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XiaoPing

(10) **Patent No.: US 8,519,973 B1**
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(54) **APPARATUS AND METHODS FOR DETECTING A CONDUCTIVE OBJECT AT A LOCATION**

(75) Inventor: **Jiang XiaoPing**, Shanghai (CN)

(73) Assignee: **Cypress Semiconductor Corporation**, San Jose, CA (US)

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This patent is subject to a terminal disclaimer.

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Related U.S. Application Data

(63) Continuation of application No. 13/204,543, filed on Aug. 5, 2011, now Pat. No. 8,174,507, which is a continuation of application No. 11/437,517, filed on May 18, 2006, now Pat. No. 8,004,497.

(51) **Int. Cl.**
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G06F 3/033 (2006.01)

(52) **U.S. Cl.**
USPC **345/173**; 345/174; 345/179; 178/18.01; 178/18.06

(58) **Field of Classification Search**
USPC 345/173, 174
See application file for complete search history.

(56) **References Cited**

U.S. PATENT DOCUMENTS

3,979,745	A	9/1976	Bishop
4,039,940	A	8/1977	Butler et al.
4,113,378	A	9/1978	Wirtz
4,145,748	A	3/1979	Eichelberger et al.
4,193,063	A	3/1980	Hitt et al.
4,238,711	A	12/1980	Wallot
4,264,903	A	4/1981	Bigelow
4,266,144	A	5/1981	Bristol
4,292,604	A	9/1981	Embree et al.
4,305,135	A	12/1981	Dahl et al.
4,586,260	A	5/1986	Baxter et al.
4,614,937	A	9/1986	Poujois
4,728,932	A	3/1988	Atherton
4,736,191	A	4/1988	Matzke et al.
4,825,147	A	4/1989	Cook et al.

(Continued)

FOREIGN PATENT DOCUMENTS

EP	0574213	A	12/1993
GB	05000604	B2	2/2005

OTHER PUBLICATIONS

USPTO Non-Final Rejection for Application No. 11/437,517 dated Aug. 5, 2009; 9 pages.

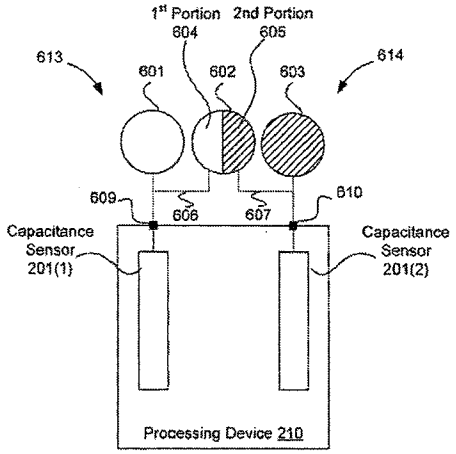
(Continued)

Primary Examiner — Bipin Shalwala
Assistant Examiner — Benyam Ketema

(57) **ABSTRACT**

A method and apparatus to determine capacitance variations of a first number of two or more sense elements of a touch screen device. A processing device is configured to detect a presence of a conductive object on any one of a second number of three or more button areas of the touch screen device. The first number of sense elements is less than the second number of button areas. The processing device is further configured to recognize an activation of one of the three or more button areas using the determined capacitance variations of the first number of two or more sense elements.

20 Claims, 10 Drawing Sheets



(56) **References Cited**

U.S. PATENT DOCUMENTS

4,831,325	A		5/1989	Watson Jr.
5,008,497	A		4/1991	Asher
5,214,388	A		5/1993	Vranish et al.
5,237,879	A		8/1993	Speeter
5,305,017	A		4/1994	Gerpheide
5,323,158	A		6/1994	Ferguson Jr.
5,373,245	A		12/1994	Vranish
5,386,219	A		1/1995	Greanias et al.
5,463,388	A		10/1995	Boie et al.
5,518,078	A	*	5/1996	Tsujioka et al. 178/18.05
5,541,580	A		7/1996	Gerston et al.
5,670,915	A		9/1997	Cooper et al.
5,760,852	A		6/1998	Wu et al.
5,801,340	A		9/1998	Peter
5,920,309	A		7/1999	Bisset et al.
5,942,733	A		8/1999	Allen et al.
6,037,929	A		3/2000	Ogura et al.
6,060,957	A		5/2000	Kodrnja et al.
6,145,850	A		11/2000	Rehm
6,184,871	B1		2/2001	Teres et al.
6,188,391	B1		2/2001	Seely et al.
6,191,723	B1		2/2001	Lewis
6,297,811	B1		10/2001	Kent et al.
6,353,200	B1		3/2002	Schwankhart
6,366,099	B1		4/2002	Reddi
6,377,129	B1		4/2002	Rhee et al.
6,380,931	B1		4/2002	Gillespie et al.
6,448,911	B1		9/2002	Somayajula
6,490,203	B1		12/2002	Tang
6,535,200	B2		3/2003	Philipp
6,577,140	B1		6/2003	Wenman
6,583,632	B2		6/2003	Von Basse et al.
6,700,392	B2		3/2004	Haase
6,781,577	B2		8/2004	Shigetaka
6,806,693	B1		10/2004	Bron
6,825,673	B1		11/2004	Yamaoka
6,838,887	B2		1/2005	Denen et al.
6,859,159	B2		2/2005	Michalski
6,879,930	B2		4/2005	Sinclair et al.
6,882,338	B2		4/2005	Flowers
6,888,536	B2		5/2005	Westerman et al.
6,891,531	B2		5/2005	Lin
6,914,547	B1		7/2005	Swaroop et al.
6,933,873	B1		8/2005	Horsley et al.
6,940,291	B1		9/2005	Ozick
6,946,853	B2		9/2005	Gifford et al.
6,958,594	B2		10/2005	Redl et al.
6,970,120	B1		11/2005	Bjornsen
6,970,126	B1		11/2005	O'Dowd et al.
7,006,078	B2		2/2006	Kim
7,031,886	B1		4/2006	Hargreaves
7,032,051	B2		4/2006	Reay et al.
7,046,230	B2		5/2006	Zadesky et al.
7,068,039	B2		6/2006	Parker
7,075,316	B2		7/2006	Umeda et al.
7,078,916	B2		7/2006	Denison
7,098,675	B2		8/2006	Inaba et al.
7,129,935	B2		10/2006	Mackey
7,148,704	B2		12/2006	Philipp
7,158,125	B2	*	1/2007	Sinclair et al. 345/173
7,235,983	B2		6/2007	O'Dowd et al.
7,253,643	B1	*	8/2007	Seguine 324/686
7,262,609	B2		8/2007	Reynolds
7,288,946	B2		10/2007	Hargreaves et al.
7,301,350	B2		11/2007	Hargreaves et al.
7,307,485	B1		12/2007	Snyder et al.
7,323,886	B2		1/2008	Lee
7,339,580	B2		3/2008	Westerman et al.
7,359,816	B2		4/2008	Kumar et al.
7,375,535	B1		5/2008	Kutz et al.
7,381,031	B2		6/2008	Kawaguchi et al.
7,382,139	B2		6/2008	Mackey
7,417,411	B2		8/2008	Hoffman et al.
7,449,895	B2		11/2008	Ely et al.
7,450,113	B2		11/2008	Gillespie et al.
7,451,050	B2		11/2008	Hargreaves
7,453,270	B2		11/2008	Hargreaves et al.
7,453,279	B2		11/2008	Corbin Jr. et al.
7,466,307	B2	*	12/2008	Trent et al. 345/173
7,479,788	B2		1/2009	Bolender et al.
7,495,659	B2		2/2009	Marriott et al.
7,499,040	B2		3/2009	Zadesky et al.
7,521,941	B2		4/2009	Ely et al.
7,548,073	B2		6/2009	Mackey et al.
7,598,822	B2		10/2009	Rajagopal et al.
7,683,641	B2		3/2010	Hargreaves et al.
7,772,514	B2		8/2010	Kirmayer
7,821,274	B2		10/2010	Philipp et al.
7,825,910	B2	*	11/2010	Won 345/173
8,040,321	B2		10/2011	Peng et al.
8,058,937	B2		11/2011	Qin et al.
2003/0091220	A1		5/2003	Sato et al.
2004/0178989	A1		9/2004	Shahoian et al.
2004/0217945	A1		11/2004	Miyamoto et al.
2004/0239616	A1	*	12/2004	Collins 345/156
2005/0031175	A1		2/2005	Hara et al.
2005/0052429	A1		3/2005	Philipp
2005/0159126	A1		7/2005	Wang
2005/0179672	A1		8/2005	Chiu et al.
2006/0016800	A1	*	1/2006	Paradiso et al. 219/497
2006/0038793	A1		2/2006	Philipp
2006/0097992	A1	*	5/2006	Gitzinger et al. 345/173
2006/0131159	A1		6/2006	Kaps et al.
2006/0197750	A1		9/2006	Kerr et al.
2006/0227117	A1	*	10/2006	Proctor 345/173
2006/0232559	A1		10/2006	Chien et al.
2006/0262101	A1		11/2006	Layton et al.
2007/0076897	A1		4/2007	Philipp
2007/0247443	A1		10/2007	Philipp
2007/0257894	A1		11/2007	Philipp
2007/0268265	A1	*	11/2007	XiaoPing 345/173
2007/0268273	A1		11/2007	Westerman et al.
2007/0268274	A1		11/2007	Westerman et al.
2007/0268275	A1		11/2007	Westerman et al.
2007/0291013	A1	*	12/2007	Won 345/173
2007/0296694	A1		12/2007	Kim et al.
2007/0296709	A1		12/2007	GuangHai
2008/0007534	A1		1/2008	Peng et al.
2008/0024455	A1		1/2008	Lee et al.
2008/0036473	A1		2/2008	Jansson
2008/0041639	A1		2/2008	Westerman et al.
2008/0041640	A1		2/2008	Gillespie et al.
2008/0042986	A1		2/2008	Westerman et al.
2008/0042987	A1		2/2008	Westerman et al.
2008/0042988	A1		2/2008	Westerman et al.
2008/0042989	A1		2/2008	Westerman et al.
2008/0042994	A1		2/2008	Gillespie et al.
2008/0068100	A1		3/2008	Goodnow et al.
2008/0111714	A1	*	5/2008	Kremin 341/33
2008/0116904	A1		5/2008	Reynolds et al.
2008/0128182	A1		6/2008	Westerman et al.
2008/0179112	A1		7/2008	Qin et al.
2008/0278178	A1	*	11/2008	Philipp 324/662
2009/0128374	A1	*	5/2009	Reynolds et al. 341/33

OTHER PUBLICATIONS

"The Virtual Keyboard: I-Tech Bluetooth/Serial Virtual Laser Keyboard Available Now!" the Virtual Laser Keyboard (VKB) Online Worldwide Shop, <http://www.virtual-laser-keyboard.com>, downloaded Apr. 13, 2006; 4 pages.

Application No. 11/493,350: "Technique for Increasing the Sensitivity of Capacitive Sensor Arrays," Lee et al., filed on Jul. 25, 2006; 48 pages.

Mark Lee, "CapSense Best Practices," Cypress Semiconductor Application Note, Oct. 16, 2006; 10 pages.

The Authoritative Dictionary of IEEE Standards Terms, 2000, IEEE Press Publications, 7th Edition, pp. 1133-1134; 4 pages.

USPTO Advisory Action for Application No. 11/230,719 dated Nov. 30, 2007; 3 pages.

USPTO Advisory Action for Application No. 11/437,517 dated Apr. 7, 2010; 3 pages.
USPTO Advisory Action for Application No. 11/477,179 dated Jun. 7, 2010; 3 pages.
USPTO Advisory Action for Application No. 12/367,279 dated Jun. 25, 2010; 3 pages.
USPTO Final Rejection for Application No. 11/230,719 dated Sep. 7, 2007; 9 pages.
USPTO Final Rejection for Application No. 11/273,708 dated Jul. 5, 2007; 8 pages.
USPTO Final Rejection for Application No. 11/395,417 dated Apr. 24, 2007; 9 pages.
USPTO Final Rejection for Application No. 11/437,517 dated Jan. 26, 2010; 11 pages.
USPTO Final Rejection for Application No. 11/477,179 dated Apr. 1, 2010; 10 pages.
USPTO Final Rejection for Application No. 11/477,179 dated Nov. 24, 2010; 10 pages.
USPTO Final Rejection for Application No. 11/484,085 dated Mar. 16, 2010; 7 pages.
USPTO Final Rejection for Application No. 11/502,267 dated Feb. 3, 2009; 10 pages.
USPTO Final Rejection for Application No. 11/600,896 dated Sep. 30, 2010; 19 pages.
USPTO Final Rejection for Application No. 12/367,279 dated Apr. 1, 2010; 6 pages.
USPTO Non-Final Rejection for Application No. 11/230,719 dated Jan. 16, 2007; 8 pages.
USPTO Non-Final Rejection for Application No. 11/230,719 dated May 11, 2006; 5 pages.
Uspto Non-Final Rejection for Application No. 11/230,719 dated May 25, 2007; 6 pages.
USPTO Non-Final Rejection for Application No. 11/230,719 dated Aug. 28, 2006; 7 pages.
USPTO Non-Final Rejection for Application No. 11/273,708 dated Mar. 19, 2007; 16 pages.
USPTO Non-Final Rejection for Application No. 11/395,417 dated Apr. 25, 2008; 7 pages.
USPTO Non-Final Rejection for Application No. 11/395,417 dated Oct. 26, 2006; 13 pages.
USPTO Non-Final Rejection for Application No. 11/395,417 dated Nov. 1, 2007; 8 pages.
USPTO Non-Final Rejection for Application No. 11/437,517 dated Aug. 3, 2010; 10 pages.
USPTO Non-Final Rejection for Application No. 11/442,212 dated Feb. 25, 2011; 13 pages.
USPTO Non-Final Rejection for Application No. 11/477,179 dated Jun. 9, 2009; 13 pages.
USPTO Non-Final Rejection for Application No. 11/477,179 dated Jul. 20, 2010; 10 pages.
USPTO Non-Final Rejection for Application No. 11/477,179 dated Nov. 18, 2009; 10 pages.
USPTO Non-Final Rejection for Application No. 11/484,085 dated Sep. 17, 2009; 8 pages.
USPTO Non-Final Rejection for Application No. 11/493,350 dated Jun. 16, 2010; 8 pages.
USPTO Non-Final Rejection for Application No. 11/493,350 dated Nov. 9, 2010; 9 pages.
USPTO Non-Final Rejection for Application No. 11/502,267 dated Aug. 11, 2008; 10 pages.
USPTO Non-Final Rejection for Application No. 11/600,255 dated Mar. 29, 2010; 10 pages.
USPTO Non-Final Rejection for Application No. 11/600,896 dated Jan 26, 2011; 12 pages.
USPTO Non-Final Rejection for Application No. 11/600,896 dated May 14, 2010; 15 pages.
USPTO Non-Final Rejection for Application No. 11/600,896 dated Dec. 16, 2009; 13 pages.
USPTO Non-Final Rejection for Application No. 11/700,314 dated Mar. 26, 2010; 7 pages.
USPTO Non-Final Rejection for Application No. 12/367,279 dated Oct. 29, 2009; 8 pages.
USPTO Notice of Allowance for Application No. 11/230,719 dated Jan. 16, 2008; 4 pages.
USPTO Notice of Allowance for Application No. 11/273,708 dated Aug. 9, 2007; 4 pages.
USPTO Notice of Allowance for Application No. 11/395,417 dated Nov. 6, 2008; 7 pages.
USPTO Notice of Allowance for Application No. 11/437,517 dated Feb. 3, 2011; 10 pages.
USPTO Notice of Allowance for Application No. 11/437,517 dated May 19, 2011; 9 pages.
USPTO Notice of Allowance for Application No. 11/437,517 dated Jun. 16, 2011; 9 pages.
USPTO Notice of Allowance for Application No. 11/484,085 dated Jun. 10, 2010; 4 pages.
USPTO Notice of Allowance for Application No. 11/489,944 dated Apr. 9, 2007; 7 pages.

* cited by examiner

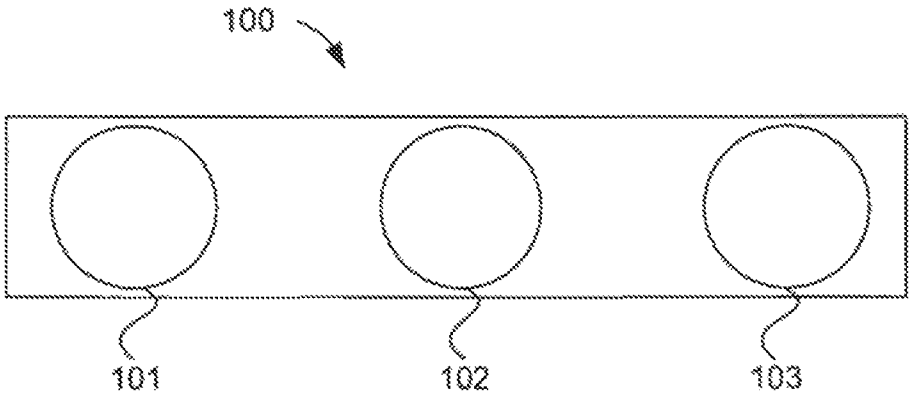
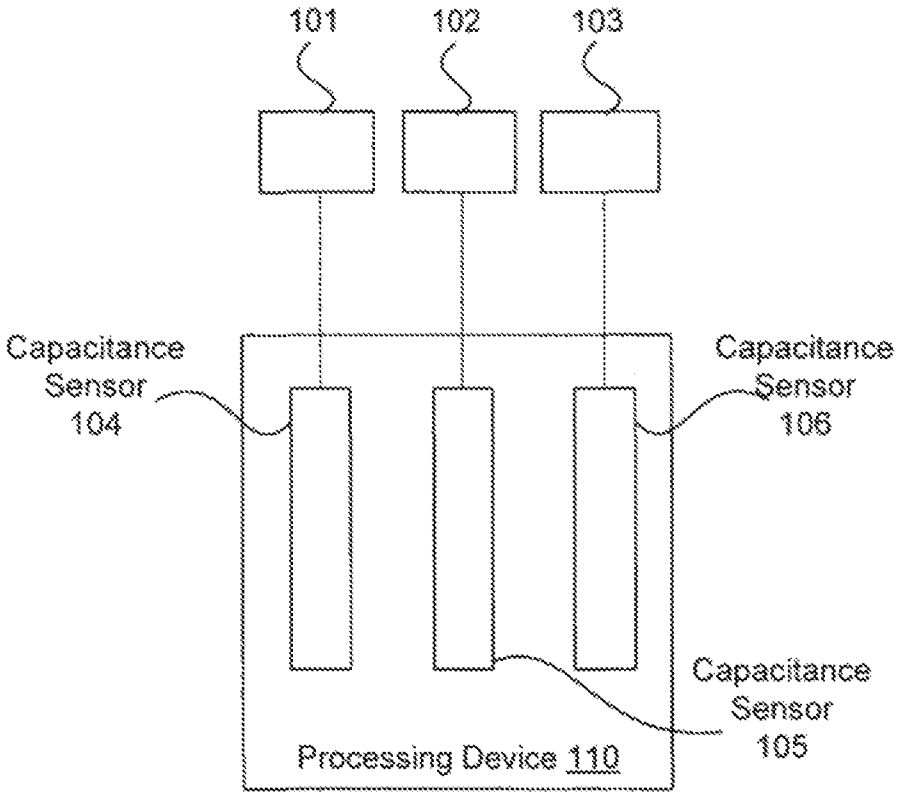


FIG. 1A



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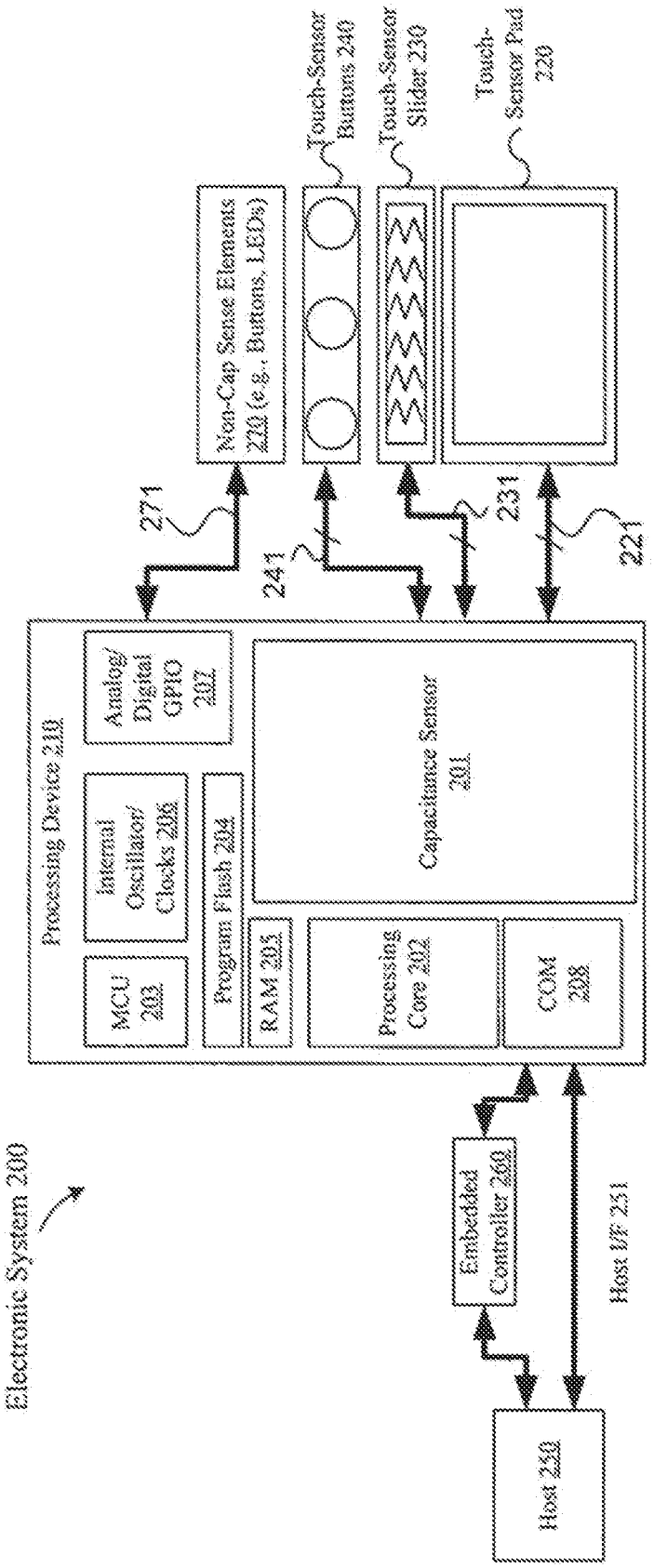

FIG. 2

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