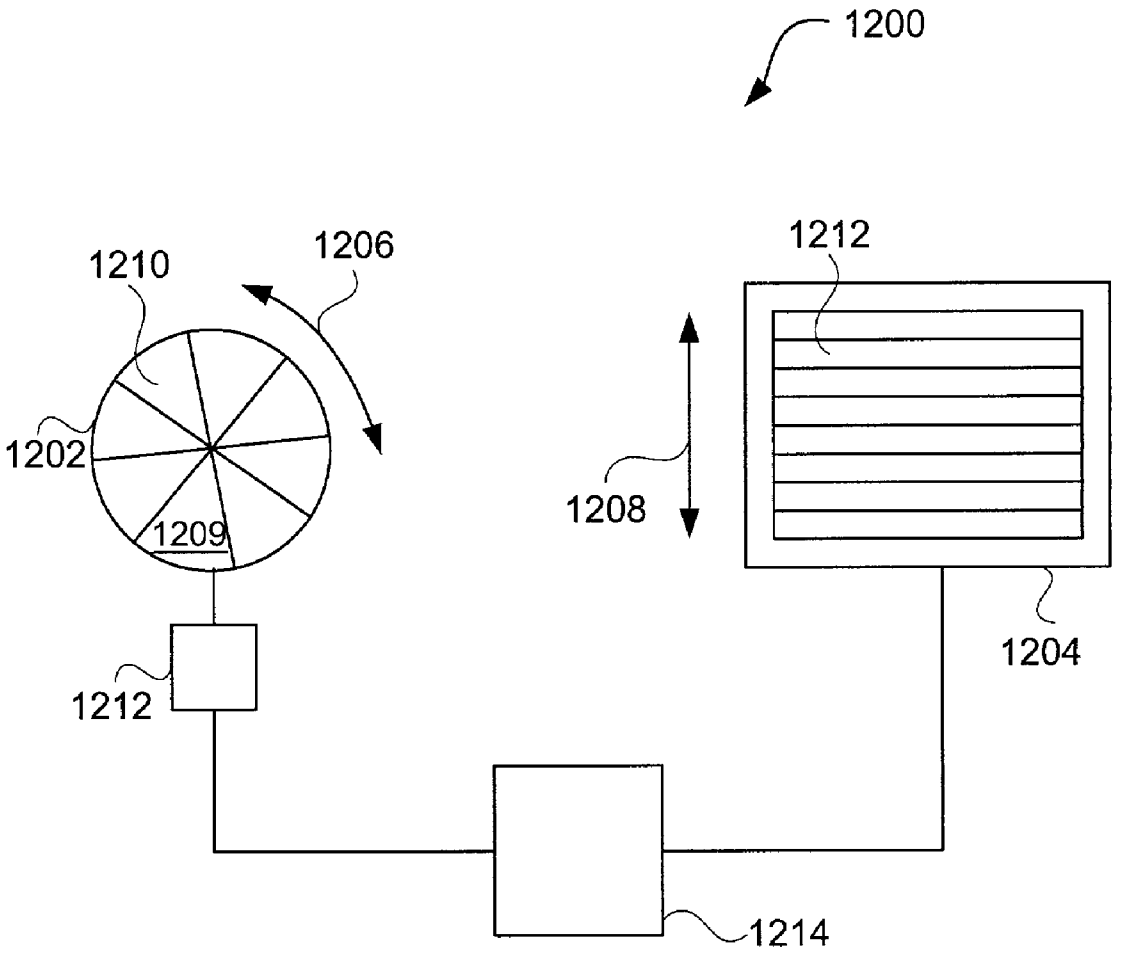


FIG. 12

METHOD AND APPARATUS FOR ACCELERATED SCROLLING

CROSS-REFERENCE TO RELATED APPLICATIONS

This application claims benefit of priority from U.S. Provisional Patent Application No. 60/346,237, filed Oct. 22, 2001, and entitled "METHOD AND SYSTEM FOR LIST SCROLLING," which is hereby incorporated by reference herein. Further, this application claims benefit of priority from U.S. Provisional Patent Application No. 60/387,692, filed Jun. 10, 2002, and entitled "METHOD AND APPARATUS FOR USE OF ROTATIONAL USER INPUTS," which is hereby incorporated by reference herein. Still further, this application claims benefit of priority from U.S. Provisional Patent Application No. 60/359,551, filed Feb. 25, 2002, and entitled "TOUCH PAD FOR HANDHELD DEVICE," which is hereby incorporated by reference herein.

This application is related to U.S. patent application Ser. No. 10/072,765, filed Feb. 7, 2002, and entitled "MOUSE HAVING A ROTARY DIAL," which is hereby incorporated by reference herein. This application is also related to U.S. patent application Ser. No. 10/188,182, filed Jul. 1, 2002, and entitled "TOUCH PAD FOR HANDHELD DEVICE," which is incorporated by reference herein.

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention relates generally to a computing device and, more particularly, to a handheld computing device having a rotational input unit.

2. Description of the Related Art

There exist today many styles of input devices for performing operations with respect to a consumer electronic device. The operations generally correspond to moving a cursor and making selections on a display screen. By way of example, the input devices may include 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 consideration when designing the consumer electronic device. In handheld computing devices, the input devices are typically buttons and switches. Buttons and switches are generally mechanical in nature and provide limited control with regard to the movement of a cursor (or other selector) and the making of 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 the case of handheld personal digital assistants (PDAs), the input devices tend to utilize touch-sensitive display screens. When using a touch screen, a user makes a selection on the display screen by pointing directly to objects on the screen using a stylus or finger.

In portable computing devices such as laptop computers, the input devices are commonly touch pads. With a touch pad, the movement of an input pointer (i.e., cursor) corresponds to the relative movements of the user's finger (or stylus) as the finger is moved along a surface of the touch pad. Touch pads can also make a selection on the display screen 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 stationary devices such as desktop computers, the input devices are generally selected from keyboards, mice and trackballs. With a mouse, the movement of the input pointer corresponds to the relative movements of the mouse as the user moves the mouse along a surface. With a trackball, the movement of the input pointer corresponds to the relative movements of a ball as the user rotates the ball within a housing. Both mice and trackball devices generally include one or more buttons for making selections on the display screen.

In addition to allowing input pointer movements and selections with respect to a Graphical User Interface (GUI) presented on a display screen, the input devices may also allow a user to scroll across the display screen in the horizontal or vertical directions. For example, a mouse may include a scroll wheel that allows a user to simply roll the scroll wheel forward or backward to perform a scrolling action. In addition, touch pads may provide dedicated active areas that implement scrolling when the user passes his or her finger linearly across the active area in the x and y directions. Both devices may also implement scrolling via horizontal and vertical scroll bars that are displayed as part of the GUI. Using this technique, scrolling is implemented by positioning the input pointer over the desired scroll bar, selecting the desired scroll bar, and moving the scroll bar by moving the mouse or finger in the y direction (forwards and backwards) for vertical scrolling or in the x direction (left and right) for horizontal scrolling.

Further, consumer electronic products other than computers, such as cordless telephones, stereo receivers and compact-disc (CD) players, have used dials to enable users to select a phone number, a radio frequency and a specific CD, respectively. Here, typically, a limited-resolution display is used together with the dial. The display, at best, displays only a single item (number, frequency or label) in a low resolution manner using a character generator LCD. In other words, these devices have used single line, low resolution LCD readouts.

Thus, there is always a need for improved user input devices that facilitate greater ease of use of computing devices.

SUMMARY OF THE INVENTION

The present invention relates to improved approaches for users of computing devices to interact with graphical user interfaces. A rotational user action supplied by a user via a user input device can provide accelerated scrolling. The accelerated nature of the scrolling enables users to scroll or traverse a lengthy data set (e.g., list of items) faster and with greater ease. The amount of acceleration provided can be performed in successive stages, and/or performed based on the speed of the rotational user action. In one embodiment, the rotational user action is transformed into linear action with respect to a graphical user interface. The resulting acceleration effect causes the linear action to be enhanced such that a lengthy data set is able to be rapidly traversed. Other aspects and features of the invention will become apparent below. Although the type of computing device can vary, the invention is particularly well-suited for use with a media player.

The invention can be implemented in numerous ways, including as a method, system, device, apparatus, graphical user interface, or computer readable medium. Several embodiments of the invention are discussed below.

As a method for scrolling through portions of a data set, one embodiment of the invention includes at least the acts of: receiving a number of units associated with a rotational user input; determining an acceleration factor pertaining to

the rotational user input; modifying the number of units by the acceleration factor; determining a next portion of the data set based on the modified number of units; and presenting the next portion of the data set.

As a method for scrolling through portions of a data set associated with a handheld electronics device, one embodiment of the invention includes at least the acts of: receiving a rotational user input; determining an acceleration value pertaining to the rotational user input; and scrolling to a next portion of the data set based on at least the acceleration value. The acceleration value specifies a degree of acceleration associated with the rate at which the scrolling through the portions of the data set is to be achieved.

As a method for scrolling through portions of a data set associated with a handheld electronics device, another embodiment of the invention includes at least the acts of: receiving a rotational user input; determining whether or not to provide acceleration with respect to the rotational user input; and scrolling to a next portion of the data set in either an accelerated manner when the determining determines that acceleration is to be provided, or in an unaccelerated manner when the determining determines that acceleration is not to be provided.

As a method for scrolling through portions of a file, one embodiment of the invention includes at least the acts of: receiving a number of units from a rotational input device; determining a speed of rotation for the rotational input device; applying acceleration when the speed of rotation is greater than a speed threshold; removing any acceleration being applied when the speed of rotation is less then the speed threshold; modifying the number of units in accordance with the acceleration, if any; determining a next portion of the file based on the modified number of units; and presenting the next portion of the file.

As a portable media player, one embodiment of the invention includes at least: a storage disk drive that stores media content for each of a plurality of media items; a display screen that displays a portion of the media items at a time; a user input device that enables a user of the portable media player to at least scroll through the plurality of media items using a rotational action with respect to the user input device; and a processor that determines a rate of scrolling and thus determines a next portion of the media items to be displayed

As a method for displaying a portion of a list of media items on a display of a media player, the media player having a rotational input device, one embodiment of the invention includes at least the acts of: determining a rate of turn of the rotational input device; obtaining a length of the list of media items; determining a next portion of the list of media items to be displayed based on the rate of the turn of the rotational input device and the length of the list of media items; and displaying the next portion of the list of media items.

As a method for displaying a portion of a list of items on a display of a computing device, the computing device having a rotational input device, one embodiment of the invention includes at least the acts of: determining an indication of turning of the rotational input device; determining a next portion of the list of items to be displayed based on the indication of turning of the rotational input device; and displaying the next portion of the list of items.

As a consumer electronics product, one embodiment of the invention includes at least: a storage disk that stores a plurality of media items; a display for displaying a first portion of the plurality of media items; and a user input device that enables a user of the consumer electronics product to at least scroll through a list of the plurality of media items in accordance with a user-controlled scroll rate; and a processor. The processor determines an acceleration factor for use in scrolling through the list of the plurality of media items and causes the consumer electronics product to display a second portion of the plurality of media items. The location of second portion of the plurality of media items within the list of the plurality of media items is dependent on at least the user-controlled scroll rate and the acceleration factor.

Other aspects and advantages of the invention will become apparent from the following detailed description, taken in conjunction with the accompanying drawings, illustrating by way of example the principles of the invention.

BRIEF DESCRIPTION OF THE DRAWINGS

The present invention is illustrated by way of example, and not by way of limitation, in the figures of the accompanying drawings and in which like reference numerals refer to similar elements and in which:

FIG. **1** is a flow diagram of scroll processing according to one embodiment of the invention.

FIG. **2** is a flow diagram of list navigation processing according to another embodiment of the invention.

FIG. **3** is a flow diagram of acceleration amount processing according to one embodiment of the invention.

FIG. **4** is a flow diagram of acceleration amount processing according to another embodiment of the invention.

FIG. **5** is a representative acceleration state machine according to one embodiment of the invention.

FIG. **6** is a flow diagram of next portion determination processing according to one embodiment of the invention.

FIG. **7**A is a perspective diagram of a computer system in accordance with one embodiment of the invention.

FIG. **7**B is a perspective diagram of a media player in accordance with one embodiment of the present invention.

FIG. **8**A is a block diagram of a media player according to one embodiment of the invention.

FIG. **8**B is a block diagram of a computing system according to one embodiment of the invention.

FIG. **9** shows the media player of FIG. **7**B being used by a user in accordance with one embodiment of the invention.

FIG. **10**A is a flow diagram of user input processing according to one embodiment of the invention.

FIG. **10**B is a flow diagram of user input processing according to another embodiment of the invention.

FIG. **11** is a flow diagram of user input processing according to another embodiment of the invention.

FIG. **12** is a block diagram of a rotary input display system in accordance with one embodiment of the invention.

DETAILED DESCRIPTION OF THE INVENTION

The present invention relates to improved approaches for users of computing devices to interact with graphical user interfaces. A rotational user action supplied by a user via a user input device can provide accelerated scrolling. The accelerated nature of the scrolling enables users to scroll or traverse a lengthy data set (e.g., list of items) faster and with greater ease. The amount of acceleration provided can be performed in successive stages, and/or performed based on the speed of the rotational user action. In one embodiment, the rotational user action is transformed into linear action with respect to a graphical user interface. The resulting

acceleration effect causes the linear action to be enhanced such that a lengthy data set is able to be rapidly traversed. Other aspects and features of the invention will become apparent below. Although the type of computing device can vary, the invention is particularly well-suited for use with a media player.

Embodiments of the invention are discussed below with reference to FIGS. **1**–**12**. However, those skilled in the art will readily appreciate that the detailed description given herein with respect to these figures is for explanatory purposes as the invention extends beyond these limited embodiments.

FIG. **1** is a flow diagram of scroll processing **100** according to one embodiment of the invention. The scroll processing **100** assists a user in scrolling through a data set. The scroll processing **100** initially receives **102** a number of units associated with a rotational user input. The number of units is an indication of an amount of rotational movement a user has invoked with respect to a rotational input device.

Next, an acceleration factor is determined **104**. The acceleration factor is an indication of the degree of acceleration to be utilized with the scroll processing **100**. After the acceleration factor is determined **104**, the number of units that are associated with the rotational user input is modified **106** by the acceleration factor. In one embodiment, the number of units is modified by multiplication with the acceleration factor. In various other embodiments, the number of units can be modified in various other ways.

After the number of units has been modified **106**, a next portion of the data set that is being scrolled through can be determined **108** based on the modified number of units. Once the next portion has been determined **108**, the next portion of the data set can be presented **110**. Typically, the next portion of the data set associated with the scroll processing **100** is presented **110** to the user that caused the rotational user input. In one embodiment, the next portion of the data set can be presented **110** to the user by displaying the next portion of the data set on a display device. In another embodiment of the invention, the next portion of the data set can be presented **110** to the user by displaying the next portion of the data set with at least one item distinctively or distinguishly displayed (e.g., highlighted) from the other items. In still another embodiment, the next portion of the data set can be presented **110** to the user by playing or executing a file. After the next portion of the data set has been presented **110**, the scroll processing **100** is complete and ends. However, the scroll processing **100** will repeat for each rotational user input.

Here, the faster the rate of rotational user input, the further down a list the next item becomes. It should be noted that the rate of rotational user input can be relative or absolute in nature. Still further, the rate of rotational user input need not be an actual velocity value, but could be a count or other value that is proportional to or influenced by the rate of rotational user input.

A data set as used herein pertains to a set of data. As one example, the data set can be a list of items (e.g., a list of songs). As another example, the data set can be a media file (e.g., MP3 or other audio file, video file, or image file). In one embodiment, the data set can be considered a sequential data set because the data within the set is often sequential. For example, the songs in a list are arranged sequentially and the data within an audio file are also arranged sequentially.

FIG. **2** is a flow diagram of list navigation processing **200** according to another embodiment of the invention. The list navigation processing **200** initially determines **202** a rate of rotational user input (e.g., dial turn). The rotational user input is provided through user interaction with a rotational input device. A list length is then obtained **204** and a current item in the list is identified. Typically, the current item is the item in the list that is being displayed. In one embodiment, the current item is highlighted such that it is distinctively displayed from other items of the list that are simultaneously displayed.

A next item in the list to be displayed is then determined **206** based on the rotational user input. The determination **206** of the next item in the list can also be dependent on the list length and the current item in the list. For example, the greater the rate of the rotational user input, the further apart the next item is from the current item in the list. The rate of the rotational user input and the length of the list can affect whether acceleration (e.g., acceleration factor) is provided for navigating the list. Thereafter, the list navigation processing **200** displays **208** a next item and one or more subsequent (or neighboring) items thereto. For example, the next item and the one or more subsequent items can be displayed **208** by a display screen produced by a display device. Additionally, the list navigation processing **200** can provide **210** an audio feedback. The audio feedback provides an audible sound that indicates feedback to the user as to the rate at which the items in the list are being traversed. The audible feedback can thus also be proportional to the rate of rotational user input.

FIG. **3** is a flow diagram of acceleration amount processing **300** according to one embodiment of the invention. The acceleration amount processing **300** is, for example, processing that can be performed to determine an acceleration factor. In one embodiment, the acceleration amount processing **300** is, for example, suitable for use as the operation **104** illustrated in FIG. **1**. In another embodiment, the acceleration amount processing **300** is, for example, suitable for use as a sub-operation for the operation **206** illustrated in FIG. **2**.

The acceleration amount processing **300** initially determines **302** a speed of a rotational user input. As previously noted with respect to FIG. **1**, the rotational user input is provided by a rotational input device that is interacted with by a user. In one embodiment, the speed of the rotational user input is determined **302** based on the number of rotational units identified by the rotational user input. More particularly, in another embodiment, the speed of the rotational user input is determined **302** based on the number of rotational units and an amount of time over which such rotational inputs were received. The speed of the rotational user input can, for example, be considered to be the speed of a user movement or the speed of rotation of a rotational input device.

After the speed of the rotational user input has been determined **302**, a decision **304** determines whether the speed of the rotational user input is slow. The speed of the rotational user input can be determined or estimated, directly or indirectly, in a variety of ways. In one embodiment, a threshold is used to distinguish between slow and fast speeds of the rotational user input. The precise rate of rotation that is deemed to be the threshold between slow and fast can vary with application. The threshold can be determined experimentally based upon the particular application for which the acceleration amount processing **300** is utilized.

Once the decision **304** determines that the speed of the rotational user input is slow, then the acceleration factor (AF) is set **306** to zero (0). On the other hand, when the decision **304** determines that the speed of the rotational user input is not slow (i.e., the speed is fast), then a decision **308** determines whether an amount of time ($\Delta t1$) since the last

time the acceleration was altered exceeds a first threshold (TH1). When the decision **308** determines that the amount of time ($\Delta t1$) since the last acceleration update is longer than the first threshold amount (TH1), then the acceleration factor is modified **310**. In particular, in this embodiment, the modification **310** causes the acceleration factor to be doubled.

Following the operation **310**, as well as following the operation **306**, an acceleration change time is stored **312**. The acceleration change time reflects the time that the acceleration factor was last updated. The acceleration change time is stored such that the decision **308** understands the amount of time since the acceleration was last modified (i.e., $\Delta t1$). Following the operation **312**, as well as directly following the decision **308** when the amount of time since the last acceleration update was made is less than the first threshold (TH1), the acceleration amount processing **300** is complete and ends.

Hence, according to the acceleration amount processing **300**, when the speed of the rotational user input is deemed slow, the acceleration factor is reset to zero (0), which indicates that no acceleration effect is imposed. On the other hand, when the speed of the rotational user input indicates that the speed of such rotation is fast, then the acceleration effect being imposed is doubled. In effect, then, if the user interacts with the rotational input device such that the speed of rotation is slow, then no acceleration effect is provided. In such case, the user can scroll through a data set (e.g., list, audio file) with high resolution. On the other hand, when the user interacts with the rotational input device with a high speed of rotation, then the acceleration effect is step-wise increased (e.g., via doubling or other means). The acceleration effect provided by the invention enables a user to interact with a rotational input device in an efficient, user-friendly manner such that long or extensive data sets can be scrolled through in a rapid manner.

FIG. **4** is a flow diagram of acceleration amount processing **400** according to another embodiment of the invention. The acceleration amount processing **400** is generally similar to the acceleration amount processing **300** illustrated in FIG. **3**. However, the acceleration amount processing **400** includes additional operations that can be optionally provided. More specifically, the acceleration amount processing **400** can utilize a decision **402** to determine whether a duration of time ($\Delta t2$) since the last rotational user input is greater than a second threshold (TH2). When the decision **402** determines that the duration of time ($\Delta t2$) since the last rotational user input exceeds the second threshold (TH2), then the acceleration factor is reset **306** to zero (0). Here, when the user has not provided a subsequent rotational user input for more than the duration of the second threshold (TH2), then the acceleration amount processing **400** is reset to no acceleration because it assumes that the user is restarting a scrolling operation and thus would not want to continue with a previous accelerated rate of scrolling.

The rate at which the acceleration effect is doubled is restricted such that the doubling (i.e., operation **310**) can only occur at a rate below a maximum rate. The acceleration amount processing **400** also includes a decision **404** that determines whether the acceleration factor (AF) has reached a maximum acceleration factor (AF_{MAX}). The decision **404** can be utilized to limit the maximum acceleration that can be imposed by the acceleration amount processing **400**. For example, the acceleration factor (AF) could be limited to a factor of eight (8), representing that with maximum acceleration scrolling would occur at a rate eight (8) times faster than non-accelerated scrolling.

Still further, the acceleration amount processing **400** stores **406** a last input time. The last input time (t2) represents the time the last rotational user input was received (or processed). Note that the duration of time ($\Delta t2$) can be determined by the difference between a current time associated with an incoming rotational user input and the last input time (t2).

As previously noted, the acceleration amount processing **300**, **400** is, for example, processing that can be performed to determine an acceleration factor. However, although not depicted in FIG. **3** or **4**, when the length of the data set (e.g., list) is short, then the acceleration can be set to zero (i.e., no acceleration) and the acceleration amount processing **300**, **400** can be bypassed. For example, in one embodiment, where the data set is a list, if the display screen can display only five (5) entries at a time, then the list can be deemed short if it does not include more than twenty (20) items. Consequently, according to another embodiment of the invention, the acceleration effect imposed by the invention can be dependent on the length of the data set (e.g., list).

The accelerated scrolling can also be depicted as a state machine having states representing different acceleration levels or different rates of acceleration. The particulars of such a state machine will vary widely with implementation.

FIG. **5** is a representative acceleration state machine **500** according to one embodiment of the invention. The acceleration state machine **500** has four states of acceleration. A first state **502** provides no acceleration. From the first state **502**, when the speed of a next rotational user input is slow, the acceleration state machine **500** remains at the first state **502**. Alternatively, when the speed of the rotational user input is fast, the acceleration state machine **500** transitions from a first state **502** to a second state **504**. The second state **504** provides 2× acceleration, meaning that the resulting rate of scrolling would be twice that of the first state. When the acceleration state machine **500** is at the second state **504**, when the speed of a next rotational user input is slow, the acceleration state machine **500** transitions back to the first state **502**. Alternatively, when the speed of the next rotational user input is fast, the acceleration state machine **500** transitions from the second state **504** to a third state **506**. The third state **506** provides 4× acceleration, meaning that the rate of scrolling would be four times that of the first state **502** or twice that of the second state **504**. At the third state **506**, when the speed of the next rotational user input is slow, the acceleration state machine **500** transitions from the third state **506** to the first state **502**. Alternatively, when the speed of the next rotational user input is fast, the acceleration state machine **500** transitions from the third state **506** to a fourth state **508**. At the fourth state **508**, 8× acceleration is provided, meaning that the acceleration rate of scrolling is eight times that of the first state **502**, four times that of the second state **504**, or twice that of the third state **506**. At the fourth state **508**, when the speed of the next rotational user input is slow, the acceleration state machine **500** transitions from the fourth state **508** to the first state **502**. Alternatively, when the speed of the next rotational user input is fast, the acceleration state machine **500** remains at the fourth state **508**.

FIG. **6** is a flow diagram of next portion determination processing **600** according to one embodiment of the invention. The next portion determination processing **600** is, for example, processing performed by the operation **108** illustrated in FIG. **1**

The next portion determination processing **600** receives **602** the modified number of the units. For example, at operation **106** of FIG. **1**, the number of units was modified **106** by the acceleration factor to determine the modified

number of units. A remainder value is then added **604** to the modified number of units. The remainder value pertains to a previously determined remainder value as discussed below. Next, the modified number of units is divided **606** by a chunking value to view a next portion. The next portion is a subset of the data set that is eventually presented on a display device. For example, the next portion can pertain to one or more items in a list when the data set pertains to a list of items. In another example, the next portion can pertain to a segment or position in a audio file when the data set pertains to an audio file. In any case, the remainder value from the operation **606** is then saved **608** for subsequent usage in computing a subsequent next portion. Following the operation **608**, the next portion determination processing **600** is complete and ends. Although the use of the remainder value is not necessary, the scrolling provided by the invention may be smoother to the user when the remainder is carried forward as described above.

As one example of the scroll processing according to the invention, consider the following exemplary case. Assume that the number of units associated with a rotational user input is 51 units. Also assume that an acceleration factor was determined to be 2. Hence, the modified number of units, according to one embodiment, would then be 102 units (51*2). In one implementation, a previous remainder value (if not stale) can be added to the modified number of units. Assume that the previous remainder value was 3, then the modified number of units becomes 105 (102+3). Thereafter, to determine the next portion of the data set, the modified number of units (105) is then divided by a chunking value (e.g., 5). Hence, the resulting value 20 indicates that the next portion of the data set is to be presented (i.e., displayed on a display device) would be 20 items down (up) in the list from the current item.

The scroll, list navigation or acceleration amount processing discussed above can be utilized with respect to an audio player having a screen that displays a list of songs, or that provides a scroll bar indicating position of playing within an audio file. Typically, such an audio player typically displays different screens on the display. Each such screen can be individually scrolled through using separate position and acceleration values. Alternatively, the acceleration values can be shared across multiple different screens. Each such screen could be associated with a different list that is partially displayed on the screen, a portion of which is displayed on the screen at a time and, through scrolling, the portion can be altered in an accelerated manner. The file can be a list or represent a scroll bar reflecting play position in a song. Additional details of screens suitable for use with an audio player are described in U.S. Provisional Patent Application No. 60/399,806, filed on Jul. 30, 2002, which is hereby incorporated herein by reference.

FIG. **7**A is a perspective diagram of a computer system **650** in accordance with one embodiment of the invention. The computer system **650** includes a base housing **652** that encloses electronic circuitry that performs the computing operations for the computing system **650**. Typically, the electronic circuitry includes a microprocessor, memory, I/O controller, graphics controller, etc. The housing **652** also provides a removable computer readable medium drive **654** in which a removable computer readable medium can be placed so as to electronically or optically read data therefrom. The computer housing **652** is also coupled to a display device **656** on which a screen display can be presented for a user of the computer system **650** to view. Still further, the computer system **650** includes a keyboard apparatus **658**. The keyboard apparatus **658** allows a user to interact with a computer program (application program or operating system) performed by the computer system **650**. In this regard, the keyboard apparatus **658** includes a plurality of keys **660** and a rotational input unit **662**. The rotational input unit **662** allows a user to perform a rotational movement with respect to the rotational input unit **662**. The rotational movement (rotational user input) can then be processed by the electronic circuitry of the computer system **650** and used to manipulate navigation or selection actions with respect to a graphical user interface being presented to the user on the display device **656**. The keyboard apparatus **658** can also include a button **664** associated with the rotational input unit **662**. As shown in FIG. **7**A, the button **664** can be provided at a center region of the rotational input unit **662**. However, the button **664** is not required and, if provided, can be placed elsewhere, such as outside the periphery of the rotational input unit **662**.

FIG. **7**B is a perspective diagram of a media player **700** in accordance with one embodiment of the present invention. The term "media player" generally refers to computing devices that are dedicated to processing media such as audio, video or other images. In one implementation, the media player is a portable computing device. Examples of media players include music players, game players, video players, video recorders, cameras and the like. These computing devices are generally portable so as to allow a user to listen to music, play games or video, record video or take pictures wherever the user travels. In one embodiment, the media player is a handheld device that is sized for placement into a pocket of the user (i.e., pocket-sized). By being pocket-sized, the user does not have to directly carry the device and therefore the device can be taken almost anywhere the user travels (e.g., the user is not limited by carrying a large, bulky and often heavy device, as in a portable computer). For example, in the case of a music player (e.g., MP3 player), a user may use the device while working out at the gym. In the case of a camera, a user may use the device while mountain climbing. Furthermore, the device may be operated by the user's hands, no reference surface such as a desktop is needed. In one implementation, the music player can be pocket-sized and rather lightweight (e.g., dimensions of 2.43 by 4.02 by 0.78 inches and a weight of 6.5 ounces) for true portability.

The media player **700** typically has connection capabilities that allow a user to upload and download data to and from a host device such as a general purpose computer (e.g., desktop computer or portable computer). For example, in the case of a camera, photo images may be downloaded to the general purpose computer for further processing (e.g., printing). With regard to music players, songs and playlists stored on the general purpose computer may be downloaded into the music player. In one embodiment, the media player **700** can be a pocket-sized handheld MP3 music player that allows a user to store a large collection of music.

As shown in FIG. **7**B, the media player **700** includes a housing **702** that encloses various electrical components (including integrated circuit chips and other circuitry) to provide computing capabilities for the media player **700**. The integrated circuit chips and other circuitry may include a microprocessor, memory (e.g., ROM or RAM), a power source (e.g., a battery), a circuit board, a hard drive, and various input/output (I/O) support circuitry. In the case of music players, the electrical components may include components for outputting music such as an amplifier and a digital signal processor (DSP). In the case of video recorders or cameras, the electrical components may include components for capturing images such as image sensors (e.g.,

charge-coupled device (CCD) or complimentary oxide semiconductor (CMOS)) or optics (e.g., lenses, splitters, filters). The housing may also define the shape or form of the media player. That is, the contour of the housing **702** may embody the outward physical appearance of the media player **700**.

The media player **700** also includes a display screen **704**. The display screen **704** is used to display a Graphical User Interface (GUI) as well as other information to the user (e.g., text, objects, graphics). By way of example, the display screen **704** may be a liquid crystal display (LCD). In one particular embodiment, the display screen corresponds to a high-resolution display with a white LED backlight to give clear visibility in daylight as well as in low-light conditions. Additionally, according to one embodiment, the display screen **704** can be about 2 inches (measured diagonally) and provide a 160-by-128 pixel resolution. The display screen **704** can also operate to simultaneously display characters of multiple languages. As shown in FIG. **7**B, the display screen **704** is visible to a user of the media player **700** through an opening **705** in the housing **702**, and through a transparent wall **706** that is disposed over the opening **705**. Although transparent, the transparent wall **706** may be considered part of the housing **702** since it helps to define the shape or form of the media player **700**.

The media player **700** includes a rotational input device **710**. The rotational input device **710** receives a rotational input action from a user of the media player **700**. The rotational input action is used to control one or more control functions for controlling or interacting with the media player **700** (or application operating thereon). In one embodiment, the control function corresponds to a scrolling feature. The direction of scrolling can vary depending on implementation. For example, scrolling may be implemented vertically (up or down) or horizontally (left or right). For example, in the case of a music player, the moving finger may initiate a control function for scrolling through a song menu displayed on the display screen **704**. The term "scrolling" as used herein generally pertains to moving displayed data (e.g., text or graphics) across a viewing area on a display screen **704** so that at least one new item of data (e.g., line of text or graphics) is brought into view in the viewing area. In essence, the scrolling function allows a user to view sets of data currently outside of the viewing area. The viewing area may be the entire viewing area of the display screen **704** or it may be only a portion of the display screen **704** (e.g., a window frame).

By way of example, in the case of a music player (e.g., MP3 player), the scrolling feature may be used to help browse through songs stored in the music player. To elaborate, the display screen **704**, during operation, may display a list of media items (e.g., songs). A user of the media player **700** is able to linearly scroll through the list of media items by providing a rotational input action using the rotational input device **710**. The displayed items from the list of media items are varied commensurate with the rotational input action such that the user is able to effectively scroll through the list of media items. However, since the list of media items can be rather lengthy, the invention provides the ability for the user to rapidly traverse (or scroll) through the list of media items. In effect, the user is able to accelerate their traversal of the list of media items by providing the rotational input action at greater speeds. The direction of the rotational input action may be arranged to control the direction of scrolling.

In addition to above, the media player **700** may also include one or more buttons **712**. The buttons **712** are configured to provide one or more dedicated control functions for making selections or issuing commands associated with operating the media player **700**. By way of example, in the case of a music player, the button functions may be associated with opening a menu, playing a song, fast forwarding a song, seeking through a menu and the like. In most cases, the button functions are implemented via a mechanical clicking action. The position of the buttons **712** relative to the rotational input device **710** may be widely varied. For example, they may be adjacent to one another or spaced apart. In the illustrated embodiment, the buttons **712** are configured to surround the inner and outer perimeter of the rotational input device **710**. In this manner, the buttons **712** may provide tangible surfaces that define the outer boundaries of the rotational input device **710**. As shown, there are four buttons **712**A that surround the outer perimeter and one button **712**B disposed in the center or middle of the rotational input device **710**. By way of example, the plurality of buttons **712** may consist of a menu button, play/stop button, forward seek button, reverse seek button, and the like.

Moreover, the media player **700** may also include a power switch **714**, a headphone jack **716** and a data port **718**. The power switch **714** is configured to turn the media device **700** on and off. The headphone jack **716** is capable of receiving a headphone connector associated with headphones configured for listening to sound being outputted by the media device **700**. The data port **718** is capable of receiving a data connector/cable assembly configured for transmitting and receiving data to and from a host device, such as a general purpose computer. By way of example, the data port **718** may be used to upload or download songs to and from the media device **700**. The data port **718** may be widely varied. For example, the data port may be a PS/2 port, a serial port, a parallel port, a USB port, a FireWire port, and the like. In some cases, the data port **718** may be a radio frequency (RF) link or optical infrared (IR) link to eliminate the need for a cable. Although not shown in FIG. **7**B, the media player **700** may also include a power port that receives a power connector/cable assembly configured for delivering power to the media player **700**. In some cases, the data port **718** may serve as both a data and a power port.

FIG. **8**A is a block diagram of a media player **800** according to one embodiment of the invention. The media player **800** can, for example, represent internal components of the media player **700**.

The media player **800** includes a processor **802** that pertains to a microprocessor or controller for controlling the overall operation of the media player **800**. The media player **800** stores media data pertaining to media items in a file system **804** and a cache **806**. The file system **804** is, typically, a storage disk or a plurality of disks. The file system typically provides high capacity storage capability for the media player **800**. However, since the access time to the file system **804** is relatively slow, the media player **800** also includes a cache **806**. The cache **806** is, for example, Random-Access Memory (RAM) provided by semiconductor memory. The relative access time to the cache **806** is substantially shorter than for the file system **804**. However, the cache **806** does not have the large storage capacity of the file system **804**. Further, the file system **804**, when active, consumes more power than does the cache **806**. The power consumption is particularly important when the media player **800** is a portable media player that is powered by a battery (not shown).

The media player **800** also includes a user input device **808** that allows a user of the media player **800** to interact with the media player **800**. For example, the user input

device **808** can take a variety of forms, such as a button, keypad, dial, etc. Still further, the media player **800** includes a display **810** (screen display) that can be controlled by the processor **802** to display information to the user. A data bus **811** can facilitate data transfer between at least the file system **804**, the cache **806**, the processor **802**, and the coder/decoder (CODEC) **812**. The media player **800** can also include an audio feedback unit (not shown) to provide audio feedback for user interactions (such as with the user input device **808**).

In one embodiment, the media player **800** serves to store a plurality of media items (e.g., songs) in the file system **804**. When a user desires to have the media player play a particular media item, a list of available media items is displayed on the display **810**. Then, using the user input device **808**, a user can select one of the available media items. The processor **802**, upon receiving a selection of a particular media item, supplies the media data (e.g., audio file) for the particular media item to a coder/decoder (CODEC) **812**. The CODEC **812** then produces analog output signals for a speaker **814**. The speaker **814** can be a speaker internal to the media player **800** or external to the media player **800**. For example, headphones or earphones that connect to the media player **800** would be considered an external speaker.

FIG. **8**B is a block diagram of a computing system **850** according to one embodiment of the invention. The computing system **850** can, for example, represent a portion of any of the computer system **650** shown in FIG. **7**A, the media player **700** shown in FIG. **7**B, or the media player **800** shown in FIG. **8**A.

The computing system **850** includes a housing **852** that exposes a rotational input device **854**. The housing **852** can be a computer's housing or an input/output device's housing. The rotational input device **854** permits a user to interact with the computing system **850** through a rotational action. The rotational action results from either rotation of the rotational input device **854** itself or by rotation of a stylus or user's finger about the rotational input device **854**. As examples, the rotational input device **854** can be a rotary dial (including, e.g., a navigational wheel or a scroll wheel) capable of being rotated or a touch pad capable of rotational sensing. In one embodiment, the touch pad has a circular shape. A rotation pickup unit **856** couples to the rotational input device **854** to sense the rotational action. For example, the rotational pickup unit **856** can be optically or electrically coupled to the rotational input device **854**.

The computing system **850** further includes a processor **858**, a display **860** and an audio feedback unit **862**. Signals pertaining to the rotational action are supplied to the processor **858**. The processor **858** not only performs processing operations for application programs hosted by the computing system **850** but also can control the display **860** and the audio feedback unit **862**. Alternatively, a specialized controller or other circuitry can support the processor **858** in controlling the display **860** or the audio feedback unit **862**.

The processor **858** causes a display screen to be produced on the display **860**. In one implementation, the display screen includes a selectable list of items (e.g., media items) from which a user may select one or more of the items. By the user providing a rotational action with respect to the rotational input device **854**, the list can be scrolled through. The processor **858** receives the signals pertaining to the rotational action from the rotation pickup unit **856**. The processor **858** then determines the next items of the list that are to be presented on a display screen by the display **860**. In making this determination, the processor **858** can take into consideration the length of the list. Typically, the processor **858** will determine the rate of the rotational action such that the transitioning to different items in the media list can be performed at a rate proportional to the rate of the rotational action.

The processor **858** can also control the audio feedback unit **862** to provide audio feedback to a user. The audio feedback can, for example, be a clicking sound produced by the audio feedback unit **862**. In one embodiment, the audio feedback unit **862** is a piezoelectric buzzer. As the rate of transitioning through the list of items increases, the frequency of the clicking sounds can increase. Alternatively, when the rate that the rotational input device **854** is turned slows, the rate of transitioning through the list of items decreases, and thus the frequency of the clicking sounds correspondingly slows. Hence, the clicking sounds provide audio feedback to the user as to the rate in which the items within the list of items are being traversed.

FIG. **9** shows the media player **700** of FIG. **7**B being used by a user **920** in accordance with one embodiment of the invention. In this embodiment, the user **920** is linearly scrolling (as shown by arrow **924**) through a list of songs **922** displayed on the display screen **904** via a slider bar **923**. As shown, the media device **900** is comfortably held in one hand **926** while being comfortably addressed by the other hand **928**. This configuration generally allows the user **920** to easily actuate the rotational input device **910** with one or more fingers. For example, the thumb **930** and right-most fingers **931** (or left-most fingers if left handed) of the first hand **926** are used to grip the sides of the media player **900** while a finger **932** of the opposite hand **928** is used to actuate the rotational input device **910**.

Referring to FIG. **9**, and in accordance with one embodiment of the invention, the rotational input device **910** can be continuously actuated by a circular motion of the finger **932** as shown by arrow **934**. For example, the finger may rotate relative to an imaginary axis. In particular, the finger can be rotated through 360 degrees of rotation without stopping. This form of motion may produce incremental or accelerated scrolling through the list of songs **922** being displayed on the display screen **904**.

FIG. **10**A is a flow diagram of user input processing **1000** according to one embodiment of the invention. The user input processing **1000** is, for example, performed with respect to the computer system **650** illustrated in FIG. **7**A or the media player **700** illustrated in FIG. **7**B.

The user input processing **1000** displays **1002** a graphical user interface. Then, a rotational movement associated with a user input action is received **1004**. Here, the user input action is generally angular, as opposed to linear, and thus pertains to a rotational movement. As discussed in more detail below, the rotational movement can be provided by the user input action. In one example, the rotational movement can be caused by a user acting to rotate a navigational wheel through a user input action. In another example, the rotational movement can be caused by a user's finger or a stylist being moved in a rotational manner through a user input action with respect to a touch pad. After the rotational movement has been received **1004**, the rotational movement is converted **1006** into a linear movement. The linear movement is then applied **1008** to at least one object of the graphical user interface. For example, the object of the graphical user interface can be a list, menu or other object having a plurality of selectable items. The linear movement can effect a scroll type action with respect to the object (e.g., list or menu). Alternatively, the linear movement can effect a level adjustment (e.g., volume adjustment) or position

adjustment (e.g., slider bar position). After the linear movement has been applied **1008**, the user input processing **1000** is complete and ends.

FIG. **10**B is a flow diagram of user input processing **1050** according to another embodiment of the invention. The user input processing **1050** is, for example, performed with respect to the computer system **650** illustrated in FIG. **7**A or the media player **700** illustrated in FIG. **7**B.

The operations **1052-1060** performed by the user input processing **1050** are similar to those like operations performed by the user input processing **1000** illustrated in FIG. **10**A. Additionally, the user input processing **1050** operates to provide **1056** audible feedback corresponding to the rotational movements. In other words, as the rotational movement associated with user input action is received **1054**, audible feedback corresponding to the rotational movement is provided **1056**. Such audible feedback provides the user with feedback concerning the extent to which rotational movement has been input. In one embodiment, the rotational movement associated with user input action is converted into linear movement and applied to an object of a graphical user interface. For example, when the object of the graphical user interface is a multi-item list that is displayed for user scrolling and selection actions, the rotational movement associated with the user input action represents a distance traversed in the multi-item list. When acceleration is applied, the distance traversed is increased (e.g., multiplied). In one embodiment, the audible feedback is provided through a piezoelectric buzzer that is controlled by a processor (or other circuitry). For example, the audio feedback unit **862** shown in FIG. **8**B can be a piezoelectric buzzer. The controller for the piezoelectric buzzer can, for example, be a processor of the computer system **650** or the media player **700**, or some other circuitry coupled to the piezoelectric buzzer.

FIG. **11** is a flow diagram of user input processing **1100** according to another embodiment of the invention. The user input processing **1100** is, for example, performed by a computing device, such as the computer system **650** illustrated in FIG. **7**A or the media player **700** illustrated in FIG. **7**B.

The user input processing **1100** begins by the display **1102** of a portion of a list of items together with a select bar. The select bar typically points to or highlights one or more of the items of the list of items. In general, the select bar can be associated with any sort of visual indication specifying one or more of the items of the list of items. Hence, the select bar is one type of visual indicator. Next, a decision **1104** determines whether a rotational movement input has been received. When the decision **1104** determines that a rotational movement input has not yet been received, then a decision **1106** determines whether another input has been received. Here, the inputs are provided by a user of the computing device performing or associated with the user input processing **1100**. When the decision **1106** determines that another input has been received, then other processing is performed **1108** to perform any operations or actions caused by the other input. Following the operation **1108**, the user input processing **1100** is complete and ends. On the other hand, when the decision **1106** determines that no other input has been received, then the user input processing **1100** returns to repeat the decision **1104**.

Once the decision **1104** determines that a rotational movement input has been received, then the rotational movement is converted **1110** to a linear movement. Then, a next portion of the list of items (and placement of the select bar over one of the items) is determined **1112**. Thereafter, the next portion of the list of items is displayed **1114**. The linear movement operates to move the select bar (or other visual identifier) within the list. In other words, the select bar is scrolled upwards or downwards (in an accelerated or unaccelerated manner) by the user in accordance with the linear motion. As the scrolling occurs, the portion of the list being displayed changes. Following the operation **1114**, the user input processing **1100** is complete and ends. However, if desired, the user input processing **1100** can continue following operation **1114** by returning to the decision **1104** such that subsequent rotational movement inputs can be processed to view other portions of the list items in a similar manner.

FIG. **12** is a block diagram of a rotary input display system **1200** in accordance with one embodiment of the invention. By way of example, the rotary input display system **1200** can be performed by a computing device, such as the computer system **650** illustrated in FIG. **7**A or the media player **700** illustrated in FIG. **7**B. The rotary input display system **1200** utilizes a rotational input device **1202** and a display screen **1204**. The rotational input device **1202** is configured to transform a rotational motion **1206** by a user input action (e.g., a swirling or whirling motion) into translational or linear motion **1208** on the display screen **1204**. In one embodiment, the rotational input device **1402** is arranged to continuously determine either the angular position of the rotational input device **1202** or the angular position of an object relative to a planar surface **1209** of the rotational input device **1202**. This allows a user to linearly scroll through a media list **1211** on the display screen **1204** by inducing the rotational motion **1206** with respect to the rotational input device **1202**.

The rotary input display system **1200** also includes a control assembly **1212** that is coupled to the rotational input device **1202**. The control assembly **1212** is configured to acquire the position signals from the sensors and to supply the acquired signals to a processor **1214** of the system. By way of example, the control assembly **1212** may include an application-specific integrated circuit (ASIC) that is configured to monitor the signals from the sensors to compute the angular location and direction (and optionally speed and acceleration) from the monitored signals and to report this information to the processor **1214**.

The processor **1214** is coupled between the control assembly **1212** and the display screen **1204**. The processor **1214** is configured to control display of information on the display screen **1204**. In one sequence, the processor **1214** receives angular motion information from the control assembly **1212** and then determines the next items of the media list **1211** that are to be presented on the display screen **1204**. In making this determination, the processor **1214** can take into consideration the length of the media list **1211**. Typically, the processor **1214** will determine the rate of movement such that the transitioning to different items in the media list **1211** can be performed faster or in an accelerated manner when moved at non-slow speeds or proportional with greater speeds. In effect, to the user, rapid rotational motion causes faster transitioning through the list of media items **1211**. Alternatively, the control assembly **1212** and processor **1214** may be combined in some embodiments.

Although not shown, the processor **1214** can also control a buzzer to provide audio feedback to a user. The audio feedback can, for example, be a clicking sound produced by a buzzer **1216**. In one embodiment, the buzzer **1216** is a piezoelectric buzzer. As the rate of transitioning through the list of media items increases, the frequency of the clicking sounds increases. Alternatively, when the rate of transitioning slows, the frequency of the clicking sounds correspond-

ingly slows. Hence, the clicking sounds provide audio feedback to the user as to the rate in which the media items within the list of media items are being traversed.

The various aspects, features or embodiments of the invention described above can be used alone or in various combinations. The invention is preferably implemented by a combination of hardware and software, but can also be implemented in hardware or software. The invention can also be embodied as computer readable code on a computer readable medium. The computer readable medium is any data storage device that can store data which can thereafter be read by a computer system. Examples of the computer readable medium include read-only memory, random-access memory, CD-ROMs, DVDs, magnetic tape, optical data storage devices, and carrier waves. The computer readable medium can also be distributed over network-coupled computer systems so that the computer readable code is stored and executed in a distributed fashion.

The advantages of the invention are numerous. Different embodiments or implementations may yield one or more of the following advantages. It should be noted that this is not an exhaustive list and there may be other advantages which are not described herein. One advantage of the invention is that a user is able to traverse through a displayed list of items using a rotational user input action. Another advantage of the invention is that a user is able to easily and rapidly traverse a lengthy list of items. Still another advantage of the invention is the rate of traversal of the list of media items can be dependent on the rate of rotation of a dial (or navigation wheel). Yet still another advantage of the invention is that audible sounds are produced to provide feedback to users of their rate of traversal of the list of media items.

The many features and advantages of the present invention are apparent from the written description, and thus, it is intended by the appended claims to cover all such features and advantages of the invention. Further, since numerous modifications and changes will readily occur to those skilled in the art, it is not desired to limit the invention to the exact construction and operation as illustrated and described. Hence, all suitable modifications and equivalents may be resorted to as falling within the scope of the invention.

What is claimed is:

1. A method for scrolling through portions of a data set to be displayed on a portable media player having a display device, the portable media player having a rotational input device, said method comprising:

receiving a number of units associated with a rotational user input, the rotational user input being provided by a user through interaction with the rotational input device;

determining an acceleration factor pertaining to the rotational user input;

modifying the number of units by the acceleration factor;

determining a next portion of the data set based on the modified number of units; and

presenting the next portion of the data set,

wherein as the interaction with the rotational input device occurs, the display device provides visual feedback for the user of the portable media player, and

wherein as the interaction with the rotational input device occurs, audio feedback and the visual feedback are provided for the user of the portable media player.

2. A method as recited in claim **1**, wherein the data set pertains to a list of items, and the portions of the data set include one or more of the items.

3. A method as recited in claim **1**, wherein the data set pertains to a media file, and the portions of the data set pertain to one or more sections of the media file.

4. A method as recited in claim **3**, wherein the media file is an audio file.

5. A method as recited in claim **1**, wherein the rotational user input is a touch pad.

6. A method as recited in claim **5**, wherein the touch pad is a circular touch pad.

7. A method as recited in claim **1**, wherein the acceleration factor is dependent upon a rate of speed for the rotational user input.

8. A method as recited in claim **1**, wherein the acceleration factor provides a range of acceleration.

9. A method as recited in claim **1**, wherein the acceleration factor can successively increase to provided successively greater levels of acceleration.

10. A method as recited in claim **1**, wherein said determining of the next data portion comprises:

converting the modified number of units into the next portion based on a predetermined value.

11. A method as recited in claim **1**, wherein said determining of the next data portion comprises:

dividing the modified number of units by a chunking value.

12. A method as recited in claim **1**, wherein said determining of the next data portion comprises:

adding a prior remainder value to the modified number of units; and

converting the modified number of units into the next portion.

13. A method for scrolling through portions of a data set to be displayed on a portable media player having a display device, the portable media player having a rotational input device, said method comprising:

(a) receiving a number of units from the rotational input device, the number of units being associated with a rotational user input being provided by a user through interaction with the rotational input device;

(b) determining a speed of rotation for the rotational input device;

(c) applying acceleration when the speed of rotation is greater than a speed threshold;

(d) removing any acceleration being applied when the speed of rotation is less then the speed threshold;

(e) modifying the number of units in accordance with the acceleration, if any;

(f) determining a next portion of the data set based on the modified number of units; and

(g) presenting the next portion of the data set,

wherein as the interaction with the rotational input device occurs, the display device provides visual and/or audible feedback for the user of the portable media player, and

wherein as the interaction with the rotational input device occurs, audio feedback and the visual feedback are provided for the user of the portable media player.

14. A method as recited in claim **13**, wherein said applying (c) of the acceleration successively increases an amount of acceleration being applied.

15. A method as recited in claim **14**, wherein said applying (c) comprises:

(c1) obtaining a current acceleration amount being applied for a previous number of units from the rotational input device; and

(c2) determining an increased acceleration amount to be applied to a current number of units from the rotational input device.

16. A method as recited in claim **15**, wherein the increased acceleration amount is an integer multiple of the current acceleration amount.

17. A method as recited in claim **15**, wherein said applying (c) further comprises:

(c3) determining whether the time since the acceleration was last changed is greater than a duration threshold; and

(c4) preventing said applying of the acceleration or the increased acceleration amount when the time since the acceleration was last changed is not greater than the duration threshold.

18. A method as recited in claim **13**, wherein said applying (c) comprises:

(c1) determining whether the time since the acceleration was last changed is greater than a duration threshold; and

(c2) preventing said applying of the acceleration when the time since the acceleration was last changed is not greater than the duration threshold.

19. A method as recited in claim **13**, wherein said determining (f) of the next data portion comprises:

(f1) converting the modified number of units into the next portion based on a predetermined value.

20. A method as recited in claim **13**, wherein said determining (f) of the next data portion comprises:

(f1) dividing the modified number of units by a chunking value.

21. A method as recited in claim **13**, wherein said determining (f) of the next data portion comprises:

(f1) adding a prior remainder value to the modified number of units; and

(f2) converting the modified number of units into the next portion.

22. A method as recited in claim **1**, wherein the data set pertains to a list of items, and wherein one of the items on the list of items is distinguishly displayed from the other items in the list of items based on the rotational user input, thereby providing the visual feedback.

23. A method as recited in claim **13**, wherein the next portion of the data set pertains to a list of items, and wherein, said presenting (g) of the next portion causes one of the items on the list of items to be distinguishly displayed from the other items in the list of items based on the rotational user input, thereby providing the visual feedback.

24. A method for scrolling through portions of a data set to be displayed on a portable media player having a display device, the portable media player having a rotational input device, said method comprising:

receiving a number of units associated with a rotational user input, the rotational user input being provided by a user through interaction with the rotational input device;

determining a multiplier pertaining to the rotational user input;

modifying the number of units by the multiplier;

determining a next portion of the data set based on the modified number of units; and

presenting the next portion of the data set,

wherein as the interaction with the rotational input device occurs, visual feedback conelated to the rotational user input is provided on the display device for the user of the portable media player, and

wherein as the interaction with the rotational input device occurs, audio feedback and the visual feedback are provided for the user of the portable media player.

25. A method as recited in claim **24**, wherein the rotational user input is a touch pad.

26. A method as recited in claim **25**, wherein the touch pad is a circular touch pad.

27. A method as recited in claim **25**, wherein the multiplier is dependent upon a rate of speed for the rotational user input.

28. A method for scrolling through portions of a data set to be displayed on a portable media player having a display device, the portable media player having a rotational input device, said method comprising:

receiving a number of units associated with a rotational user input, the rotational user input being provided by a user through interaction with the rotational input device;

determining a multiplier pertaining to the rotational user input;

modifying the number of units by the multiplier;

determining a next portion of the data set based on the modified number of units; and

presenting the next portion of the data set,

wherein as the interaction with the rotational input device occurs, visual feedback correlated to the rotational user input is provided on the display device for the user of the portable media player, and

wherein the multiplier can successively increase to provided successively greater levels of acceleration.

29. A computer readable medium including at least computer program code for scrolling through portions of a data set to be displayed on a portable media player having a display device, the portable media player having a rotational input device, said computer readable medium comprising:

computer program code for receiving a number of units associated with a rotational user input, the rotational user input being provided by a user through interaction with the rotational input device;

computer program code for determining an acceleration factor pertaining to the rotational user input;

computer program code for modifying the number of units by the acceleration factor;

computer program code for determining a next portion of the data set based on the modified number of units; and

computer program code for presenting the next portion of the data set,

wherein as the interaction with the rotational input device occurs, the display device provides visual feedback for the user of the portable media player, and

wherein as the interaction with the rotational input device occurs, audio feedback and the visual feedback are provided for the user of the portable media player.

30. A computer readable medium as recited in claim **29**, wherein the data set pertains to a list of items, and the portions of the data set include one or more of the items.

31. A computer readable medium including at least computer program code for scrolling through portions of a data set to be displayed on a portable media player having a display device, the portable media player having a rotational input device, said computer readable medium comprising:

computer program code for receiving a number of units associated with a rotational user input, the rotational user input being provided by a user through interaction with the rotational input device;

computer program code for determining an acceleration factor pertaining to the rotational user input;

computer program code for modifying the number of units by the acceleration factor;

computer program code for determining a next portion of the data set based on the modified number of units; and

computer program code for presenting the next portion of the data set,

wherein as the interaction with the rotational input device occurs, the display device provides visual feedback for the user of the portable media player, and

wherein the data set pertains to a media file, and the portions of the data set pertain to one or more sections of the media file.

32. A computer readable medium as recited in claim **31**, wherein the media file is an audio file.

33. A computer readable medium as recited in claim **29**, wherein the rotational user input is a touch pad.

34. A computer readable medium as recited in claim **33**, wherein the touch pad is a circular touch pad.

35. A computer readable medium as recited in claim **29**, wherein the acceleration factor is dependent upon a rate of speed for the rotational user input.

36. A computer readable medium as recited in claim **29**, wherein the acceleration factor provides a range of acceleration.

37. A computer readable medium as recited in claim **29**, wherein the acceleration factor can successively increase to provided successively greater levels of acceleration.

38. A computer readable medium as recited in claim **29**, wherein said computer program code for determining of the next data portion comprises:

computer program code for converting the modified number of units into the next portion based on a predetermined value.

39. A computer readable medium as recited in claim **29**, wherein said computer program code for determining of the next data portion comprises:

computer program code for dividing the modified number of units by a chunking value.

40. A computer readable medium as recited in claim **29**, wherein said computer program code for determining of the next data portion comprises:

computer program code for adding a prior remainder value to the modified number of units; and

computer program code for converting the modified number of units into the next portion.

* * * * *

UNITED STATES PATENT AND TRADEMARK OFFICE

CERTIFICATE OF CORRECTION

PATENT NO. : 7,312,785 B2
APPLICATION NO. : 10/256716
DATED : December 25, 2007
INVENTOR(S) : Tsuk et al.

It is certified that error appears in the above-identified patent and that said Letters Patent is hereby corrected as shown below:

Title page, page 4, after "OTHER PUBLICATIONS", insert:

--"About Quicktip ®," www.logicad3d.com/docs/qt.html, downloaded April 8, 2002.--

Signed and Sealed this

Thirty-first Day of March, 2009

John Doll

JOHN DOLL
Acting Director of the United States Patent and Trademark Office