AO 120 (Rev. 2/99)

TO: Mail Stop 8 Director of the U.S. Patent & Trademark Office P.O. Box 1450 Alexandria, VA 22313-1450	**REPORT ON THE FILING OR DETERMINATION OF AN ACTION REGARDING A PATENT OR TRADEMARK**

In Compliance with 35 § 290 and/or 15 U.S.C. § 1116 you are hereby advised that a court action has been filed in the U.S. District Court NDCA on the following X Patents or ☐ Trademarks:

DOCKET NO.	DATE FILED	U.S. DISTRICT COURT
CV 13-04034 DMR	8/29/13	Oakland Division, 1301 Clay St., Suite 400S, Oakland, CA 94612

PLAINTIFF	DEFENDANT
CYPRESS SEMICONDUCTOR CORPORATION	LG ELECTRONICS, INC.,ET.AL

PATENT OR TRADEMARK NO.	DATE OF PATENT OR TRADEMARK	HOLDER OF PATENT OR TRADEMARK
1 6,012,103		*See attached complaint
2 6,249,825		
3 6,493,770		
4 8,004,497		
5 8,059,015		

In the above—entitled case, the following patent(s) have been included:

DATE INCLUDED	INCLUDED BY ☐ Amendment ☐ Answer ☐ Cross Bill ☐ Other Pleading	
PATENT OR TRADEMARK NO.	DATE OF PATENT OR TRADEMARK	HOLDER OF PATENT OR TRADEMARK
1 8,519,973		
2		
3		
4		
5		

In the above—entitled case, the following decision has been rendered or judgement issued:

DECISION/JUDGEMENT

CLERK	(BY) DEPUTY CLERK	DATE
Richard W. Wieking	Valerie Kyono	August 30, 2013

Copy 1—Upon initiation of action, mail this copy to Commissioner Copy 3—Upon termination of action, mail this copy to Commissioner
Copy 2—Upon filing document adding patent(s), mail this copy to Commissioner Copy 4—Case file copy

enjoined by this Court.

42. On information and belief, LGE's infringement has been, and continues to be, willful, wanton, and deliberate, without license or excuse and with full knowledge of the '825 patent.

THIRD CLAIM FOR RELIEF
(Infringement of the '770 Patent)

43. Cypress incorporates and realleges the allegations of the preceding paragraphs as though set forth in full herein.

44. Cypress has not licensed or otherwise authorized LGE to make, use, offer for sale, sell, or import into the United States any products that embody the inventions of the '770 patent.

45. LGE has directly infringed and continues to directly infringe the '770 patent by making, using, importing, offering for sale or selling the LGE Infringing USB Products in the United States.

46. LGE has had actual knowledge of the '770 patent since at least April 1, 2011.

47. LGE has indirectly infringed and continues to indirectly infringe the '770 patent by inducing end-users to infringe the '770 patent by using the LGE Infringing USB Products. LGE intentionally took action that induced end-users to infringe the '770 patent by marketing, selling, and supporting the infringing devices. On information and belief, at least one LGE end customer or distributor has directly infringed the '770 patent by acting as instructed by LGE. For example, LGE supplies end customers and distributors of the LGE Infringing USB Products with user manuals and other information that instruct downstream users how to operate the LGE Infringing USB Products, with knowledge that use in accordance with such instructions infringes the '770 patent. As detailed by the user manuals and other information supplied by LGE, the LGE Infringing USB Products infringe multiple Cypress patents. Sale or use of the LGE Infringing USB Products by end customers or distributors in accordance with LGE's instructions constitutes direct infringement of the '770 patent. LGE had awareness of the '770 patent and knew, or was willfully blind to the fact, that its actions would cause direct infringement by end-users.

48. LGE has indirectly infringed and continues to indirectly infringe the '770 patent

by contributing to direct infringement by end-users who use the LGE Infringing USB Products. LGE supplied a component whose use by downstream users is infringing; the component is not a common component suitable for non-infringing use; and LGE supplied the component with the knowledge of the '770 patent and knowledge that the component was especially made or adapted for use in an infringing manner.

49. LGE's actions are in violation of one or more of the provisions of 35 U.S.C. § 271.

50. Cypress has been damaged and irreparably injured by LGE's infringing activities and will continue to be so damaged and irreparably injured unless LGE's infringing activities are enjoined by this Court.

51. On information and belief, LGE's infringement has been, and continues to be, willful, wanton, and deliberate, without license or excuse and with full knowledge of the '770 patent.

FOURTH CLAIM FOR RELIEF
(Infringement of the '497 Patent)

52. Cypress incorporates and realleges the allegations of the preceding paragraphs as though set forth in full herein.

53. Cypress has not licensed or otherwise authorized LGE to make, use, offer for sale, sell, or import into the United States any products that embody the inventions of the '497 patent.

54. LGE has directly infringed and continues to directly infringe the '497 patent by making, using, importing, offering for sale or selling the LGE Infringing Touchscreen Products in the United States.

55. LGE has had actual knowledge of the '497 patent since at least August 25, 2011.

56. LGE has had actual knowledge of the published application that finally issued as the '497 patent since at least July 12, 2011.

57. LGE has indirectly infringed and continues to indirectly infringe the '497 patent by inducing end-users to infringe the '497 patent by using the LGE Infringing Touchscreen Products. LGE intentionally took action that induced end-users to infringe the '497 patent by marketing, selling, and supporting the infringing devices. On information and belief, at least one

LGE end customer or distributor has directly infringed the '497 patent by acting as instructed by LGE. For example, LGE supplies end customers and distributors of the LGE Infringing Touchscreen Products with user manuals and other information that instruct downstream users how to operate the LGE Infringing Touchscreen Products, with knowledge that use in accordance with such instructions infringes the '497 patent. As detailed by the user manuals and other information supplied by LGE, the LGE Infringing Touchscreen Products infringe multiple Cypress patents. Sale or use of the LGE Infringing Touchscreen Products by end customers or distributors in accordance with LGE's instructions constitutes direct infringement of the '497 patent. LGE had awareness of the '497 patent and knew, or was willfully blind to the fact, that its actions would cause direct infringement by end-users.

58. LGE has indirectly infringed and continues to indirectly infringe the '497 patent by contributing to direct infringement by end-users who use the LGE Infringing Touchscreen Products. LGE supplied a component whose use by downstream users is infringing; the component is not a common component suitable for non-infringing use; and LGE supplied the component with the knowledge of the '497 patent and knowledge that the component was especially made or adapted for use in an infringing manner.

59. LGE's actions are in violation of one or more of the provisions of 35 U.S.C. § 271.

60. Cypress has been damaged and irreparably injured by LGE's infringing activities and will continue to be so damaged and irreparably injured unless LGE's infringing activities are enjoined by this Court.

61. Cypress is entitled to damages based on the provisional rights granted under 35 U.S.C. § 154 (d).

62. On information and belief, LGE's infringement has been, and continues to be, willful, wanton, and deliberate, without license or excuse and with full knowledge of the '497 patent.

FIFTH CLAIM FOR RELIEF
(Infringement of the '015 Patent)

63. Cypress incorporates and realleges the allegations of the preceding paragraphs as though set forth in full herein.

64. Cypress has not licensed or otherwise authorized LGE to make, use, offer for sale, sell, or import into the United States any products that embody the inventions of the '015 patent.

65. LGE has directly infringed and continues to directly infringe the '015 patent by making, using, importing, offering for sale or selling the LGE Infringing Touchscreen Products in the United States.

66. LGE has had actual knowledge of the '015 patent since at least March 7, 2012.

67. LGE has had actual knowledge of the published application that finally issued as the '015 patent since at least July 12, 2011.

68. LGE has indirectly infringed and continues to indirectly infringe the '015 patent by inducing end-users to infringe the '015 patent by using the LGE Infringing Touchscreen Products. LGE intentionally took action that induced end-users to infringe the '015 patent by marketing, selling, and supporting the infringing devices. On information and belief, at least one LGE end customer or distributor has directly infringed the '015 patent by acting as instructed by LGE. For example, LGE supplies end customers and distributors of the LGE Infringing Touchscreen Products with user manuals and other information that instruct downstream users how to operate the LGE Infringing Touchscreen Products, with knowledge that use in accordance with such instructions infringes the '015 patent. As detailed by the user manuals and other information supplied by LGE, the LGE Infringing Touchscreen Products infringe multiple Cypress patents. Sale or use of the LGE Infringing Touchscreen Products by end customers or distributors in accordance with LGE's instructions constitutes direct infringement of the '015 patent. LGE had awareness of the '015 patent and knew, or was willfully blind to the fact, that its actions would cause direct infringement by end-users.

69. LGE has indirectly infringed and continues to indirectly infringe the '015 patent by contributing to direct infringement by end-users who use the LGE Infringing Touchscreen Products. LGE supplied a component whose use by downstream users is infringing; the component is not a common component suitable for non-infringing use; and LGE supplied the component with the knowledge of the '015 patent and knowledge that the component was especially made or adapted for use in an infringing manner.

70. LGE's actions are in violation of one or more of the provisions of 35 U.S.C. § 271.

71. Cypress has been damaged and irreparably injured by LGE's infringing activities and will continue to be so damaged and irreparably injured unless LGE's infringing activities are enjoined by this Court.

72. Cypress is entitled to damages based on the provisional rights granted under 35 U.S.C. § 154 (d).

73. On information and belief, LGE's infringement has been, and continues to be, willful, wanton, and deliberate, without license or excuse and with full knowledge of the '015 patent.

SIXTH CLAIM FOR RELIEF
(Infringement of the '973 Patent)

74. Cypress incorporates and realleges the allegations of the preceding paragraphs as though set forth in full herein.

75. Cypress has not licensed or otherwise authorized LGE to make, use, offer for sale, sell, or import into the United States any products that embody the inventions of the '973 patent.

76. LGE has directly infringed and continues to directly infringe the '973 patent by making, using, importing, offering for sale or selling the LGE Infringing Touchscreen Products in the United States.

77. LGE has had actual knowledge of the '973 patent since at least August 29, 2013.

78. LGE has indirectly infringed and continues to indirectly infringe the '973 patent by inducing end-users to infringe the '973 patent by using the LGE Infringing Touchscreen Products. LGE intentionally took action that induced end-users to infringe the '973 patent by marketing, selling, and supporting the infringing devices. On information and belief, at least one LGE end customer or distributor has directly infringed the '973 patent by acting as instructed by LGE. For example, LGE supplies end customers and distributors of the LGE Infringing Touchscreen Products with user manuals and other information that instruct downstream users how to operate the LGE Infringing Touchscreen Products, with knowledge that use in accordance with such instructions infringes the '973 patent. As detailed by the user manuals and other information supplied by LGE, the LGE Infringing Touchscreen Products infringe multiple

Cypress patents. Sale or use of the LGE Infringing Touchscreen Products by end customers or distributors in accordance with LGE's instructions constitutes direct infringement of the '973 patent. LGE had awareness of the '973 patent and knew, or was willfully blind to the fact, that its actions would cause direct infringement by end-users.

79. LGE has indirectly infringed and continues to indirectly infringe the '973 patent by contributing to direct infringement by end-users who use the LGE Infringing Touchscreen Products. LGE supplied a component whose use by downstream users is infringing; the component is not a common component suitable for non-infringing use; and LGE supplied the component with the knowledge of the '973 patent and knowledge that the component was especially made or adapted for use in an infringing manner.

80. LGE's actions are in violation of one or more of the provisions of 35 U.S.C. § 271.

81. Cypress has been damaged and irreparably injured by LGE's infringing activities and will continue to be so damaged and irreparably injured unless LGE's infringing activities are enjoined by this Court.

82. On information and belief, LGE's infringement has been, and continues to be, willful, wanton, and deliberate, without license or excuse and with full knowledge of the '973 patent.

PRAYER FOR RELIEF

WHEREFORE, Cypress requests that this Court grant the following relief:

a. Enter judgment that the LGE Infringing USB Products infringe the '103, '825, and '770 patents and the LGE Infringing Touchscreen Products infringe the '497, '015, and '973 patents;

b. Enter an order permanently enjoining LGE and its officers, directors, agents, servants, employees, attorneys, licensees, successors, assigns, and customers, and those in active concert or participation with any of them, from making, using, offering to sell, or selling in the United States or importing into the United States any devices that infringe any claim of the Asserted Patents;

c. Award Cypress its damages, including lost profits, resulting from LGE's infringement in an amount to be determined at trial, pursuant to 35 U.S.C. §§ 154 and 284;

d. Find this to be an exceptional case pursuant to 35 U.S.C. § 285;

e. Award Cypress prejudgment interest and post-judgment interest on its damages and award Cypress its costs;

f. Perform an accounting of LGE's infringing sales not presented at trial and award Cypress additional damages from any such infringing sales; and

g. Award Cypress its costs and attorneys' fees and such other and further relief as the Court deems just and appropriate.

DEMAND FOR JURY TRIAL

Pursuant to Rule 38(b) of the Federal Rules of Civil Procedure, Cypress hereby demands trial by jury on all issues raised by the Complaint.

Dated: August 29, 2013

Respectfully submitted,

KAYE SCHOLER LLP

By /s/ Michael J. Malecek
Michael J. Malecek
Attorneys for Plaintiff
CYPRESS SEMICONDUCTOR CORPORATION

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Attorneys for Plaintiff
CYPRESS SEMICONDUCTOR CORPORATION

UNITED STATES DISTRICT COURT

NORTHERN DISTRICT OF CALIFORNIA

CYPRESS SEMICONDUCTOR CORPORATION, Plaintiff, v. LG ELECTRONICS, INC., LG ELECTRONICS U.S.A., INC., and LG ELECTRONICS MOBILECOMM U.S.A., INC., Defendants.	Case No. **COMPLAINT FOR PATENT INFRINGEMENT** **JURY TRIAL DEMANDED**

Plaintiff Cypress Semiconductor Corporation ("Cypress" or "Plaintiff") alleges:

PARTIES

1. Cypress is a corporation organized and existing under the laws of the State of Delaware with its principal place of business located at 198 Champion Court, San Jose, California. Cypress is a supplier of high-performance, mixed-signal, programmable solutions that provide customers with rapid time-to-market and exceptional system value. Cypress's innovations are used in a wide variety of consumer electronics, such as networking and telecommunication equipment, touchscreen devices, mobile handsets, video and imaging devices, as well as in military communication devices.

2. On information and belief, Defendant LG Electronics, Inc. ("LGE Inc.") is a corporation organized and existing under the laws of Korea with a principal place of business at 20, Yeouido-dong, Yeongdeungpo-Gu, Seoul 150-721, Korea.

3. On information and belief, Defendant LG Electronics U.S.A., Inc. ("LGE U.S.A.") is a corporation organized and existing under the laws of the State of Delaware with a principal place of business at 1000 Sylvan Avenue, Englewood Cliffs, New Jersey 07632.

4. On information and belief, Defendant LG Electronics Mobilecomm U.S.A., Inc. ("LGE Mobilecomm") is a corporation organized and existing under the laws of the State of California with a principal place of business at 10225 Willow Creek Road, San Diego, California 92131.

5. As further described below, LGE Inc., LGE U.S.A., and LGE Mobilecomm (collectively, "LGE") manufacture and sell mobile phones and other products that infringe multiple Cypress patents.

JURISDICTION AND VENUE

6. This action arises under the patent laws of the United States, 35 U.S.C. § 100, *et seq*. This Court has subject matter jurisdiction over this action under 28 U.S.C. §§ 1331 and 1338(a).

7. This Court has personal jurisdiction over LGE and venue is proper in the Northern District of California pursuant to 28 U.S.C. § 1391(b) and (c) and § 1400(b). LGE maintains

offices in this District, transacts business involving infringing products within this District, and offers infringing products for sale in this District. On information and belief, LGE derives significant revenue from the sale of infringing products distributed and used within this District, and/or expects or should reasonably expect its actions to have consequences within this District, and derives substantial revenue from interstate and international commerce.

INTRADISTRICT ASSIGNMENT

8. This is an Intellectual Property Action to be assigned on a district-wide basis pursuant to Civil Local Rule 3-2(c).

BACKGROUND

9. For over thirty years, Cypress has been a pioneer and market innovator in semiconductor technology. Cypress products include the PSoC® 1, PSoC® 3, PSoC® 4, and PSoC® 5 programmable system-on-chip families, and Cypress is the world leader in capacitive user interface solutions including CapSense® touch sensing, TrueTouch® touchscreens, and trackpad solutions for notebook PCs and peripherals. Cypress is also the world leader in universal serial bus ("USB") controllers, which enhance connectivity and performance in a wide range of consumer and industrial products. Cypress is also the world leader in static random access memory ("SRAM") and nonvolatile RAM memories.

10. To develop its industry-leading products, Cypress has made extensive and continuous investments in research and development ("R&D"). Cypress's R&D efforts have been essential to its success as a supplier of semiconductor solutions. Cypress's R&D organization works closely with its manufacturing facilities, suppliers and customers to improve semiconductor designs and lower manufacturing costs.

11. To protect these critical R&D efforts, Cypress places a high value on its intellectual property. Cypress has applied for and received over 2000 patents worldwide in a variety of semiconductor-related technologies, and has more than 800 pending U.S. and foreign patent applications. Cypress has over 250 issued U.S. patents and over 200 pending U.S. patent applications directed towards USB and touchscreen technology.

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12. To protect the interests of Cypress's customers, who benefit from Cypress's leading-edge technology and rely upon Cypress's proprietary solutions to compete in the marketplace, Cypress cannot allow unauthorized use of its intellectual property.

CYPRESS PATENTS

13. On January 4, 2000, the United States Patent and Trademark Office duly and legally issued United States Patent No. 6,012,103 ("the '103 patent"), entitled "Bus Interface System and Method," to Cypress. Cypress owns the '103 patent by assignment. A true and correct copy of the '103 patent is attached as Exhibit A to this Complaint.

14. On June 19, 2001, the United States Patent and Trademark Office duly and legally issued United States Patent No. 6,249,825 ("the '825 patent"), entitled "Universal Serial Bus Interface System and Method," to Cypress. Cypress owns the '825 patent by assignment. A true and correct copy of the '825 patent is attached as Exhibit B to this Complaint.

15. On December 10, 2002, the United States Patent and Trademark Office duly and legally issued United States Patent No. 6,493,770 ("the '770 patent"), entitled "System for Reconfiguring a Peripheral Device by Downloading Information from a Host and Electronically Simulating a Physical Disconnection and Reconnection to Reconfigure the Device," to Cypress. Cypress owns the '770 patent by assignment. A true and correct copy of the '770 patent is attached as Exhibit C to this Complaint.

16. On August 23, 2011, the United States Patent and Trademark Office duly and legally issued United States Patent No. 8,004,497 ("the '497 patent"), entitled "Two-Pin Buttons," to Cypress. Cypress owns the '497 patent by assignment. A true and correct copy of the '497 patent is attached as Exhibit D to this Complaint.

17. On November 15, 2011, the United States Patent and Trademark Office duly and legally issued United States Patent No. 8,059,015 ("the '015 patent"), entitled "Capacitance Sensing Matrix for Keyboard Architecture," to Cypress. Cypress owns the '015 patent by assignment. A true and correct copy of the '015 patent is attached as Exhibit E to this Complaint.

18. On August 27, 2013, the United States Patent and Trademark Office duly and legally issued United States Patent No. 8,519,973 ("the '973 patent"), entitled "Apparatus and

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Methods for Detecting a Conductive Object at a Location," to Cypress. Cypress owns the '973 patent by assignment. A true and correct copy of the '973 patent is attached as Exhibit F to this Complaint.

19. The '103 patent, '825 patent, and '770 patent will be referred to below as the "Cypress USB Patents." The '497 patent, '015 patent, and '973 patent will be referred to below as the "Cypress Touchscreen Patents" (and together with the USB Patents, the "Asserted Patents").

INFRINGEMENT BY LGE

20. The products manufactured, imported and sold by LGE that infringe one or more claims of the Cypress USB Patents include, but are not limited to, the Fathom VS750 mobile phone and associated software, firmware, and peripheral components, as well as other LGE mobile phones and products, and associated software, firmware, and peripheral components that incorporate the same or similar USB features, functionality, and/or architecture (collectively, the "LGE Infringing USB Products"). The identification of products and parts in this Complaint is by way of example only, and on information and belief, the exemplary products and parts identified in this Complaint are representative of all LGE products and parts with reasonably similar features, functionality and/or architecture, whether discontinued, current or future.

21. The products manufactured, imported and sold by LGE that infringe one or more claims of the Cypress Touchscreen patents include, but are not limited to, the Optimus S LS670 mobile phone and associated software, firmware, and peripheral components, as well as other LGE mobile phones and products, and associated software, firmware, and peripheral components that incorporate the same or similar touchscreen features, functionality, and/or architecture (collectively, the "LGE Infringing Touchscreen Products"). The identification of products and parts in this Complaint is by way of example only, and on information and belief, the exemplary products and parts identified in this Complaint are representative of all LGE products and parts with reasonably similar features, functionality and/or architecture, whether discontinued, current or future.

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22. The LGE Infringing USB Products and LGE Infringing Touchscreen Products (collectively, the "LGE Infringing Products") have no substantial non-infringing use.

23. According to LGE's website and other publicly available documents, and on information and belief, the LGE Infringing Products are sold to distributors and end customers in the United States. These distributors and end customers are supplied with user manuals and other information that instruct downstream users how to operate the LGE Infringing Products, and LGE provides these instructions while knowing since at least 2011 that the LGE Infringing Products infringe multiple Cypress patents, including one or more of the Asserted Patents. Sale or use of the LGE Infringing Products in accordance with LGE's instructions on how to operate these devices constitutes direct infringement of the Asserted Patents.

24. LGE is aware that the LGE Infringing Products infringe the Asserted Patents. In an effort to resolve LGE's infringement without resorting to litigation, Cypress made LGE aware of the Cypress USB Patents in April 2011 and the Cypress Touchscreen Patents in July 2011, and on multiple subsequent occasions. LGE ultimately refused to participate in any further licensing negotiations and, on information and belief, continued infringing the Asserted Patents.

FIRST CLAIM FOR RELIEF
(Infringement of the '103 Patent)

25. Cypress incorporates and realleges the allegations of the preceding paragraphs as though set forth in full herein.

26. Cypress has not licensed or otherwise authorized LGE to make, use, offer for sale, sell, or import into the United States any products that embody the inventions of the '103 patent.

27. LGE has directly infringed and continues to directly infringe the '103 patent by making, using, importing, offering for sale or selling the LGE Infringing USB Products in the United States.

28. LGE has had actual knowledge of the '103 patent since at least April 1, 2011.

29. LGE has indirectly infringed and continues to indirectly infringe the '103 patent by inducing end-users to infringe the '103 patent by using the LGE Infringing USB Products. LGE intentionally took action that induced end-users to infringe the '103 patent by marketing,

selling, and supporting the infringing devices. On information and belief, at least one LGE end customer or distributor has directly infringed the '103 patent by acting as instructed by LGE. For example, LGE supplies end customers and distributors of the LGE Infringing USB Products with user manuals and other information that instruct downstream users how to operate the LGE Infringing USB Products, with knowledge that use in accordance with such instructions infringes the '103 patent. As detailed by the user manuals and other information supplied by LGE, the LGE Infringing USB Products infringe multiple Cypress patents. Sale or use of the LGE Infringing USB Products by end customers or distributors in accordance with LGE's instructions constitutes direct infringement of the '103 patent. LGE had awareness of the '103 patent and knew, or was willfully blind to the fact, that its actions would cause direct infringement by end-users.

30. LGE has indirectly infringed and continues to indirectly infringe the '103 patent by contributing to direct infringement by end-users who use the LGE Infringing USB Products. LGE supplied a component whose use by downstream users is infringing; the component is not a common component suitable for non-infringing use; and LGE supplied the component with the knowledge of the '103 patent and knowledge that the component was especially made or adapted for use in an infringing manner.

31. LGE's actions are in violation of one or more of the provisions of 35 U.S.C. § 271.

32. Cypress has been damaged and irreparably injured by LGE's infringing activities and will continue to be so damaged and irreparably injured unless LGE's infringing activities are enjoined by this Court.

33. On information and belief, LGE's infringement has been, and continues to be, willful, wanton, and deliberate, without license or excuse and with full knowledge of the '103 patent.

SECOND CLAIM FOR RELIEF
(Infringement of the '825 Patent)

34. Cypress incorporates and realleges the allegations of the preceding paragraphs as though set forth in full herein.

35. Cypress has not licensed or otherwise authorized LGE to make, use, offer for sale,

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sell, or import into the United States any products that embody the inventions of the '825 patent.

36. LGE has directly infringed and continues to directly infringe the '825 patent by making, using, importing, offering for sale or selling the LGE Infringing USB Products in the United States.

37. LGE has had actual knowledge of the '825 patent since at least April 1, 2011.

38. LGE has indirectly infringed and continues to indirectly infringe the '825 patent by inducing end-users to infringe the '825 patent by using the LGE Infringing USB Products. LGE intentionally took action that induced end-users to infringe the '825 patent by marketing, selling, and supporting the infringing devices. On information and belief, at least one LGE end customer or distributor has directly infringed the '825 patent by acting as instructed by LGE. For example, LGE supplies end customers and distributors of the LGE Infringing USB Products with user manuals and other information that instruct downstream users how to operate the LGE Infringing USB Products, with knowledge that use in accordance with such instructions infringes the '825 patent. As detailed by the user manuals and other information supplied by LGE, the LGE Infringing USB Products infringe multiple Cypress patents. Sale or use of the LGE Infringing USB Products by end customers or distributors in accordance with LGE's instructions constitutes direct infringement of the '825 patent. LGE had awareness of the '825 patent and knew, or was willfully blind to the fact, that its actions would cause direct infringement by end-users.

39. LGE has indirectly infringed and continues to indirectly infringe the '825 patent by contributing to direct infringement by end-users who use the LGE Infringing USB Products. LGE supplied a component whose use by downstream users is infringing; the component is not a common component suitable for non-infringing use; and LGE supplied the component with the knowledge of the '825 patent and knowledge that the component was especially made or adapted for use in an infringing manner.

40. LGE's actions are in violation of one or more of the provisions of 35 U.S.C. § 271.

41. Cypress has been damaged and irreparably injured by LGE's infringing activities and will continue to be so damaged and irreparably injured unless LGE's infringing activities are

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
Address: COMMISSIONER FOR PATENTS
P.O. Box 1450
Alexandria, Virginia 22313-1450
www.uspto.gov

APPLICATION NO.	ISSUE DATE	PATENT NO.	ATTORNEY DOCKET NO.	CONFIRMATION NO.
11/440,924	11/15/2011	8059015	CD06015	9376

60909 7590 10/26/2011

CYPRESS SEMICONDUCTOR CORPORATION
198 CHAMPION COURT
SAN JOSE, CA 95134-1709

ISSUE NOTIFICATION

The projected patent number and issue date are specified above.

Determination of Patent Term Adjustment under 35 U.S.C. 154 (b)
(application filed on or after May 29, 2000)

The Patent Term Adjustment is 915 day(s). Any patent to issue from the above-identified application will include an indication of the adjustment on the front page.

If a Continued Prosecution Application (CPA) was filed in the above-identified application, the filing date that determines Patent Term Adjustment is the filing date of the most recent CPA.

Applicant will be able to obtain more detailed information by accessing the Patent Application Information Retrieval (PAIR) WEB site (http://pair.uspto.gov).

Any questions regarding the Patent Term Extension or Adjustment determination should be directed to the Office of Patent Legal Administration at (571)-272-7702. Questions relating to issue and publication fee payments should be directed to the Application Assistance Unit (AAU) of the Office of Data Management (ODM) at (571)-272-4200.

APPLICANT(s) (Please see PAIR WEB site http://pair.uspto.gov for additional applicants):

Liu Hua, Shanghai, CHINA;
Jiang XiaoPing, Shanghai, CHINA;

IR103 (Rev. 10/09)

INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)	Application Number	11440924
	Filing Date	2006-05-25
	First Named Inventor	Liu Hua
	Art Unit	2612
	Examiner Name	Timothy Edwards, Jr.
	Attorney Docket Number	CD06015

	9	4727767	B1	1988-03-01	Aiki et al.	Entire Document
	10	4772874	B1	1988-09-20	Hasegawa, Hiroshi	Entire Document
	11	4954823	B1	1990-09-04	Binstead, Ronald P.	Entire Document
	12	5844506	B1	1998-12-01	Binstead, Ronald Peter	Entire Document
	13	7202855	B1	2007-04-10	Shigetaka et al.	Entire Document
	14	7202859	B1	2007-04-10	Speck et al.	Entire Document
	15	7362244	B1	2008-04-22	Sun, Ben-Chang	Entire Document
If you wish to add additional U.S. Patent citation information please click the Add button.						

U.S.PATENT APPLICATION PUBLICATIONS

Examiner Initial*	Cite No	Publication Number	Kind Code[1]	Publication Date	Name of Patentee or Applicant of cited Document	Pages,Columns,Lines where Relevant Passages or Relevant Figures Appear
Change(s) applied to document, /T.W./ 10/11/2011	1	20060192690		08-2006	Philipp	
	2	20080007434		01-2008	Hristov	
If you wish to add additional U.S. Published Application citation information please click the Add button.						

EFS Web 2.1.14

ALL REFERENCES CONSIDERED EXCEPT WHERE LINED THROUGH. /TE/

UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
Address: COMMISSIONER FOR PATENTS
P.O. Box 1450
Alexandria, Virginia 22313-1450
www.uspto.gov

Bib Data Sheet

CONFIRMATION NO. 9376

SERIAL NUMBER	FILING OR 371(c) DATE	CLASS	GROUP ART UNIT	ATTORNEY DOCKET NO.
11/440,924	05/25/2006 RULE	341	2612	CD06015

APPLICANTS

Liu Hua, Shanghai, CHINA;
Jiang XiaoPing, Shanghai, CHINA;

** **CONTINUING DATA** *************************

** **FOREIGN APPLICATIONS** ********************

IF REQUIRED, FOREIGN FILING LICENSE GRANTED
** 06/16/2006

	STATE OR COUNTRY	SHEETS DRAWING	TOTAL CLAIMS	INDEPENDENT CLAIMS
Foreign Priority claimed ☐ yes ☒ no 35 USC 119 (a-d) conditions met ☐ yes ☒ no ☐ Met after Allowance Verified and Acknowledged ______ Examiner's Signature Initials	CHINA	14	26	3

ADDRESS
60909

TITLE

CAPACITANCE SENSING MATRIX FOR KEYBOARD ARCHITECTURE

FILING FEE RECEIVED		
1808	FEES: Authority has been given in Paper No. _________ to charge/credit DEPOSIT ACCOUNT No. _________ for following:	☐ All Fees ☐ 1.16 Fees (Filing) ☐ 1.17 Fees (Processing Ext. of time) ☐ 1.18 Fees (Issue) ☐ Other ________ ☐ Credit

PART B - FEE(S) TRANSMITTAL

Complete and send this form, together with applicable fee(s), to: Mail **Mail Stop ISSUE FEE**
Commissioner for Patents
P.O. Box 1450
Alexandria, Virginia 22313-1450
or Fax (571)-273-2885

INSTRUCTIONS: This form should be used for transmitting the ISSUE FEE and PUBLICATION FEE (if required). Blocks 1 through 5 should be completed where appropriate. All further correspondence including the Patent, advance orders and notification of maintenance fees will be mailed to the current correspondence address as indicated unless corrected below or directed otherwise in Block 1, by (a) specifying a new correspondence address; and/or (b) indicating a separate "FEE ADDRESS" for maintenance fee notifications.

CURRENT CORRESPONDENCE ADDRESS (Note: Use Block 1 for any change of address)

60909 7590 09/01/2011
CYPRESS SEMICONDUCTOR CORPORATION
198 CHAMPION COURT
SAN JOSE, CA 95134-1709

Note: A certificate of mailing can only be used for domestic mailings of the Fee(s) Transmittal. This certificate cannot be used for any other accompanying papers. Each additional paper, such as an assignment or formal drawing, must have its own certificate of mailing or transmission.

Certificate of Mailing or Transmission
I hereby certify that this Fee(s) Transmittal is being deposited with the United States Postal Service with sufficient postage for first class mail in an envelope addressed to the Mail Stop ISSUE FEE address above, or being facsimile transmitted to the USPTO (571) 273-2885, on the date indicated below.

(Depositor's name)
(Signature)
(Date)

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
11/440,924	05/25/2006	Liu Hua	CD06015	9376

TITLE OF INVENTION: CAPACITANCE SENSING MATRIX FOR KEYBOARD ARCHITECTURE

APPLN. TYPE	SMALL ENTITY	ISSUE FEE DUE	PUBLICATION FEE DUE	PREV. PAID ISSUE FEE	TOTAL FEE(S) DUE	DATE DUE
nonprovisional	NO	$1510	$300	$0	$1810	12/01/2011

EXAMINER	ART UNIT	CLASS-SUBCLASS
EDWARDS JR, TIMOTHY	2612	341-033000

1. Change of correspondence address or indication of "Fee Address" (37 CFR 1.363).
   - ☐ Change of correspondence address (or Change of Correspondence Address form PTO/SB/122) attached.
   - ☐ "Fee Address" indication (or "Fee Address" Indication form PTO/SB/47; Rev 03-02 or more recent) attached. **Use of a Customer Number is required.**

2. For printing on the patent front page, list
   (1) the names of up to 3 registered patent attorneys or agents OR, alternatively,
   (2) the name of a single firm (having as a member a registered attorney or agent) and the names of up to 2 registered patent attorneys or agents. If no name is listed, no name will be printed.
   1 ______
   2 ______
   3 ______

3. ASSIGNEE NAME AND RESIDENCE DATA TO BE PRINTED ON THE PATENT (print or type)

PLEASE NOTE: Unless an assignee is identified below, no assignee data will appear on the patent. If an assignee is identified below, the document has been filed for recordation as set forth in 37 CFR 3.11. Completion of this form is NOT a substitute for filing an assignment.

(A) NAME OF ASSIGNEE: Cypress Semiconductor Corporation
(B) RESIDENCE: (CITY and STATE OR COUNTRY): San Jose, CA

Please check the appropriate assignee category or categories (will not be printed on the patent): ☐ Individual ☑ Corporation or other private group entity ☐ Government

4a. The following fee(s) are submitted:
- ☑ Issue Fee
- ☑ Publication Fee (No small entity discount permitted)
- ☐ Advance Order - # of Copies ______

4b. Payment of Fee(s): **(Please first reapply any previously paid issue fee shown above)**
- ☐ A check is enclosed.
- ☐ Payment by credit card. Form PTO-2038 is attached.
- ☑ The Director is hereby authorized to charge the required fee(s), any deficiency, or credit any overpayment, to Deposit Account Number 50-3781 (enclose an extra copy of this form).

5. **Change in Entity Status** (from status indicated above)
- ☐ a. Applicant claims SMALL ENTITY status. See 37 CFR 1.27.
- ☐ b. Applicant is no longer claiming SMALL ENTITY status. See 37 CFR 1.27(g)(2).

NOTE: The Issue Fee and Publication Fee (if required) will not be accepted from anyone other than the applicant; a registered attorney or agent; or the assignee or other party in interest as shown by the records of the United States Patent and Trademark Office.

Authorized Signature ______ Date 9/29/11

Typed or printed name Larry Johnson Registration No. 56,861

This collection of information is required by 37 CFR 1.311. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.14. This collection is estimated to take 12 minutes to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, Virginia 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, Virginia 22313-1450.

Under the Paperwork Reduction Act of 1995, no persons are required to respond to a collection of information unless it displays a valid OMB control number.

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Application of:	)	Examiner: EDWARDS JR, TIMOTHY
	)	
Liu Hua	)	Group Art Unit: 2612
	)	
Application No.: 11/440,924	)	Confirmation No.: 9376
	)	
Filed: 05-25-2006	)	
	)	
For: CAPACITANCE SENSING MATRIX FOR KEYBOARD ARCHITECTURE	)	

ISSUE FEE TRANSMITTAL

Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Sir:

Applicant is in receipt of a Notice of Allowance and Fee Due Form, mailed September 1, 2011, in connection with the above-identified application. The Issue Fee is due on or before December 1, 2011. Applicant hereby submits the Issue Fee and/or the Publication Fee.

The Commissioner is hereby authorized to charge any appropriate fees under 37 C.F.R. §§ 1.16, 1.17, 1.18, 1.19, 1.20 and 1.21 that may be required to issue the present application, and to credit any overpayments, to Deposit Account No. 50-3781.

Customer No.: 60909

Should the Patent Office have any questions regarding this submission or the application in general, the Patent Office is urged to contact the Applicant's attorney, Larry Johnson, by telephone at (408) 545-7194. All correspondence should continue to be directed to the address given below.

Respectfully submitted,

Dated: 9/29/11 By: ______________________

Larry Johnson
Attorney for Applicant
Registration No. 56,861

Cypress Semiconductor Corporation
198 Champion Court
San Jose, CA 95134
Facsimile: (408) 545-6911
Customer No.: 60909

Electronic Patent Application Fee Transmittal

Application Number:	11440924
Filing Date:	25-May-2006
Title of Invention:	CAPACITANCE SENSING MATRIX FOR KEYBOARD ARCHITECTURE
First Named Inventor/Applicant Name:	Liu Hua
Filer:	Larry Joel Johnson/Lauren Navarro
Attorney Docket Number:	CD06015

Filed as Large Entity

Utility under 35 USC 111(a) Filing Fees

Description	Fee Code	Quantity	Amount	Sub-Total in USD($)
Basic Filing:				
Pages:				
Claims:				
Miscellaneous-Filing:				
Petition:				
Patent-Appeals-and-Interference:				
Post-Allowance-and-Post-Issuance:				
Utility Appl issue fee	1501	1	1740	1740
Publ. Fee- early, voluntary, or normal	1504	1	300	300

Description	Fee Code	Quantity	Amount	Sub-Total in USD($)
Extension-of-Time:				
Miscellaneous:				
		Total in USD ($)		**2040**

Electronic Acknowledgement Receipt

EFS ID:	11092114
Application Number:	11440924
International Application Number:	
Confirmation Number:	9376
Title of Invention:	CAPACITANCE SENSING MATRIX FOR KEYBOARD ARCHITECTURE
First Named Inventor/Applicant Name:	Liu Hua
Customer Number:	60909
Filer:	Larry Joel Johnson/Lauren Navarro
Filer Authorized By:	Larry Joel Johnson
Attorney Docket Number:	CD06015
Receipt Date:	30-SEP-2011
Filing Date:	25-MAY-2006
Time Stamp:	17:48:43
Application Type:	Utility under 35 USC 111(a)

Payment information:

Submitted with Payment	yes
Payment Type	Deposit Account
Payment was successfully received in RAM	$2040
RAM confirmation Number	7687
Deposit Account	503781
Authorized User	

The Director of the USPTO is hereby authorized to charge indicated fees and credit any overpayment as follows:

Charge any Additional Fees required under 37 C.F.R. Section 1.16 (National application filing, search, and examination fees)

Charge any Additional Fees required under 37 C.F.R. Section 1.17 (Patent application and reexamination processing fees)

Charge any Additional Fees required under 37 C.F.R. Section 1.19 (Document supply fees)

Charge any Additional Fees required under 37 C.F.R. Section 1.20 (Post Issuance fees)

Charge any Additional Fees required under 37 C.F.R. Section 1.21 (Miscellaneous fees and charges)

File Listing:

Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
1	Issue Fee Payment (PTO-85B)	CD06015_TransmittalLetterPayment_09302011.pdf	408429 1af3ff0270a912bcf749b74a3952775fc4203c0d	no	1
Warnings:					
Information:					
2	Transmittal Letter	CD06015_TransmittalLetter_09302011.pdf	160104 328c4ba67f9b2cf3b985af650a46ed4681e4cbd2	no	2
Warnings:					
Information:					
3	Fee Worksheet (SB06)	fee-info.pdf	32058 88d2761376f454966184a801337268ed822b215d	no	2
Warnings:					
Information:					
		Total Files Size (in bytes):	600591		

This Acknowledgement Receipt evidences receipt on the noted date by the USPTO of the indicated documents, characterized by the applicant, and including page counts, where applicable. It serves as evidence of receipt similar to a Post Card, as described in MPEP 503.

<u>New Applications Under 35 U.S.C. 111</u>
If a new application is being filed and the application includes the necessary components for a filing date (see 37 CFR 1.53(b)-(d) and MPEP 506), a Filing Receipt (37 CFR 1.54) will be issued in due course and the date shown on this Acknowledgement Receipt will establish the filing date of the application.

<u>National Stage of an International Application under 35 U.S.C. 371</u>
If a timely submission to enter the national stage of an international application is compliant with the conditions of 35 U.S.C. 371 and other applicable requirements a Form PCT/DO/EO/903 indicating acceptance of the application as a national stage submission under 35 U.S.C. 371 will be issued in addition to the Filing Receipt, in due course.

<u>New International Application Filed with the USPTO as a Receiving Office</u>
If a new international application is being filed and the international application includes the necessary components for an international filing date (see PCT Article 11 and MPEP 1810), a Notification of the International Application Number and of the International Filing Date (Form PCT/RO/105) will be issued in due course, subject to prescriptions concerning national security, and the date shown on this Acknowledgement Receipt will establish the international filing date of the application.

UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
Address: COMMISSIONER FOR PATENTS
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Alexandria, Virginia 22313-1450
www.uspto.gov

NOTICE OF ALLOWANCE AND FEE(S) DUE

60909 7590 09/01/2011
CYPRESS SEMICONDUCTOR CORPORATION
198 CHAMPION COURT
SAN JOSE, CA 95134-1709

EXAMINER	
EDWARDS JR, TIMOTHY	
ART UNIT	PAPER NUMBER
2612	

DATE MAILED: 09/01/2011

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
11/440,924	05/25/2006	Liu Hua	CD06015	9376

TITLE OF INVENTION: CAPACITANCE SENSING MATRIX FOR KEYBOARD ARCHITECTURE

APPLN. TYPE	SMALL ENTITY	ISSUE FEE DUE	PUBLICATION FEE DUE	PREV. PAID ISSUE FEE	TOTAL FEE(S) DUE	DATE DUE
nonprovisional	NO	$1510	$300	$0	$1810	12/01/2011

THE APPLICATION IDENTIFIED ABOVE HAS BEEN EXAMINED AND IS ALLOWED FOR ISSUANCE AS A PATENT. PROSECUTION ON THE MERITS IS CLOSED. THIS NOTICE OF ALLOWANCE IS NOT A GRANT OF PATENT RIGHTS. THIS APPLICATION IS SUBJECT TO WITHDRAWAL FROM ISSUE AT THE INITIATIVE OF THE OFFICE OR UPON PETITION BY THE APPLICANT. SEE 37 CFR 1.313 AND MPEP 1308.

THE ISSUE FEE AND PUBLICATION FEE (IF REQUIRED) MUST BE PAID WITHIN THREE MONTHS FROM THE MAILING DATE OF THIS NOTICE OR THIS APPLICATION SHALL BE REGARDED AS ABANDONED. THIS STATUTORY PERIOD CANNOT BE EXTENDED. SEE 35 U.S.C. 151. THE ISSUE FEE DUE INDICATED ABOVE DOES NOT REFLECT A CREDIT FOR ANY PREVIOUSLY PAID ISSUE FEE IN THIS APPLICATION. IF AN ISSUE FEE HAS PREVIOUSLY BEEN PAID IN THIS APPLICATION (AS SHOWN ABOVE), THE RETURN OF PART B OF THIS FORM WILL BE CONSIDERED A REQUEST TO REAPPLY THE PREVIOUSLY PAID ISSUE FEE TOWARD THE ISSUE FEE NOW DUE.

HOW TO REPLY TO THIS NOTICE:

I. Review the SMALL ENTITY status shown above.

If the SMALL ENTITY is shown as YES, verify your current SMALL ENTITY status:

A. If the status is the same, pay the TOTAL FEE(S) DUE shown above.

B. If the status above is to be removed, check box 5b on Part B - Fee(s) Transmittal and pay the PUBLICATION FEE (if required) and twice the amount of the ISSUE FEE shown above, or

If the SMALL ENTITY is shown as NO:

A. Pay TOTAL FEE(S) DUE shown above, or

B. If applicant claimed SMALL ENTITY status before, or is now claiming SMALL ENTITY status, check box 5a on Part B - Fee(s) Transmittal and pay the PUBLICATION FEE (if required) and 1/2 the ISSUE FEE shown above.

II. PART B - FEE(S) TRANSMITTAL, or its equivalent, must be completed and returned to the United States Patent and Trademark Office (USPTO) with your ISSUE FEE and PUBLICATION FEE (if required). If you are charging the fee(s) to your deposit account, section "4b" of Part B - Fee(s) Transmittal should be completed and an extra copy of the form should be submitted. If an equivalent of Part B is filed, a request to reapply a previously paid issue fee must be clearly made, and delays in processing may occur due to the difficulty in recognizing the paper as an equivalent of Part B.

III. All communications regarding this application must give the application number. Please direct all communications prior to issuance to Mail Stop ISSUE FEE unless advised to the contrary.

IMPORTANT REMINDER: Utility patents issuing on applications filed on or after Dec. 12, 1980 may require payment of maintenance fees. It is patentee's responsibility to ensure timely payment of maintenance fees when due.

PART B - FEE(S) TRANSMITTAL

Complete and send this form, together with applicable fee(s), to: Mail **Mail Stop ISSUE FEE**
Commissioner for Patents
P.O. Box 1450
Alexandria, Virginia 22313-1450
or Fax (571)-273-2885

INSTRUCTIONS: This form should be used for transmitting the ISSUE FEE and PUBLICATION FEE (if required). Blocks 1 through 5 should be completed where appropriate. All further correspondence including the Patent, advance orders and notification of maintenance fees will be mailed to the current correspondence address as indicated unless corrected below or directed otherwise in Block 1, by (a) specifying a new correspondence address; and/or (b) indicating a separate "FEE ADDRESS" for maintenance fee notifications.

CURRENT CORRESPONDENCE ADDRESS (Note: Use Block 1 for any change of address)

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198 CHAMPION COURT
SAN JOSE, CA 95134-1709

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Certificate of Mailing or Transmission

I hereby certify that this Fee(s) Transmittal is being deposited with the United States Postal Service with sufficient postage for first class mail in an envelope addressed to the Mail Stop ISSUE FEE address above, or being facsimile transmitted to the USPTO (571) 273-2885, on the date indicated below.

(Depositor's name)

(Signature)

(Date)

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
11/440,924	05/25/2006	Liu Hua	CD06015	9376

TITLE OF INVENTION: CAPACITANCE SENSING MATRIX FOR KEYBOARD ARCHITECTURE

APPLN. TYPE	SMALL ENTITY	ISSUE FEE DUE	PUBLICATION FEE DUE	PREV. PAID ISSUE FEE	TOTAL FEE(S) DUE	DATE DUE
nonprovisional	NO	$1510	$300	$0	$1810	12/01/2011

EXAMINER	ART UNIT	CLASS-SUBCLASS
EDWARDS JR, TIMOTHY	2612	341-033000

1. Change of correspondence address or indication of "Fee Address" (37 CFR 1.363).

❑ Change of correspondence address (or Change of Correspondence Address form PTO/SB/122) attached.

❑ "Fee Address" indication (or "Fee Address" Indication form PTO/SB/47; Rev 03-02 or more recent) attached. **Use of a Customer Number is required.**

2. For printing on the patent front page, list

(1) the names of up to 3 registered patent attorneys or agents OR, alternatively,

(2) the name of a single firm (having as a member a registered attorney or agent) and the names of up to 2 registered patent attorneys or agents. If no name is listed, no name will be printed.

1____________________

2____________________

3____________________

3. ASSIGNEE NAME AND RESIDENCE DATA TO BE PRINTED ON THE PATENT (print or type)

PLEASE NOTE: Unless an assignee is identified below, no assignee data will appear on the patent. If an assignee is identified below, the document has been filed for recordation as set forth in 37 CFR 3.11. Completion of this form is NOT a substitute for filing an assignment.

(A) NAME OF ASSIGNEE

(B) RESIDENCE: (CITY and STATE OR COUNTRY)

Please check the appropriate assignee category or categories (will not be printed on the patent) : ❑ Individual ❑ Corporation or other private group entity ❑ Government

4a. The following fee(s) are submitted:

❑ Issue Fee

❑ Publication Fee (No small entity discount permitted)

❑ Advance Order - # of Copies ____________________

4b. Payment of Fee(s): **(Please first reapply any previously paid issue fee shown above)**

❑ A check is enclosed.

❑ Payment by credit card. Form PTO-2038 is attached.

❑ The Director is hereby authorized to charge the required fee(s), any deficiency, or credit any overpayment, to Deposit Account Number ____________ (enclose an extra copy of this form).

5. **Change in Entity Status** (from status indicated above)

❑ a. Applicant claims SMALL ENTITY status. See 37 CFR 1.27.

❑ b. Applicant is no longer claiming SMALL ENTITY status. See 37 CFR 1.27(g)(2).

NOTE: The Issue Fee and Publication Fee (if required) will not be accepted from anyone other than the applicant; a registered attorney or agent; or the assignee or other party in interest as shown by the records of the United States Patent and Trademark Office.

Authorized Signature ______________________________ Date ______________________________

Typed or printed name ______________________________ Registration No. ______________________________

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
Address: COMMISSIONER FOR PATENTS
P.O. Box 1450
Alexandria, Virginia 22313-1450
www.uspto.gov

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
11/440,924	05/25/2006	Liu Hua	CD06015	9376

60909 7590 09/01/2011

CYPRESS SEMICONDUCTOR CORPORATION
198 CHAMPION COURT
SAN JOSE, CA 95134-1709

EXAMINER	
EDWARDS JR, TIMOTHY	
ART UNIT	PAPER NUMBER
2612	

DATE MAILED: 09/01/2011

Determination of Patent Term Adjustment under 35 U.S.C. 154 (b)
(application filed on or after May 29, 2000)

The Patent Term Adjustment to date is 709 day(s). If the issue fee is paid on the date that is three months after the mailing date of this notice and the patent issues on the Tuesday before the date that is 28 weeks (six and a half months) after the mailing date of this notice, the Patent Term Adjustment will be 709 day(s).

If a Continued Prosecution Application (CPA) was filed in the above-identified application, the filing date that determines Patent Term Adjustment is the filing date of the most recent CPA.

Applicant will be able to obtain more detailed information by accessing the Patent Application Information Retrieval (PAIR) WEB site (http://pair.uspto.gov).

Any questions regarding the Patent Term Extension or Adjustment determination should be directed to the Office of Patent Legal Administration at (571)-272-7702. Questions relating to issue and publication fee payments should be directed to the Customer Service Center of the Office of Patent Publication at 1-(888)-786-0101 or (571)-272-4200.

Privacy Act Statement

The Privacy Act of 1974 (P.L. 93-579) requires that you be given certain information in connection with your submission of the attached form related to a patent application or patent. Accordingly, pursuant to the requirements of the Act, please be advised that: (1) the general authority for the collection of this information is 35 U.S.C. 2(b)(2); (2) furnishing of the information solicited is voluntary; and (3) the principal purpose for which the information is used by the U.S. Patent and Trademark Office is to process and/or examine your submission related to a patent application or patent. If you do not furnish the requested information, the U.S. Patent and Trademark Office may not be able to process and/or examine your submission, which may result in termination of proceedings or abandonment of the application or expiration of the patent.

The information provided by you in this form will be subject to the following routine uses:

1. The information on this form will be treated confidentially to the extent allowed under the Freedom of Information Act (5 U.S.C. 552) and the Privacy Act (5 U.S.C 552a). Records from this system of records may be disclosed to the Department of Justice to determine whether disclosure of these records is required by the Freedom of Information Act.
2. A record from this system of records may be disclosed, as a routine use, in the course of presenting evidence to a court, magistrate, or administrative tribunal, including disclosures to opposing counsel in the course of settlement negotiations.
3. A record in this system of records may be disclosed, as a routine use, to a Member of Congress submitting a request involving an individual, to whom the record pertains, when the individual has requested assistance from the Member with respect to the subject matter of the record.
4. A record in this system of records may be disclosed, as a routine use, to a contractor of the Agency having need for the information in order to perform a contract. Recipients of information shall be required to comply with the requirements of the Privacy Act of 1974, as amended, pursuant to 5 U.S.C. 552a(m).
5. A record related to an International Application filed under the Patent Cooperation Treaty in this system of records may be disclosed, as a routine use, to the International Bureau of the World Intellectual Property Organization, pursuant to the Patent Cooperation Treaty.
6. A record in this system of records may be disclosed, as a routine use, to another federal agency for purposes of National Security review (35 U.S.C. 181) and for review pursuant to the Atomic Energy Act (42 U.S.C. 218(c)).
7. A record from this system of records may be disclosed, as a routine use, to the Administrator, General Services, or his/her designee, during an inspection of records conducted by GSA as part of that agency's responsibility to recommend improvements in records management practices and programs, under authority of 44 U.S.C. 2904 and 2906. Such disclosure shall be made in accordance with the GSA regulations governing inspection of records for this purpose, and any other relevant (i.e., GSA or Commerce) directive. Such disclosure shall not be used to make determinations about individuals.
8. A record from this system of records may be disclosed, as a routine use, to the public after either publication of the application pursuant to 35 U.S.C. 122(b) or issuance of a patent pursuant to 35 U.S.C. 151. Further, a record may be disclosed, subject to the limitations of 37 CFR 1.14, as a routine use, to the public if the record was filed in an application which became abandoned or in which the proceedings were terminated and which application is referenced by either a published application, an application open to public inspection or an issued patent.
9. A record from this system of records may be disclosed, as a routine use, to a Federal, State, or local law enforcement agency, if the USPTO becomes aware of a violation or potential violation of law or regulation.

Notice of Allowability	Application No. 11/440,924	Applicant(s) HUA ET AL.	
	Examiner TIMOTHY EDWARDS JR	Art Unit 2612	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address--

All claims being allowable, PROSECUTION ON THE MERITS IS (OR REMAINS) CLOSED in this application. If not included herewith (or previously mailed), a Notice of Allowance (PTOL-85) or other appropriate communication will be mailed in due course. **THIS NOTICE OF ALLOWABILITY IS NOT A GRANT OF PATENT RIGHTS.** This application is subject to withdrawal from issue at the initiative of the Office or upon petition by the applicant. See 37 CFR 1.313 and MPEP 1308.

1. ☒ This communication is responsive to *amendment filed June 24, 2011*.

2. ☐ An election was made by the applicant in response to a restriction requirement set forth during the interview on _____; the restriction requirement and election have been incorporated into this action.

3. ☒ The allowed claim(s) is/are *1-23,26,27 and 29*.

4. ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
   a) ☐ All b) ☐ Some* c) ☐ None of the:
   1. ☐ Certified copies of the priority documents have been received.
   2. ☐ Certified copies of the priority documents have been received in Application No. _____ .
   3. ☐ Copies of the certified copies of the priority documents have been received in this national stage application from the International Bureau (PCT Rule 17.2(a)).

   * Certified copies not received: _____.

Applicant has THREE MONTHS FROM THE "MAILING DATE" of this communication to file a reply complying with the requirements noted below. Failure to timely comply will result in ABANDONMENT of this application.
THIS THREE-MONTH PERIOD IS NOT EXTENDABLE.

5. ☐ A SUBSTITUTE OATH OR DECLARATION must be submitted. Note the attached EXAMINER'S AMENDMENT or NOTICE OF INFORMAL PATENT APPLICATION (PTO-152) which gives reason(s) why the oath or declaration is deficient.

6. ☐ CORRECTED DRAWINGS (as "replacement sheets") must be submitted.
   (a) ☐ including changes required by the Notice of Draftsperson's Patent Drawing Review (PTO-948) attached
   1) ☐ hereto or 2) ☐ to Paper No./Mail Date _____.
   (b) ☐ including changes required by the attached Examiner's Amendment / Comment or in the Office action of Paper No./Mail Date _____.

   Identifying indicia such as the application number (see 37 CFR 1.84(c)) should be written on the drawings in the front (not the back) of each sheet. Replacement sheet(s) should be labeled as such in the header according to 37 CFR 1.121(d).

7. ☐ DEPOSIT OF and/or INFORMATION about the deposit of BIOLOGICAL MATERIAL must be submitted. Note the attached Examiner's comment regarding REQUIREMENT FOR THE DEPOSIT OF BIOLOGICAL MATERIAL.

Attachment(s)

1. ☐ Notice of References Cited (PTO-892)
2. ☐ Notice of Draftperson's Patent Drawing Review (PTO-948)
3. ☐ Information Disclosure Statements (PTO/SB/08), Paper No./Mail Date _____
4. ☐ Examiner's Comment Regarding Requirement for Deposit of Biological Material
5. ☐ Notice of Informal Patent Application
6. ☐ Interview Summary (PTO-413), Paper No./Mail Date _____ .
7. ☐ Examiner's Amendment/Comment
8. ☒ Examiner's Statement of Reasons for Allowance
9. ☐ Other _____.

DETAILED ACTION

Allowable Subject Matter

1. Claims 1-23, 26, 29 are allowed.

2. The following is an examiner's statement of reasons for allowance: applicant has amended claims with subject matter which was indicated as being allowable. Application is in condition for allowance.

Any comments considered necessary by applicant must be submitted no later than the payment of the issue fee and, to avoid processing delays, should preferably accompany the issue fee. Such submissions should be clearly labeled "Comments on Statement of Reasons for Allowance."

Conclusion

Any inquiry concerning this communication should be directed to Examiner Timothy Edwards, Jr. at telephone number (571) 272-3067. The examiner can normally be reached on Monday-Thursday, 8:00 a.m.-6:00 p.m. The examiner cannot be reached on Fridays.

If attempt to reach the Examiner by telephone are unsuccessful, the Examiner's Supervisor, Brian Zimmerman, can be reached at (571) 272-3059.

Any inquiry of a general nature or relating to the status of this application should be directed to the Group receptionist whose telephone number is (571) 272-4700, Mon-Fri., 8:30 a.m.-5:00 p.m.

Any response to this action should be fax to:

(571) 273-8300 (for formal communications intended for entry).

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http:/pair-direct.uspto.gov or contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

/Timothy Edwards, Jr. /
Primary Examiner, Art Unit 2612
August 31, 2011

Search Notes	Application/Control No.	Applicant(s)/Patent Under Reexamination
	11440924	HUA ET AL.
	Examiner	**Art Unit**
	Timothy Edwards, Jr.	2612

SEARCHED

Class	Subclass	Date	Examiner
341	22, 33	12/13/08	/TE/
345	156, 168, 173		
178	18.05, 18.06		
	UPDATED SEARCH	9/17/09	/TE/
324	658-668		
	UPDATED SEARCH	1/14/10	/TE/

SEARCH NOTES

Search Notes	Date	Examiner
EAST TEXT SEARCH	12/13/08	/TE/
UPDATED EAST TEXT SEARCH	9/17/09	/TE/
UPDATED EAST SEARCH	1/14/10	/TE/
UPDATED EAST TEXT SEARCH	5/10/11	/TE/

INTERFERENCE SEARCH

Class	Subclass	Date	Examiner
341	33	7/4/10	/TE/
324	662		
178	18.05, 18.06		
345	173		

	/TIMOTHY EDWARDS JR/ Primary Examiner.Art Unit 2612

Issue Classification	Application/Control No. 11/440,924	Applicant(s)/Patent under Reexamination HUA ET AL.	
	Examiner TIMOTHY EDWARDS JR	Art Unit 2612	

ISSUE CLASSIFICATION

ORIGINAL					CROSS REFERENCE(S)							
CLASS			SUBCLASS		CLASS	SUBCLASS (ONE SUBCLASS PER BLOCK)						
341			33		324	662						
INTERNATIONAL CLASSIFICATION					345	173						
H	0	3	K	17/96	178	18.05	18.06					
				/								
				/								
				/								
				/								

		Total Claims Allowed: 26	
N/A (Assistant Examiner) (Date)	/Timothy Edwards, Jr./ 8/31/11 (Primary Examiner) (Date)	O.G. Print Claim(s)	O.G. Print Fig.
(Legal Instruments Examiner) (Date)		1	5A

☐ Claims renumbered in the same order as presented by applicant ☐ CPA ☐ T.D. ☐ R.1.47

Final	Original	Final	Original	Final	Original	Final	Original	Final	Original	Final	Original	Final	Original
1	1		31		61		91		121		151		181
2	2		32		62		92		122		152		182
4	3		33		63		93		123		153		183
3	4		34		64		94		124		154		184
5	5		35		65		95		125		155		185
7	6		36		66		96		126		156		186
8	7		37		67		97		127		157		187
9	8		38		68		98		128		158		188
10	9		39		69		99		129		159		189
11	10		40		70		100		130		160		190
12	11		41		71		101		131		161		191
13	12		42		72		102		132		162		192
14	13		43		73		103		133		163		193
18	14		44		74		104		134		164		194
19	15		45		75		105		135		165		195
20	16		46		76		106		136		166		196
21	17		47		77		107		137		167		197
22	18		48		78		108		138		168		198
23	19		49		79		109		139		169		199
15	20		50		80		110		140		170		200
16	21		51		81		111		141		171		201
24	22		52		82		112		142		172		202
25	23		53		83		113		143		173		203
	24		54		84		114		144		174		204
	25		55		85		115		145		175		205
26	26		56		86		116		146		176		206
6	27		57		87		117		147		177		207
	28		58		88		118		148		178		208
17	29		59		89		119		149		179		209
	30		60		90		120		150		180		210

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Applicant: Liu Hua and Jiang XiaoPing

Examiner: Timothy Edwards, Jr.

Serial No.: 11/440,924

Group Art Unit: 2612

Filed: May 25, 2006

Docket No.: CD06015

Title: Capacitive Sensing Matrix for Keyboard Architecture

Confirmation No.: 9376

Assignee: Cypress Semiconductor

RESPONSE TO NON-FINAL OFFICE ACTION DATED JUNE 10, 2011

To: Mail Stop Amendment
Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

In response to the Non-Final Office Action mailed June 10, 2011, Applicants respectfully request reconsideration of the present application and consideration of the amendments to the present application and/or associated remarks that are detailed below.

CLAIMS

Claims pending

- At time of the Action: 1-30.
- After this Response: 1-23, 26, 27, and 29.

Currently Amended claims: 1, 6, and 22.

Cancelled claims: 24, 25, 28, and 30.

Withdrawn claims: None.

New claims: None.

1. (Currently amended) A method, comprising:

assigning a plurality of keyboard keys to correspond to pre-defined areas of a sensing surface of a sensing device having a plurality of sensor elements and a plurality of capacitance sensing pins to couple the plurality of sensor elements to a processing device, wherein the pre-defined areas are disposed adjacent to one another <u>and wherein at least one of the plurality of sensor elements corresponds to multiple pre-defined areas</u>;

determining a position of a presence of the conductive object on the sensing device by measuring capacitance on the plurality of capacitance sensing pins; and

selecting a keyboard key of the plurality of keyboard keys when the position of the presence of the conductive object is determined to be within the pre-defined area of the sensing device corresponding to the keyboard key.

2. (Original) The method of claim <u>1</u>~~1~~, wherein selecting the keyboard key comprises comparing the position of the conductive object with the pre-defined areas.

3. (Original) The method of claim 1~~1~~, further comprising outputting keyboard data corresponding to the selected key from the processing device to a component external to the processing device.

4. (Previously Presented) The method of claim 1~~1~~, wherein the plurality of sensor elements are disposed in a capacitance sensor matrix comprising a plurality of rows of sensor elements and a plurality of columns of sensor elements, wherein each row and each column is coupled to one of the plurality of capacitance sensing pins, and wherein determining the position of the conductive object comprises:

measuring a capacitance of each row of sensor elements of the capacitance sensor matrix of the sensing device;

determining a first dimension position based on the measured capacitance of the rows of sensor elements;

measuring a capacitance of each column of sensor elements of the capacitance sensor matrix; and

determining a second dimension position based on the measured capacitance of the columns of sensor elements, wherein determining the position of the presence of the conductive object is determined using the first and second dimension positions.

5. (Original) The method of claim 3~~3~~, wherein assigning the plurality of keyboard keys into pre-defined areas comprises defining a data structure comprising positional data of the pre-defined areas of the plurality of keyboard keys, wherein selecting the keyboard key comprises comparing the position of the conductive object with the positional data of the pre-defined areas of the data structure to determine a pressed key

of the plurality of keyboard keys, and wherein outputting the keyboard data comprises outputting keyboard data that corresponds to the pressed key.

6. (Currently amended) An apparatus, comprising:

a sensing device comprising a plurality of sensor elements to detect a presence of a conductive object on a sensing surface of the sensing device, wherein a plurality of keyboard keys are assigned to correspond to pre-defined areas of a sensing surface of the sensing device, wherein the pre-defined areas are disposed adjacent to one another and wherein at least one of the plurality of sensor elements corresponds to multiple pre-defined areas; and

a processing device coupled to the sensing device using capacitance sensing pins, wherein the processing device is operable to determine a position of the presence of the conductive object on the sensing device by measuring capacitance on the capacitance sensing pins, and to select a keyboard key of the plurality of keyboard keys when the position of the presence of the conductive object is determined to be within the pre-defined area of the sensing device corresponding to the keyboard key.

7. (Original) The apparatus of claim 66, wherein the plurality of keyboard keys are a personal computer (PC) keyboard, and wherein the processing device is coupled to the sensing device using less than 21 capacitance sensing pins.

8. (Original) The apparatus of claim 6~~6~~, wherein the plurality of keyboard keys comprises approximately 48 keyboard keys, and wherein the processing device is coupled to the sensing device using 4 capacitance sensing pins.

9. (Original) The apparatus of claim 6~~6~~, wherein the plurality of keyboard keys comprises approximately 101 keyboard keys, and wherein the processing device is coupled to the sensing device using less than 12 capacitance sensing pins.

10. (Original) The apparatus of claim 6~~6~~, wherein the plurality of keyboard keys comprises approximately 107 keyboard keys, and wherein the processing device is coupled to the sensing device using less than 21 capacitance sensing pins.

11. (Original) The apparatus of claim 6~~6~~, wherein the plurality of keyboard keys comprises approximately 107 keyboard keys, and wherein the processing device is coupled to the sensing device using less than 12 capacitance sensing pins.

12. (Original) The apparatus of claim 6~~6~~, wherein a total surface area of the assigned keyboard keys is less than approximately 10 centimeters (cm) by 10 cm.

13. (Original) The apparatus of claim 6~~6~~, wherein a total surface area of the assigned keyboard keys is approximately 3 centimeters (cm) by 3 cm.

14. (Previously Presented) The apparatus of claim 6~~6~~, wherein the sensing device comprises a capacitance sensor matrix comprising the plurality of sensor elements configured in rows and columns to detect the presence of the conductive object on the sensing device, wherein each row and column is coupled to the processing device using

one of the capacitance sensing pins, and wherein the plurality of keyboard keys are assigned to the pre-defined areas of the capacitance sensor matrix.

15. (Original) The apparatus of claim 14~~14~~, wherein the processing device comprises one or more capacitance sensors coupled to the capacitance sensor matrix, wherein the one or more capacitance sensors are operable to measure a capacitance of each row of sensor elements of the capacitance sensor matrix, and to measure a capacitance of each column of sensor elements of the capacitance sensor matrix, and wherein the processing device is operable to determine the position of the presence of the keyboard key using the measured capacitance of the rows and columns of sensor elements of the capacitance sensor matrix.

16. (Original) The apparatus of claim 15~~15~~, wherein the one or more capacitance sensors are relaxation oscillators, wherein each relaxation oscillator comprises:

a current source to provide a charge current to the plurality of sensor elements;

a selection circuit coupled to the plurality of sensor elements and the current source, wherein the selection circuit is operable to sequentially select a sensor element of the plurality of sensor elements to provide the charge current and to measure the capacitance of each sensor element of the sensing device;

a comparator coupled to the current source and the selection circuit, wherein the comparator is operable to compare a voltage on the selected sensor element and a threshold voltage; and

a reset switch coupled to the comparator, current source, and selection circuit, wherein the reset switch is operable to reset the charge current on the selected sensor element, wherein the one or more capacitance sensors further comprise a digital counter coupled to the relaxation oscillator, wherein the digital counter is operable to count at least one of a frequency of an oscillator output or a period of the oscillator received from the relaxation oscillator.

17. (Original) The apparatus of claim 6~~6~~, further comprising a component external to the processing device, wherein the processing device is operable to send keyboard data to the component that corresponds to the selected keyboard key.

18. (Original) The apparatus of claim 17~~17~~, wherein the component external to the processing device is at least one of a processor, a driver of a processor, or an embedded controller.

19. (Original) The apparatus of claim 17~~17~~, wherein the keyboard data comprises is at least one of a keyboard data signal, or a keyboard data command.

20. (Original) The apparatus of claim 6~~6~~, wherein the sensing device is mounted on a mobile handset.

21. (Original) The apparatus of claim 6~~6~~, wherein the processing device is coupled to an additional user input device, and wherein the additional input device is at least one of a cursor positioning device, a touch-sensor pad, a touch-sensor slider, a touch-sensor button, mouse, or a touch-screen display.

22. (Currently amended) An apparatus, comprising:

a sensing device comprising a plurality of sensor elements to detect a presence of a conductive object on the sensing device, wherein a plurality of keyboard keys are assigned to correspond to pre-defined areas of a sensing surface of the sensing device, wherein the pre-defined areas are disposed adjacent to one another and wherein at least one of the plurality of sensor elements corresponds to multiple pre-defined areas;

means for determining a position of the presence of the conductive object on the sensing device; and

means for selecting a keyboard key of the plurality of keyboard keys when the position of the presence of the conductive object is determined to be within the pre-defined area of the sensing device corresponding to the keyboard key.

23. (Previously Presented) The apparatus of claim 2222, further comprising means for assigning the plurality of keyboard keys to correspond to the pre-defined areas of the sensing device.

24. (Canceled)

25. (Canceled)

26. (Original) The apparatus of claim 2222, further comprising means for outputting keyboard data based on the position of the presence of the keyboard key.

27. (Previously Presented) The method of claim 1, wherein the pre-defined areas of the plurality of keyboard keys are arranged into multiple rows on the sensing surface, wherein the plurality of sensor elements are arranged in a plurality of rows of sensor elements, and wherein at least one of the plurality of rows of sensor elements corresponds to a plurality of rows of the pre-defined areas.

28. (Canceled)

29. (Previously Presented) The apparatus of claim 6, wherein the pre-defined areas of the plurality of keyboard keys are arranged into multiple rows on the sensing surface, wherein the plurality of sensor elements are arranged in a plurality of rows of sensor elements, and wherein at least one of the plurality of rows of sensor elements corresponds to a plurality of rows of the pre-defined areas.

30. (Canceled)

REMARKS

Reconsideration of this application as amended is respectfully requested. Claims 1-30 are pending. Claims 24, 25, 28, and 30 are canceled. Claims 1, 6, and 22 are amended. No claims are withdrawn. Applicants respectfully request reconsideration of the present rejections. Applicants believe this communication to be fully responsive to all issues raised in the Action.

Claim Amendments

The amendments to the claims are fully supported by the specification as originally filed, and no new matter will be added by entry of the amendment. The amendments to the claims are made to satisfy Applicants' preferences, not necessarily to satisfy any legal requirement(s) of the patent laws. The amendments clarify the claims and are not intended to limit the scope of equivalents to which any claim element may be entitled. Applicants respectfully request reconsideration of the above-identified application in view of the amendments above and the remarks that follow.

§112 Rejections

Claims 24 and 25 were rejected under 35 U.S.C. § 112, second paragraph, as allegedly being indefinite for failing to point out and distinctly claim the subject matter which the applicant regards as the rejection.

Merely in the interest of advancing prosecution and without conceding the propriety of the rejection, Applicants have canceled claims 24 and 25, obviating the rejection.

§102 Rejections

Claims 1-7, 9-11, 14, 15, 17-23, 26, 27, and 29 were rejected under 35 U.S.C. § 102(e) as allegedly anticipated by Hristov (U.S. Published Application No, 2007/0008299, now U.S. Patent Number No. 7,821,502, hereinafter "Hristov").

In the Non-Final Office Action mailed June 10, 2011, the Examiner stated that claims 28 and 30 were objected to as being dependent upon a rejected base claim but would be allowable if rewritten in independent form including all of the limitations of the base claim and any intervening claims.

Merely in the interest of advancing prosecution and without conceding the propriety of the rejection, Applicants have cancelled claims 28 and 30 and incorporated the claimed features of claim 28 into claims 1 and 22, and incorporated the claimed features of claim 30 into claim 6.

Applicants submit that claims 1, 6, and 22, as amended, are not anticipated by Hristov for at least the reasons stated by the Examiner in the Non-Final Office Action mailed June 10, 2011. Amended claims 1, 6, and 22 are therefore in condition for allowance and Applicants respectfully request notification of same.

Claims 2-5, 9-11, 14, 15, 17-21, 23, 26, 27, and 29 are dependent on claims 1, 6, or 22 and incorporate all of the features therein. Applicants submit that claims 2-5, 9-11, 14, 15, 17-21, 23, 26, 27, and 29 are allowable for at least the reasons given for claim 1, 6, and 22 and respectfully request notification of same.

§*103 Rejections*

Claims 12 and 13 were rejected under 35 U.S.C. § 103(a) as allegedly unpatentable over Hristov.

Claims 12 and 13 are dependent on claim 6 and incorporate all of the features therein. Applicants submit that claims 12 and 13 are allowable for at least the reasons given for claim 6, and respectfully request notification of same.

Allowed Claims

The Examiner objected to claims 8, 16, 28, and 30 as being dependent upon a rejected base claim, but that stated that they would be allowable if rewritten in independent form including all of the limitations of the base claim and any intervening claims.

Merely in the interest of advancing prosecution and without conceding the propriety of the objection, Applicants have amended claims 1 and 22 to include the features of claim 28, and amended claim 6 to include the features of claim 30. Applicants have canceled claims 28 and 30, obviating the objection. Applicants respectfully submit that adding the allowable material of claim 30 to claim 6, as amended, obviates the objection to claims 8 and 16, which are dependent on claim 6.

Applicants submit that claims 8 and 16 are in condition for allowance and respectfully request notification of same.

Reservation of Rights

Applicants believe every assertion by the Office Action has been addressed, however in the interest of clarity and brevity, Applicants may not have asserted every available argument for each assertion made in the Office Action. Applicants reserve all rights not exercised in connection with this response, such as the right to challenge or rebut any tacit or explicit characterization of any reference or of any of the present claims, the right to challenge or rebut any asserted factual or legal basis of any of the rejections, the right to swear behind any cited reference such as provided under 37 C.F.R. § 1.131 or otherwise, or the right to assert co-ownership of any cited reference. Applicants do not admit that any of the cited references or any other references of record is relevant to the present claims, or that they constitute prior art. To the extent that any rejection or assertion is based upon the Examiner's personal knowledge, rather than any objective evidence of record as manifested by a cited prior art reference, Applicants timely object to such reliance on Official Notice, and reserve all rights to request that the Examiner provide a reference or affidavit in support of such assertion, as required by MPEP § 2144.03. Applicants reserve all rights to pursue any cancelled claims in a subsequent patent application claiming the benefit of priority of the present patent application, and to request rejoinder of any withdrawn claim, as required by MPEP § 821.04.

Conclusion

Applicants respectfully submit that the claims are in condition for allowance and notification to that effect is earnestly requested. The Examiner is invited to telephone Applicants' agent, Ryan Seguine, at (425) 753-4459.

Please charge any additional fees under 37 CFR §§ 1.16, 1.17, 1.18, 1.20 and 1.21 that may be required to maintain pendency of the present application, or apply any credits to our PTO deposit account number: 50-3781.

Respectfully submitted,

Liu Hua and Jiang XiaoPing

By their Representative,

Date: June 24, 2011

By: /Ryan Seguine/
Ryan D. Seguine
Reg. No. 64,577

Cypress Semiconductor Corporation
198 Champion Court
San Jose, CA 95134
Facsimile: (408) 545-6911

Customer No. 60909

Electronic Acknowledgement Receipt

EFS ID:	10384348
Application Number:	11440924
International Application Number:	
Confirmation Number:	9376
Title of Invention:	CAPACITANCE SENSING MATRIX FOR KEYBOARD ARCHITECTURE
First Named Inventor/Applicant Name:	Liu Hua
Customer Number:	60909
Filer:	Andrew J. Bateman/Hilary Link
Filer Authorized By:	Andrew J. Bateman
Attorney Docket Number:	CD06015
Receipt Date:	24-JUN-2011
Filing Date:	25-MAY-2006
Time Stamp:	16:15:44
Application Type:	Utility under 35 USC 111(a)

Payment information:

Submitted with Payment	no

File Listing:

Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
1	Amendment/Req. Reconsideration-After Non-Final Reject	CD06015_NonFinalOAResponse_06242011.pdf	59983 10d1ddfa9f6c10357df53163122fd1f672fd7cb5	no	14

Warnings:

Information:

Total Files Size (in bytes):	59983

This Acknowledgement Receipt evidences receipt on the noted date by the USPTO of the indicated documents, characterized by the applicant, and including page counts, where applicable. It serves as evidence of receipt similar to a Post Card, as described in MPEP 503.

New Applications Under 35 U.S.C. 111
If a new application is being filed and the application includes the necessary components for a filing date (see 37 CFR 1.53(b)-(d) and MPEP 506), a Filing Receipt (37 CFR 1.54) will be issued in due course and the date shown on this Acknowledgement Receipt will establish the filing date of the application.

National Stage of an International Application under 35 U.S.C. 371
If a timely submission to enter the national stage of an international application is compliant with the conditions of 35 U.S.C. 371 and other applicable requirements a Form PCT/DO/EO/903 indicating acceptance of the application as a national stage submission under 35 U.S.C. 371 will be issued in addition to the Filing Receipt, in due course.

New International Application Filed with the USPTO as a Receiving Office
If a new international application is being filed and the international application includes the necessary components for an international filing date (see PCT Article 11 and MPEP 1810), a Notification of the International Application Number and of the International Filing Date (Form PCT/RO/105) will be issued in due course, subject to prescriptions concerning national security, and the date shown on this Acknowledgement Receipt will establish the international filing date of the application.

UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
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Alexandria, Virginia 22313-1450
www.uspto.gov

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
11/440,924	05/25/2006	Liu Hua	CD06015	9376

60909 7590 06/10/2011
CYPRESS SEMICONDUCTOR CORPORATION
198 CHAMPION COURT
SAN JOSE, CA 95134-1709

EXAMINER	
EDWARDS JR, TIMOTHY	

ART UNIT	PAPER NUMBER
2612	

MAIL DATE	DELIVERY MODE
06/10/2011	PAPER

Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

PTOL-90A (Rev. 04/07)

Office Action Summary	Application No.	Applicant(s)
	11/440,924	HUA ET AL.
	Examiner	**Art Unit**
	TIMOTHY EDWARDS JR	2612

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *12 October 2010*.

2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *1-30* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☐ Claim(s) *1-7,9-15,17-27 and 29* is/are rejected.

7)☐ Claim(s) *8,16,28 and 30* is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☐ The drawing(s) filed on _____ is/are: a)☐ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☒ Information Disclosure Statement(s) (PTO/SB/08)
Paper No(s)/Mail Date _____.
4) ☐ Interview Summary (PTO-413)
Paper No(s)/Mail Date. _____ .
5) ☐ Notice of Informal Patent Application
6) ☐ Other: _____.

DETAILED ACTION

Claim Rejections - 35 USC § 112

1. The following is a quotation of the second paragraph of 35 U.S.C. 112:

> The specification shall conclude with one or more claims particularly pointing out and distinctly claiming the subject matter which the applicant regards as his invention.

2. Claims 24 and 25 rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention.

Claim 24 recite “means for reducing a number of capacitance sensing pins”. Examiner is unclear how this reduction is accomplished by software, hardware or both.

Claim 25 recite “means for reducing total area of the sensing device while maintaining a number of keyboard keys on a device”. Examiner is unclear how this reduction is accomplished by software, hardware or both.

Claim Rejections - 35 USC § 102

1. The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

> A person shall be entitled to a patent unless –
>
> (e) the invention was described in (1) an application for patent, published under section 122(b), by another filed in the United States before the invention by the applicant for patent or (2) a patent granted on an application for patent by another filed in the United States before the invention by the applicant for patent, except that an international application filed under the treaty defined in section 351(a) shall have the effects for purposes of this subsection of an application filed in the United States only if the international application designated the United States and was published under Article 21(2) of such treaty in the English language.

2. Claims 1-7, 9-11, 14, 15, 17-23, 26, 27, 29 are rejected under 35 U.S.C. 102(e) as being anticipated by Hristov 2007/0008299.

Considering claim 1, Hristov teaches a method comprising **a**) assigning a plurality of keyboard keys to a pre-defined areas of a sensing surface of a sensing device having a plurality of capacitance sensing pins to couple the plurality of sensor elements to a processing device (see paragraph 0009 and fig 3, items 28 and 44); **a1**) wherein the pre-defined areas are disposed adjacent to one another (see fig 3); **b**) determining a position of a presence of the conductive object on the sensing device by measuring capacitance of the plurality of sensing pins (see paragraph 0036); c) selecting a keyboard key of the plurality of keyboard keys when position of the presence of the conductive object is determined to be within the pre-defined area of the sensing device corresponding to the keyboard key (see paragraph 0022).

Considering claim 2 Hristov teaches the limitation of this claim (see paragraph 0036).

Considering claim 3 Hristov teaches the limitation of this claim (see paragraph 0047 and fig 3, items 44 and 46).

Considering claim 4 Hristov teaches the limitation of this claim (see paragraph 0046 and fig 3).

Considering claim 5 Hristov teaches the limitation of this claim (see paragraph 0051).

Considering claim 6 Hristov teaches the limitation of this claim (see paragraphs 0045-0047 and fig 3).

Considering claims 7, 9-11 Hristov teaches the limitation of this claim (see paragraph 0021 and fig 3, item 42).

Considering claim 14 Hristov teaches the limitation of this claim (see fig 3, item 44).

Considering claims 15, 27, 29 the limitations of these claims are interpreted and rejected as stated in claim 4.

Considering claim 17 the limitation of this claim is interpreted and rejected as stated in claim 3.

Considering claim 18 Hristov teaches the limitation of this claim (see fig 3, item 46).

Considering claim 19 Hristov teaches the limitation of this claim (see paragraph 0050).

Considering claim 20 Hristov teaches the limitation of this claim (see paragraph 0021).

Considering claim 21 Hristov teaches the limitation of this claim (see paragraph 0021).

Considering claim 22 the limitations of this claim are interpreted and rejected as stated in claim 1.

Considering claim 23 Hristov teaches the limitation of this claim (see fig 3).

Considering claim 26 Hristov teaches the limitation of this claim (see paragraph 0047 and fig 3).

Claim Rejections - 35 USC § 103

3. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

4. Claims 12, 13 are rejected under 35 U.S.C. 103(a) as being unpatentable over Hristov ‘299.

Considering claims 12, 13 Hristov does not specifically recite the size of the surface area of the keyboard keys. One of ordinary skill in the art readily recognizes the key area has become increasingly smaller to accommodate smaller size devices. Therefore, it would have been obvious to one of ordinary skill in the art to use any desired size key for the keyboard taught by Hristov because key size is dictated by the size of the device they are used on.

Allowable Subject Matter

5. Claims 8, 16, 28, 30 are objected to as being dependent upon a rejected base claim, but would be allowable if rewritten in independent form including all of the limitations of the base claim and any intervening claims.

Conclusion

6. The prior art made of record and not relied upon is considered pertinent to applicant's disclosure. See PTO-892.

If the claimed invention is amended, Applicant is respectfully requested to indicate the portion(s) of the specification, which dictate(s) the structure/description relied upon to assist the Examiner in proper interpretation of the amended language and also to verify and ascertain the metes and bounds of the claimed invention.

Any inquiry concerning this communication should be directed to Examiner Timothy Edwards, Jr. at telephone number (571) 272-3067. The examiner can normally be reached on Monday-Thursday, 8:00 a.m.-6:00 p.m. The examiner cannot be reached on Fridays.

If attempt to reach the Examiner by telephone are unsuccessful, the Examiner's Supervisor, Brian Zimmerman, can be reached at (571) 272-3059.

Any inquiry of a general nature or relating to the status of this application should be directed to the Group receptionist whose telephone number is (571) 272-4700, Mon-Fri., 8:30 a.m.-5:00 p.m.

Any response to this action should be fax to:

(571) 273-8300 (for formal communications intended for entry).

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http:/pair-direct.uspto.gov or contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

/Timothy Edwards, Jr. /
Primary Examiner, Art Unit 2612
June 8, 2011

Notice of References Cited	Application/Control No. 11/440,924	Applicant(s)/Patent Under Reexamination HUA ET AL.	
	Examiner TIMOTHY EDWARDS JR	Art Unit 2612	Page 1 of 1

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	E	US-			
	F	US-			
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	I	US-			
	J	US-			
	K	US-			
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*A copy of this reference is not being furnished with this Office action. (See MPEP § 707.05(a).)
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INFORMATION DISCLOSURE STATEMENT BY APPLICANT (**Not for submission under 37 CFR 1.99)**		
	Application Number	11440924
	Filing Date	2006-05-25
	First Named Inventor	Liu Hua
	Art Unit	2612
	Examiner Name	Timothy Edwards Jr.
	Attorney Docket Number	CD06015

U.S.PATENTS Remove

Examiner Initial*	Cite No	Patent Number	Kind Code[1]	Issue Date	Name of Patentee or Applicant of cited Document	Pages,Columns,Lines where Relevant Passages or Relevant Figures Appear
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	Examiner Name	Timothy Edwards Jr.
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	1	USPTO Non-Final Rejection for Application Number 11/395,674 (CD06025) dated 04/19/2010; 15 pages	☐
	2	USPTO Non-Final Rejection for Application Number 11/395,674 (CD06025) dated 11/18/2009; 11 pages	☐
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	Examiner Name	Timothy Edwards Jr.
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EXAMINER SIGNATURE

Examiner Signature	/Timothy Edwards Jr/	Date Considered	10/25/2010

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

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Index of Claims	Application/Control No. 11440924	Applicant(s)/Patent Under Reexamination HUA ET AL.
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✓	Rejected	-	Cancelled	N	Non-Elected	A	Appeal
=	Allowed	÷	Restricted	I	Interference	O	Objected

☐ Claims renumbered in the same order as presented by applicant ☐ CPA ☐ T.D. ☐ R.1.47

CLAIM		DATE								
Final	Original	03/09/2009	01/19/2010	06/07/2011						
	1	✓	✓	✓						
	2	✓	✓	✓						
	3	✓	✓	✓						
	4	✓	✓	✓						
	5	✓	✓	✓						
	6	✓	✓	✓						
	7	✓	✓	✓						
	8	✓	✓	O						
	9	✓	✓	✓						
	10	✓	✓	✓						
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	28		✓	O						
	29		✓	✓						
	30		✓	O						

EAST Search History

EAST Search History (Prior Art)

Ref #	Hits	Search Query	DBs	Default Operator	Plurals	Time Stamp
L2	97	1 and (keyboard keypad screen) and (touch near5 (space area))	US-PGPUB; USPAT; EPO; JPO; DERWENT	OR	ON	2011/05/10 16:14
L3	95	2 and (touch near5 area)	US-PGPUB; USPAT; EPO; JPO; DERWENT	OR	ON	2011/05/10 16:14
L4	73	3 and ($4defined near5 area)	US-PGPUB; USPAT; EPO; JPO; DERWENT	OR	ON	2011/05/10 16:15

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EAST Search History (Prior Art)

Ref #	Hits	Search Query	DBs	Default Operator	Plurals	Time Stamp
L1	1364	("20030064326" | "20040017355" | "20050023145" | "20050231487" | "20060026521" | "20060026536" | "20060032680" | "20060197752" | "20060197753" | "20070074913" | "20070132737" | "20070177803" | "20070229468" | "20070229469" | "20070229470" | "20070236475" | "20070247431" | "20070262962" | "20080041640" | "20080042994" | "20080048997" | "20080084400" | "20080088602" | "20080122796" | "20080165132" | "20080165140" | "20080165141" | "20080165255" | "20080192005" | "20080204426" | "20080264699" | "20080316183" | "4340777" | "4614937" | "4879508" | "5424756" | "5543591" | "5565658" | "5646377" | "5648642" | "5748185" | "5856822" | "5880411" | "5889236" | "5943052" |	US-PGPUB; USPAT; EPO; JPO; DERWENT	OR	ON	2010/10/25 08:14

		"6067019" | "6380931" | "6414671" | "6424338" | "6429857" | "6452514" | "6597347" | "6610936" | "6750852" | "6762752" | "6825890" | "6861961" | "6970160" | "7006078" | "7030860" | "7046230" | "7109978" | "7129935" | "7151276" | "7239302" | "7327352" | "7362313" | "7423635" | "7439962" | "7446300" | "7450113" | "7466307" | "7479949" | "7532205" | "7539513" | "7656392" | "7663607" | "7710397" | "7719522" | "7728377" | "7863582")				
L2	73	1 and ((capacit$6 near5 (sens$4 measur $5)) same pin) and (position$5 near6 (sens $4 determin$6))	US-PGPUB; USPAT; EPO; JPO; DERWENT	OR	ON	2010/10/25 08:16
L3	23	2 and (keyboard keypad) and (defin$9 near5 (area space coordan$6))	US-PGPUB; USPAT; EPO; JPO; DERWENT	OR	ON	2010/10/25 08:18

EAST Search History (Interference)

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PTO/SB/30EFS (07-09)
Approved for use through 07/31/2012. OMB 0651-0031
U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE

REQUEST FOR CONTINUED EXAMINATION(RCE)TRANSMITTAL
(Submitted Only via EFS-Web)

Application Number	11/440,924	Filing Date	2006-05-25	Docket Number (if applicable)	CD06015	Art Unit	2612
First Named Inventor	Liu Hua			Examiner Name	Timothy Edwards Jr.		

This is a Request for Continued Examination (RCE) under 37 CFR 1.114 of the above-identified application.
Request for Continued Examination (RCE) practice under 37 CFR 1.114 does not apply to any utility or plant application filed prior to June 8, 1995, or to any design application. The Instruction Sheet for this form is located at WWW.USPTO.GOV

SUBMISSION REQUIRED UNDER 37 CFR 1.114

Note: If the RCE is proper, any previously filed unentered amendments and amendments enclosed with the RCE will be entered in the order in which they were filed unless applicant instructs otherwise. If applicant does not wish to have any previously filed unentered amendment(s) entered, applicant must request non-entry of such amendment(s).

☐ Previously submitted. If a final Office action is outstanding, any amendments filed after the final Office action may be considered as a submission even if this box is not checked.

- ☐ Consider the arguments in the Appeal Brief or Reply Brief previously filed on ____________
- ☐ Other ____________

☒ Enclosed

- ☐ Amendment/Reply
- ☒ Information Disclosure Statement (IDS)
- ☐ Affidavit(s)/ Declaration(s)
- ☐ Other ____________

MISCELLANEOUS

☐ Suspension of action on the above-identified application is requested under 37 CFR 1.103(c) for a period of months ____________
(Period of suspension shall not exceed 3 months; Fee under 37 CFR 1.17(i) required)

☐ Other ____________

FEES

☒ **The RCE fee under 37 CFR 1.17(e) is required by 37 CFR 1.114 when the RCE is filed.**
The Director is hereby authorized to charge any underpayment of fees, or credit any overpayments, to Deposit Account No 503781

SIGNATURE OF APPLICANT, ATTORNEY, OR AGENT REQUIRED

☒ Patent Practitioner Signature
☐ Applicant Signature

PTO/SB/30EFS (07-09)
Approved for use through 07/31/2012. OMB 0651-0031
U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE

Signature of Registered U.S. Patent Practitioner			
Signature	/Larry Johnson/	Date (YYYY-MM-DD)	2010-10-12
Name	Larry Johnson	Registration Number	56861

Privacy Act Statement

The Privacy Act of 1974 (P.L. 93-579) requires that you be given certain information in connection with your submission of the attached form related to a patent application or patent. Accordingly, pursuant to the requirements of the Act, please be advised that: (1) the general authority for the collection of this information is 35 U.S.C. 2(b)(2); (2) furnishing of the information solicited is voluntary; and (3) the principal purpose for which the information is used by the U.S. Patent and Trademark Office is to process and/or examine your submission related to a patent application or patent. If you do not furnish the requested information, the U.S. Patent and Trademark Office may not be able to process and/or examine your submission, which may result in termination of proceedings or abandonment of the application or expiration of the patent.

The information provided by you in this form will be subject to the following routine uses:

1. The information on this form will be treated confidentially to the extent allowed under the Freedom of Information Act (5 U.S.C. 552) and the Privacy Act (5 U.S.C. 552a). Records from this system of records may be disclosed to the Department of Justice to determine whether the Freedom of Information Act requires disclosure of these records.

2. A record from this system of records may be disclosed, as a routine use, in the course of presenting evidence to a court, magistrate, or administrative tribunal, including disclosures to opposing counsel in the course of settlement negotiations.

3. A record in this system of records may be disclosed, as a routine use, to a Member of Congress submitting a request involving an individual, to whom the record pertains, when the individual has requested assistance from the Member with respect to the subject matter of the record.

4. A record in this system of records may be disclosed, as a routine use, to a contractor of the Agency having need for the information in order to perform a contract. Recipients of information shall be required to comply with the requirements of the Privacy Act of 1974, as amended, pursuant to 5 U.S.C. 552a(m).

5. A record related to an International Application filed under the Patent Cooperation Treaty in this system of records may be disclosed, as a routine use, to the International Bureau of the World Intellectual Property Organization, pursuant to the Patent Cooperation Treaty.

6. A record in this system of records may be disclosed, as a routine use, to another federal agency for purposes of National Security review (35 U.S.C. 181) and for review pursuant to the Atomic Energy Act (42 U.S.C. 218(c)).

7. A record from this system of records may be disclosed, as a routine use, to the Administrator, General Services, or his/her designee, during an inspection of records conducted by GSA as part of that agency's responsibility to recommend improvements in records management practices and programs, under authority of 44 U.S.C. 2904 and 2906. Such disclosure shall be made in accordance with the GSA regulations governing inspection of records for this purpose, and any other relevant (i.e., GSA or Commerce) directive. Such disclosure shall not be used to make determinations about individuals.

8. A record from this system of records may be disclosed, as a routine use, to the public after either publication of the application pursuant to 35 U.S.C. 122(b) or issuance of a patent pursuant to 35 U.S.C. 151. Further, a record may be disclosed, subject to the limitations of 37 CFR 1.14, as a routine use, to the public if the record was filed in an application which became abandoned or in which the proceedings were terminated and which application is referenced by either a published application, an application open to public inspections or an issued patent.

9. A record from this system of records may be disclosed, as a routine use, to a Federal, State, or local law enforcement agency, if the USPTO becomes aware of a violation or potential violation of law or regulation.

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Application of:	
Liu Hua, et al.	Examiner: Timothy Edwards Jr.
Application No.: 11/440,924	Group Art Unit: 2612
Filed: May 25, 2006	Confirmation No.: 9376
For: Capacitance Sensing Matrix for Keyboard Architecture	

REQUEST FOR CONTINUED EXAMINATION AND INFORMATION DISCLOSURE STATEMENT

Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Sir:

Applicant hereby submits the Request for Continued Examination to be considered with the IDS for the above referenced application. In compliance with the duty of disclosure under 37 CFR § 1.56 and in accordance with the practice under 37 CFR §§ 1.97 and 1.98, the Examiner's attention is directed to the documents listed on the enclosed PTO-1449.

In accordance with 37 CFR § 1.97(h), this Information Disclosure Statement is not to be construed as an admission that the information cited is or is considered to be material to patentability as defined in 37 CFR § 1.56(b), nor as an admission that the information constitutes prior art within the meaning of 35 USC §§ 102 and/or 103.

It is respectfully requested that the information listed on the PTO-1449 be considered by the Examiner, and that an initialed copy of the PTO-1449 be returned indicating that such information was considered.

Customer No.: 60909

The Commissioner is hereby authorized to charge any appropriate fees under 37 C.F.R. §§ 1.16, 1.17, 1.18, 1.20 and 1.21 that may be required to maintain pendency of the present application, and to credit any overpayments, to Deposit Account No. 50-3781.

Should the Patent Office have any questions regarding this submission or the application in general, the Patent Office is urged to contact the Applicant's attorney, Larry Johnson, by telephone at (408) 545-7194. All correspondence should continue to be directed to the address given below.

/

/

Respectfully submitted,

Date: 10/12/10

By: Larry Johnson
Attorney for Applicant
Registration No. 56,861

Cypress Semiconductor Corporation
198 Champion Court
San Jose, CA 95134
Facsimile: (408) 545-6911
Customer No.: 60909

INFORMATION DISCLOSURE STATEMENT BY APPLICANT (**Not for submission under 37 CFR 1.99)**		
	Application Number	11440924
	Filing Date	2006-05-25
	First Named Inventor	Liu Hua
	Art Unit	2612
	Examiner Name	Timothy Edwards Jr.
	Attorney Docket Number	CD06015

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Examiner Initial*	Cite No	Patent Number	Kind Code1	Issue Date	Name of Patentee or Applicant of cited Document	Pages,Columns,Lines where Relevant Passages or Relevant Figures Appear
	1	4614937	B1	1986-09-30	Poujois, Robert	Entire Document
	2	6597347	B1	2003-07-22	Yasutake, Taizo	Entire Document
	3	6067019	B1	2000-05-23	Scott, Thomas E.	Entire Document
	4	5543591	B1	1996-08-06	Gillespie et al.	Entire Document
	5	5748185	B1	1998-05-05	Stephan et al.	Entire Document
	6	5943052	B1	1999-08-24	Allen et al.	Entire Document
	7	6414671	B1	2002-07-02	Gillespie et al.	Entire Document
	8	6825890	B1	2004-11-30	Matsufusa	Entire Document

INFORMATION DISCLOSURE STATEMENT BY APPLICANT (**Not for submission under 37 CFR 1.99)**	Application Number	11440924
	Filing Date	2006-05-25
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	Examiner Name	Timothy Edwards Jr.
	Attorney Docket Number	CD06015

	9	7030860	B1	2006-04-18	Hsu et al.	Entire Document
	10	7663607	B1	2010-02-16	Hotelling et al.	Entire Document
	11	7719522	B1	2010-05-18	Lyon et al.	Entire Document
	12	7539513	B1	2009-05-26	Cathey et al.	Entire Document
	13	7532205	B1	2009-05-12	Gillespie et al.	Entire Document
	14	7710397	B1	2010-05-04	Krah et al.	Entire Document
	15	7439962	B1	2008-10-21	Reynolds et al.	Entire Document
	16	7151276	B1	2006-12-19	Gerlach et al.	Entire Document
	17	7109978	B1	2006-09-19	Gillespie et al.	Entire Document
	18	7129935	B1	2006-10-31	Mackey, Bob Lee	Entire Document
	19	7327352	B1	2008-02-05	Keefer et al.	Entire Document

INFORMATION DISCLOSURE STATEMENT BY APPLICANT (**Not for submission under 37 CFR 1.99)**	Application Number	11440924
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	Examiner Name	Timothy Edwards Jr.
	Attorney Docket Number	CD06015

	20	7006078	B1	2006-02-28	Kim, Wonchan	Entire Document
	21	6861961	B1	2005-03-01	Sandbach et al.	Entire Document
	22	6452514	B1	2002-09-17	Philipp, Harald	Entire Document
	23	6380931	B1	2002-04-30	Gillespie et al.	Entire Document
	24	5424756	B1	1995-06-13	Ho et al.	Entire Document
	25	4879508	B1	1989-11-07	Andermo, Nils I.	Entire Document
	26	6762752	B1	2004-07-13	Perski et al.	Entire Document
	27	6429857	B1	2002-08-06	Masters et al.	Entire Document
	28	4340777	B1	1982-07-20	DeCosta et al.	Entire Document
	29	5856822	B1	1999-01-05	Du et al.	Entire Document
	30	5880411	B1	1999-03-09	Gillespie et al.	Entire Document

INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)	Application Number		11440924
	Filing Date		2006-05-25
	First Named Inventor	Liu Hua	
	Art Unit		2612
	Examiner Name	Timothy Edwards Jr.	
	Attorney Docket Number		CD06015

	31	5889236	B1	1999-03-30	Gillespie et al.	Entire Document
	32	7362313	B1	2008-04-22	Geaghan et al.	Entire Document
	33	6610936	B1	2003-08-26	Gillespie et al.	Entire Document
	34	6750852	B1	2004-06-15	Gillespie et al.	Entire Document
	35	7450113	B1	2008-11-11	Gillespie et al.	Entire Document
	36	7479949	B1	2009-01-20	Jobs et al.	Entire Document
	37	6424338	B1	2002-07-23	Anderson, Glen J.	Entire Document
	38	7863582	B1	2009-12-22	Finley et al.	Entire Document
	39	7446300	B1	2008-11-04	Silvestre, Josep Montanya	Entire Document
	40	5646377	B1	1997-07-08	Oda, Yasuo	Entire Document
	41	7046230	B1	2006-05-16	Zadesky et al.	Entire Document

INFORMATION DISCLOSURE STATEMENT BY APPLICANT
(**Not for submission under 37 CFR 1.99)**

Application Number	11440924
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Art Unit	2612
Examiner Name	Timothy Edwards Jr.
Attorney Docket Number	CD06015

	42	7656392	B1	2010-02-02	Bolender, Robert J.	Entire Document
	43	6970160	B1	2005-11-29	Mulligan et al.	Entire Document
	44	7239302	B1	2007-07-03	Kim, In-Gwang	Entire Document
	45	7728377	B1	2010-06-01	Elsass et al.	Entire Document
	46	7030860	B1	2006-04-18	Hsu et al.	Entire Document
	47	5648642	B1	1997-07-15	Miller et al.	Entire Document
	48	5565658	B1	1996-10-15	Gerpheide et al.	Entire Document
	49	7663607	B1	2010-02-16	Hotelling et al.	Entire Document
	50	7423635	B1	2008-09-09	Taylor et al.	Entire Document
	51	7466307	B1	2008-12-16	Trent Jr. et al.	Entire Document

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INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)		
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	Attorney Docket Number	CD06015

Examiner Initial*	Cite No	Publication Number	Kind Code1	Publication Date	Name of Patentee or Applicant of cited Document	Pages,Columns,Lines where Relevant Passages or Relevant Figures Appear
	1	20040017355	A1	2004-01-29	Shim, Youngtack	Entire Document
	2	20070262962	A1	2007-11-15	XiaoPing et al.	Entire Document
	3	20030064326	A1	2003-04-03	Yamamoto et al.	Entire Document
	4	20050023145	A1	2005-02-03	Cohen et al.	Entire Document
	5	20050231487	A1	2005-10-20	Ming, Jheng Ci	Entire Document
	6	20070229468	A1	2007-10-04	Peng et al.	Entire Document
	7	20060197752	A1	2006-09-07	Hurst et al.	Entire Document
	8	20070132737	A1	2007-06-14	Mulligan et al.	Entire Document
	9	20070074913	A1	2007-04-05	Geaghan et al.	Entire Document
	10	20060026536	A1	2006-02-02	Hotelling et al.	Entire Document

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	11	20060026521	A1	2006-02-02	Hotelling et al.	Entire Document
	12	20060197753	A1	2006-09-07	Hotelling et al.	Entire Document
	13	20070177803	A1	2007-08-02	Elias et al.	Entire Document
	14	20080041640	A1	2008-02-21	Gillespie et al.	Entire Document
	15	20080042994	A1	2008-02-21	Gillespie et al.	Entire Document
	16	20080048997	A1	2008-02-28	Gillespie et al.	Entire Document
	17	20080084400	A1	2008-04-10	Rosenberg, Louis B.	Entire Document
	18	20080088602	A1	2008-04-17	Hotelling et al.	Entire Document
	19	20080122796	A1	2008-05-29	Jobs et al.	Entire Document
	20	20080165132	A1	2008-07-10	Weiss et al.	Entire Document
	21	20080165140	A1	2008-07-10	Christie et al.	Entire Document

INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)	Application Number	11440924
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	First Named Inventor	Liu Hua
	Art Unit	2612
	Examiner Name	Timothy Edwards Jr.
	Attorney Docket Number	CD06015

	22	20080165141	A1	2008-07-10	Christie et al.	Entire Document
	23	20080165255	A1	2008-07-10	Christie et al.	Entire Document
	24	20080192005	A1	2008-08-14	Elgoyhen et al.	Entire Document
	25	20080204426	A1	2008-08-28	Hotelling et al.	Entire Document
	26	20080316183	A1	2008-12-25	Westerman et al.	Entire Document
	27	20070262962	A1	2007-11-15	XiaoPing et al.	Entire Document
	28	20070229470	A1	2007-10-07	Snyder et al.	Entire Document
	29	20070229469	A1	2007-10-04	Seguine, Ryan	Entire Document
	30	20080264699	A1	2008-10-30	Chang et al.	Entire Document
	31	20060032680	A1	2006-02-16	Elias et al.	Entire Document
	32	20070247431	A1	2007-10-25	Skillman et al.	Entire Document

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	Examiner Name	Timothy Edwards Jr.
	Attorney Docket Number	CD06015

	33	20070236475	A1	2007-10-11	Wherry, Elaine	Entire Document

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	1	USPTO Non-Final Rejection for Application Number 11/395,674 (CD06025) dated 04/19/2010; 15 pages	☐
	2	USPTO Non-Final Rejection for Application Number 11/395,674 (CD06025) dated 11/18/2009; 11 pages	☐
	3	USPTO Final Rejection for Application Number 11/395,674 (CD06025) dated 07/16/2009; 12 pages	☐
	4	USPTO Non-Final Rejection for Application Number 11/395,674 (CD06025) dated 02/10/2009; 10 pages	☐
	5	USPTO Final Rejection for Application Number 11/432,130 (CD06031) dated 07/19/2010; 15 pages	☐

INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)		
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	Art Unit	2612
	Examiner Name	Timothy Edwards Jr.
	Attorney Docket Number	CD06015

	6	USPTO Non-Final Rejection for Application Number 11/432,130 (CD06031) dated 03/24/2010; 15 pages	☐
	7	USPTO Final Rejection for Application Number 11/432,130 (CD06031) dated 11/30/2009; 15 pages	☐
	8	USPTO Non-Final Rejection for Application Number 11/432,130 (CD06031) dated 06/09/2009; 14 pages	☐
	9	USPTO Requirement for Restriction/Election for Application Number 11/432,130 (CD06031) dated 03/31/2009; 6 pages	☐
	10	Chris Mack, "Semiconductor Lithography - The Basic Process," Gentleman Scientist, downloaded 04/20/2006, <http://www.lithoguru.com/scientist/lithobasics.html>; 12 pages	☐
	11	Wikipedia, the free encyclopedia, "Photolithography," downloaded 04/20/2006, <http://en.wikipedia.org/wiki/Photolithography>; 3 pages	☐
	12	USPTO Notice of Allowance for Application Number 11/396,179 (CD06024) dated 05/20/2010; 11 pages	☐
	13	USPTO Notice of Allowance for Application Number 11/396,179 (CD06024) dated 10/08/2009; 7 pages	☐
	14	USPTO Non-Final Rejection for Application Number 11/396,179 (CD06024) dated 03/19/2009; 25 pages	☐
	15	USPTO Requirement for Restriction/Election for Application Number 11/396,179 (CD06024) dated 02/03/2009; 6 pages	☐
	16	USPTO Non-Final Rejection for Application Number 11/395,674 (CD06025) dated 08/27/2010; 15 pages	☐

INFORMATION DISCLOSURE STATEMENT BY APPLICANT (**Not for submission under 37 CFR 1.99)**	Application Number		11440924
	Filing Date		2006-05-25
	First Named Inventor	Liu Hua	
	Art Unit		2612
	Examiner Name	Timothy Edwards Jr.	
	Attorney Docket Number		CD06015

	17	USPTO Advisory Action for Application Number 11/605,506 (CD06129) dated 04/12/2010; 3 pages	☐
	18	USPTO Final Rejection for Application Number 11/605,506 (CD06129) dated 02/03/2010; 14 pages	☐
	19	USPTO Non-Final Rejection for Application Number 11/605,506 (CD06129) dated 08/11/2009; 11 pages	☐
	20	USPTO Final Rejection for Application Number 11/605,819 (CD06054) dated 02/02/2010; 15 pages	☐
	21	USPTO Non-Final Rejection for Application Number 11/605,819 (CD06054) dated 08/11/2009; 12 pages	☐

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EXAMINER SIGNATURE

Examiner Signature		Date Considered	

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

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

INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)		
	Application Number	11440924
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	First Named Inventor	Liu Hua
	Art Unit	2612
	Examiner Name	Timothy Edwards Jr.
	Attorney Docket Number	CD06015

CERTIFICATION STATEMENT

Please see 37 CFR 1.97 and 1.98 to make the appropriate selection(s):

☐ That each item of information contained in the information disclosure statement was first cited in any communication from a foreign patent office in a counterpart foreign application not more than three months prior to the filing of the information disclosure statement. See 37 CFR 1.97(e)(1).

OR

☐ That no item of information contained in the information disclosure statement was cited in a communication from a foreign patent office in a counterpart foreign application, and, to the knowledge of the person signing the certification after making reasonable inquiry, no item of information contained in the information disclosure statement was known to any individual designated in 37 CFR 1.56(c) more than three months prior to the filing of the information disclosure statement. See 37 CFR 1.97(e)(2).

☐ See attached certification statement.

☐ Fee set forth in 37 CFR 1.17 (p) has been submitted herewith.

☒ None

SIGNATURE

A signature of the applicant or representative is required in accordance with CFR 1.33, 10.18. Please see CFR 1.4(d) for the form of the signature.

Signature	/Larry Johnson/	Date (YYYY-MM-DD)	2010-10-12
Name/Print	Larry Johnson	Registration Number	56861

Privacy Act Statement

The Privacy Act of 1974 (P.L. 93-579) requires that you be given certain information in connection with your submission of the attached form related to a patent application or patent. Accordingly, pursuant to the requirements of the Act, please be advised that: (1) the general authority for the collection of this information is 35 U.S.C. 2(b)(2); (2) furnishing of the information solicited is voluntary; and (3) the principal purpose for which the information is used by the U.S. Patent and Trademark Office is to process and/or examine your submission related to a patent application or patent. If you do not furnish the requested information, the U.S. Patent and Trademark Office may not be able to process and/or examine your submission, which may result in termination of proceedings or abandonment of the application or expiration of the patent.

The information provided by you in this form will be subject to the following routine uses:

1. The information on this form will be treated confidentially to the extent allowed under the Freedom of Information Act (5 U.S.C. 552) and the Privacy Act (5 U.S.C. 552a). Records from this system of records may be disclosed to the Department of Justice to determine whether the Freedom of Information Act requires disclosure of these record s.

2. A record from this system of records may be disclosed, as a routine use, in the course of presenting evidence to a court, magistrate, or administrative tribunal, including disclosures to opposing counsel in the course of settlement negotiations.

3. A record in this system of records may be disclosed, as a routine use, to a Member of Congress submitting a request involving an individual, to whom the record pertains, when the individual has requested assistance from the Member with respect to the subject matter of the record.

4. A record in this system of records may be disclosed, as a routine use, to a contractor of the Agency having need for the information in order to perform a contract. Recipients of information shall be required to comply with the requirements of the Privacy Act of 1974, as amended, pursuant to 5 U.S.C. 552a(m).

5. A record related to an International Application filed under the Patent Cooperation Treaty in this system of records may be disclosed, as a routine use, to the International Bureau of the World Intellectual Property Organization, pursuant to the Patent Cooperation Treaty.

6. A record in this system of records may be disclosed, as a routine use, to another federal agency for purposes of National Security review (35 U.S.C. 181) and for review pursuant to the Atomic Energy Act (42 U.S.C. 218(c)).

7. A record from this system of records may be disclosed, as a routine use, to the Administrator, General Services, or his/her designee, during an inspection of records conducted by GSA as part of that agency's responsibility to recommend improvements in records management practices and programs, under authority of 44 U.S.C. 2904 and 2906. Such disclosure shall be made in accordance with the GSA regulations governing inspection of records for this purpose, and any other relevant (i.e., GSA or Commerce) directive. Such disclosure shall not be used to make determinations about individuals.

8. A record from this system of records may be disclosed, as a routine use, to the public after either publication of the application pursuant to 35 U.S.C. 122(b) or issuance of a patent pursuant to 35 U.S.C. 151. Further, a record may be disclosed, subject to the limitations of 37 CFR 1.14, as a routine use, to the public if the record was filed in an application which became abandoned or in which the proceedings were terminated and which application is referenced by either a published application, an application open to public inspections or an issued patent.

9. A record from this system of records may be disclosed, as a routine use, to a Federal, State, or local law enforcement agency, if the USPTO becomes aware of a violation or potential violation of law or regulation.

Electronic Patent Application Fee Transmittal

Application Number:	11440924
Filing Date:	25-May-2006
Title of Invention:	CAPACITANCE SENSING MATRIX FOR KEYBOARD ARCHITECTURE
First Named Inventor/Applicant Name:	Liu Hua
Filer:	Andrew J. Bateman/Hilary Link
Attorney Docket Number:	CD06015

Filed as Large Entity

Utility under 35 USC 111(a) Filing Fees

Description	Fee Code	Quantity	Amount	Sub-Total in USD($)
Basic Filing:				
Pages:				
Claims:				
Miscellaneous-Filing:				
Petition:				
Patent-Appeals-and-Interference:				
Post-Allowance-and-Post-Issuance:				
Extension-of-Time:				

Description	Fee Code	Quantity	Amount	Sub-Total in USD($)
Miscellaneous:				
Request for continued examination	1801	1	810	810
		Total in USD ($)		**810**

Electronic Acknowledgement Receipt

EFS ID:	8611560
Application Number:	11440924
International Application Number:	
Confirmation Number:	9376
Title of Invention:	CAPACITANCE SENSING MATRIX FOR KEYBOARD ARCHITECTURE
First Named Inventor/Applicant Name:	Liu Hua
Customer Number:	60909
Filer:	Andrew J. Bateman/Hilary Link
Filer Authorized By:	Andrew J. Bateman
Attorney Docket Number:	CD06015
Receipt Date:	12-OCT-2010
Filing Date:	25-MAY-2006
Time Stamp:	18:12:22
Application Type:	Utility under 35 USC 111(a)

Payment information:

Submitted with Payment	yes
Payment Type	Deposit Account
Payment was successfully received in RAM	$810
RAM confirmation Number	6445
Deposit Account	503781
Authorized User	

The Director of the USPTO is hereby authorized to charge indicated fees and credit any overpayment as follows:

Charge any Additional Fees required under 37 C.F.R. Section 1.16 (National application filing, search, and examination fees)

Charge any Additional Fees required under 37 C.F.R. Section 1.17 (Patent application and reexamination processing fees)

Charge any Additional Fees required under 37 C.F.R. Section 1.19 (Document supply fees)

Charge any Additional Fees required under 37 C.F.R. Section 1.20 (Post Issuance fees)

Charge any Additional Fees required under 37 C.F.R. Section 1.21 (Miscellaneous fees and charges)

File Listing:

Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
1	Request for Continued Examination (RCE)	CD06015RCEpdf.pdf	38596 b0e06064e68fb91e761cd7e94a8561c07a0 7331b	no	3
Warnings:					
This is not a USPTO supplied RCE SB30 form.					
Information:					
2	Transmittal Letter	CD06015transmittalletter.pdf	324205 c8498949d829fc349732bfc705f949841495 bb1f	no	2
Warnings:					
Information:					
3	Information Disclosure Statement (IDS) Filed (SB/08)	CD06015IDSform.pdf	615309 17311daded17588fadc22075c93371d9f8c d861b	no	13
Warnings:					
Information:					
4	NPL Documents	CD06025nonfinal041910.pdf	529725 0daf5d0e6a230ccb4e4cabb4e64cb88e7cb e1db1	no	15
Warnings:					
Information:					
5	NPL Documents	CD06025nonfinal111809.pdf	369942 84d9df5d0d9631736cb6bc99272cdb6e55a 3b3d3	no	11
Warnings:					
Information:					
6	NPL Documents	CD06025finalrejection071609.pdf	397777 fbd0ffa98864ce763dd7147b9900767f5888 8c97	no	12
Warnings:					
Information:					
7	NPL Documents	CD06025nonfinal021009.pdf	343209 80d2af64a73970a9fecdd03c5f7905cccc9c0 750	no	10
Warnings:					
Information:					

8	NPL Documents	CD06031finalrejection071910.pdf	533411 ca8d68caee08816d0e20dddf375fb67ccdb65c0d	no	15
Warnings:					
Information:					
9	NPL Documents	CD06031finalrejection113009.pdf	524553 728288dd2b79a2fdbff362d803ac2b6ca6616d27	no	15
Warnings:					
Information:					
10	NPL Documents	CD06031nonfinal032410.pdf	507198 a7b8795acb0211196884b0afb280ac895182836f	no	15
Warnings:					
Information:					
11	NPL Documents	CD06031nonfinal060909.pdf	484915 430c6635e1ea60e237a89e395975edd6061e892c	no	14
Warnings:					
Information:					
12	NPL Documents	CD06031requirementrestriction033109.pdf	178168 d97e416b83cace911d9a8d52efe65d1e9b3974f6	no	6
Warnings:					
Information:					
13	NPL Documents	CD06031mackSemiconductorLithography.pdf	695340 995fe0a9a17f72cab08b333009010d5a57ee2f53	no	12
Warnings:					
Information:					
14	NPL Documents	CD06031wikipediaPhotolithography.pdf	276109 8421264bacf435604a806b6e75d319b8ab217831	no	3
Warnings:					
Information:					
15	NPL Documents	CD06024noa052010.pdf	421811 9eca8ecf497f59d86547500bae02d750a002092e	no	11
Warnings:					
Information:					
16	NPL Documents	CD06024noa100809.pdf	202874 57c0a7ea72a491931d27179b0557fcf53e4f232e	no	7
Warnings:					
Information:					

17	NPL Documents	CD06024nonfinal031909.pdf	834385 cbaf18bef430f03d92870ef795cea76477c29d9b	no	25
Warnings:					
Information:					
18	NPL Documents	CD06024requirementrestrict020309.pdf	187069 8b45e7125eff40ec969a102807df0084ccf00a20	no	6
Warnings:					
Information:					
19	NPL Documents	CD06025nonfinal082710.pdf	559547 a80c5a8eb2614e6e1c9c4953c9d0a589dd3e1333	no	15
Warnings:					
Information:					
20	NPL Documents	CD06129advisoryaction041210.pdf	124944 29437a62f6fa10d57318ec92916994d582b8d5ad	no	3
Warnings:					
Information:					
21	NPL Documents	CD06129finalrejection020310.pdf	434531 489b5ed075e23177a4abf5335d030ebf9f8f634d	no	14
Warnings:					
Information:					
22	NPL Documents	CD06129nonfinal081109.pdf	364846 da77964bba8c3fffcf571916a71b7b630437ce3f	no	11
Warnings:					
Information:					
23	NPL Documents	CD06054finalrejection020210.pdf	500993 11141d733cca43bd2dd6916b8d943a65d68d6612	no	15
Warnings:					
Information:					
24	NPL Documents	CD06054nonfinal081109.pdf	397602 959d321cbe8ef056300dce4923b08a875a370f06	no	12
Warnings:					
Information:					
25	Fee Worksheet (PTO-875)	fee-info.pdf	30658 dcac006074cebc20dd3dfbbeef4fcb570359c20a	no	2
Warnings:					
Information:					

Total Files Size (in bytes):	9877717

This Acknowledgement Receipt evidences receipt on the noted date by the USPTO of the indicated documents, characterized by the applicant, and including page counts, where applicable. It serves as evidence of receipt similar to a Post Card, as described in MPEP 503.

New Applications Under 35 U.S.C. 111
If a new application is being filed and the application includes the necessary components for a filing date (see 37 CFR 1.53(b)-(d) and MPEP 506), a Filing Receipt (37 CFR 1.54) will be issued in due course and the date shown on this Acknowledgement Receipt will establish the filing date of the application.

National Stage of an International Application under 35 U.S.C. 371
If a timely submission to enter the national stage of an international application is compliant with the conditions of 35 U.S.C. 371 and other applicable requirements a Form PCT/DO/EO/903 indicating acceptance of the application as a national stage submission under 35 U.S.C. 371 will be issued in addition to the Filing Receipt, in due course.

New International Application Filed with the USPTO as a Receiving Office
If a new international application is being filed and the international application includes the necessary components for an international filing date (see PCT Article 11 and MPEP 1810), a Notification of the International Application Number and of the International Filing Date (Form PCT/RO/105) will be issued in due course, subject to prescriptions concerning national security, and the date shown on this Acknowledgement Receipt will establish the international filing date of the application.

UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
Address: COMMISSIONER FOR PATENTS
P.O. Box 1450
Alexandria, Virginia 22313-1450
www.uspto.gov

NOTICE OF ALLOWANCE AND FEE(S) DUE

60909 7590 07/09/2010

CYPRESS SEMICONDUCTOR CORPORATION
198 CHAMPION COURT
SAN JOSE, CA 95134-1709

EXAMINER	
EDWARDS JR, TIMOTHY	
ART UNIT	PAPER NUMBER
2612	

DATE MAILED: 07/09/2010

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
11/440,924	05/25/2006	Liu Hua	CD06015	9376

TITLE OF INVENTION: CAPACITANCE SENSING MATRIX FOR KEYBOARD ARCHITECTURE

APPLN. TYPE	SMALL ENTITY	ISSUE FEE DUE	PUBLICATION FEE DUE	PREV. PAID ISSUE FEE	TOTAL FEE(S) DUE	DATE DUE
nonprovisional	NO	$1510	$300	$0	$1810	10/12/2010

THE APPLICATION IDENTIFIED ABOVE HAS BEEN EXAMINED AND IS ALLOWED FOR ISSUANCE AS A PATENT. PROSECUTION ON THE MERITS IS CLOSED. THIS NOTICE OF ALLOWANCE IS NOT A GRANT OF PATENT RIGHTS. THIS APPLICATION IS SUBJECT TO WITHDRAWAL FROM ISSUE AT THE INITIATIVE OF THE OFFICE OR UPON PETITION BY THE APPLICANT. SEE 37 CFR 1.313 AND MPEP 1308.

THE ISSUE FEE AND PUBLICATION FEE (IF REQUIRED) MUST BE PAID WITHIN THREE MONTHS FROM THE MAILING DATE OF THIS NOTICE OR THIS APPLICATION SHALL BE REGARDED AS ABANDONED. THIS STATUTORY PERIOD CANNOT BE EXTENDED. SEE 35 U.S.C. 151. THE ISSUE FEE DUE INDICATED ABOVE DOES NOT REFLECT A CREDIT FOR ANY PREVIOUSLY PAID ISSUE FEE IN THIS APPLICATION. IF AN ISSUE FEE HAS PREVIOUSLY BEEN PAID IN THIS APPLICATION (AS SHOWN ABOVE), THE RETURN OF PART B OF THIS FORM WILL BE CONSIDERED A REQUEST TO REAPPLY THE PREVIOUSLY PAID ISSUE FEE TOWARD THE ISSUE FEE NOW DUE.

HOW TO REPLY TO THIS NOTICE:

I. Review the SMALL ENTITY status shown above.

If the SMALL ENTITY is shown as YES, verify your current SMALL ENTITY status:

A. If the status is the same, pay the TOTAL FEE(S) DUE shown above.

B. If the status above is to be removed, check box 5b on Part B - Fee(s) Transmittal and pay the PUBLICATION FEE (if required) and twice the amount of the ISSUE FEE shown above, or

If the SMALL ENTITY is shown as NO:

A. Pay TOTAL FEE(S) DUE shown above, or

B. If applicant claimed SMALL ENTITY status before, or is now claiming SMALL ENTITY status, check box 5a on Part B - Fee(s) Transmittal and pay the PUBLICATION FEE (if required) and 1/2 the ISSUE FEE shown above.

II. PART B - FEE(S) TRANSMITTAL, or its equivalent, must be completed and returned to the United States Patent and Trademark Office (USPTO) with your ISSUE FEE and PUBLICATION FEE (if required). If you are charging the fee(s) to your deposit account, section "4b" of Part B - Fee(s) Transmittal should be completed and an extra copy of the form should be submitted. If an equivalent of Part B is filed, a request to reapply a previously paid issue fee must be clearly made, and delays in processing may occur due to the difficulty in recognizing the paper as an equivalent of Part B.

III. All communications regarding this application must give the application number. Please direct all communications prior to issuance to Mail Stop ISSUE FEE unless advised to the contrary.

IMPORTANT REMINDER: Utility patents issuing on applications filed on or after Dec. 12, 1980 may require payment of maintenance fees. It is patentee's responsibility to ensure timely payment of maintenance fees when due.

PART B - FEE(S) TRANSMITTAL

Complete and send this form, together with applicable fee(s), to: Mail **Mail Stop ISSUE FEE**
Commissioner for Patents
P.O. Box 1450
Alexandria, Virginia 22313-1450
or Fax (571)-273-2885

INSTRUCTIONS: This form should be used for transmitting the ISSUE FEE and PUBLICATION FEE (if required). Blocks 1 through 5 should be completed where appropriate. All further correspondence including the Patent, advance orders and notification of maintenance fees will be mailed to the current correspondence address as indicated unless corrected below or directed otherwise in Block 1, by (a) specifying a new correspondence address; and/or (b) indicating a separate "FEE ADDRESS" for maintenance fee notifications.

CURRENT CORRESPONDENCE ADDRESS (Note: Use Block 1 for any change of address)

60909 7590 07/09/2010

CYPRESS SEMICONDUCTOR CORPORATION
198 CHAMPION COURT
SAN JOSE, CA 95134-1709

Note: A certificate of mailing can only be used for domestic mailings of the Fee(s) Transmittal. This certificate cannot be used for any other accompanying papers. Each additional paper, such as an assignment or formal drawing, must have its own certificate of mailing or transmission.

Certificate of Mailing or Transmission

I hereby certify that this Fee(s) Transmittal is being deposited with the United States Postal Service with sufficient postage for first class mail in an envelope addressed to the Mail Stop ISSUE FEE address above, or being facsimile transmitted to the USPTO (571) 273-2885, on the date indicated below.

(Depositor's name)

(Signature)

(Date)

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
11/440,924	05/25/2006	Liu Hua	CD06015	9376

TITLE OF INVENTION: CAPACITANCE SENSING MATRIX FOR KEYBOARD ARCHITECTURE

APPLN. TYPE	SMALL ENTITY	ISSUE FEE DUE	PUBLICATION FEE DUE	PREV. PAID ISSUE FEE	TOTAL FEE(S) DUE	DATE DUE
nonprovisional	NO	$1510	$300	$0	$1810	10/12/2010

EXAMINER	ART UNIT	CLASS-SUBCLASS
EDWARDS JR, TIMOTHY	2612	341-033000

1. Change of correspondence address or indication of "Fee Address" (37 CFR 1.363).
   - ❑ Change of correspondence address (or Change of Correspondence Address form PTO/SB/122) attached.
   - ❑ "Fee Address" indication (or "Fee Address" Indication form PTO/SB/47; Rev 03-02 or more recent) attached. **Use of a Customer Number is required.**

2. For printing on the patent front page, list
   (1) the names of up to 3 registered patent attorneys or agents OR, alternatively,
   (2) the name of a single firm (having as a member a registered attorney or agent) and the names of up to 2 registered patent attorneys or agents. If no name is listed, no name will be printed.
   1 ______________________
   2 ______________________
   3 ______________________

3. ASSIGNEE NAME AND RESIDENCE DATA TO BE PRINTED ON THE PATENT (print or type)

PLEASE NOTE: Unless an assignee is identified below, no assignee data will appear on the patent. If an assignee is identified below, the document has been filed for recordation as set forth in 37 CFR 3.11. Completion of this form is NOT a substitute for filing an assignment.

(A) NAME OF ASSIGNEE

(B) RESIDENCE: (CITY and STATE OR COUNTRY)

Please check the appropriate assignee category or categories (will not be printed on the patent) : ❑ Individual ❑ Corporation or other private group entity ❑ Government

4a. The following fee(s) are submitted:
- ❑ Issue Fee
- ❑ Publication Fee (No small entity discount permitted)
- ❑ Advance Order - # of Copies ______________

4b. Payment of Fee(s): **(Please first reapply any previously paid issue fee shown above)**
- ❑ A check is enclosed.
- ❑ Payment by credit card. Form PTO-2038 is attached.
- ❑ The Director is hereby authorized to charge the required fee(s), any deficiency, or credit any overpayment, to Deposit Account Number ____________ (enclose an extra copy of this form).

5. **Change in Entity Status** (from status indicated above)
- ❑ a. Applicant claims SMALL ENTITY status. See 37 CFR 1.27.
- ❑ b. Applicant is no longer claiming SMALL ENTITY status. See 37 CFR 1.27(g)(2).

NOTE: The Issue Fee and Publication Fee (if required) will not be accepted from anyone other than the applicant; a registered attorney or agent; or the assignee or other party in interest as shown by the records of the United States Patent and Trademark Office.

Authorized Signature ______________________ Date ______________________

Typed or printed name ______________________ Registration No. ______________________

UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
Address: COMMISSIONER FOR PATENTS
P.O. Box 1450
Alexandria, Virginia 22313-1450
www.uspto.gov

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
11/440,924	05/25/2006	Liu Hua	CD06015	9376

60909 7590 07/09/2010

CYPRESS SEMICONDUCTOR CORPORATION
198 CHAMPION COURT
SAN JOSE, CA 95134-1709

EXAMINER	
EDWARDS JR, TIMOTHY	
ART UNIT	PAPER NUMBER
2612	

DATE MAILED: 07/09/2010

Determination of Patent Term Adjustment under 35 U.S.C. 154 (b)
(application filed on or after May 29, 2000)

The Patent Term Adjustment to date is 594 day(s). If the issue fee is paid on the date that is three months after the mailing date of this notice and the patent issues on the Tuesday before the date that is 28 weeks (six and a half months) after the mailing date of this notice, the Patent Term Adjustment will be 594 day(s).

If a Continued Prosecution Application (CPA) was filed in the above-identified application, the filing date that determines Patent Term Adjustment is the filing date of the most recent CPA.

Applicant will be able to obtain more detailed information by accessing the Patent Application Information Retrieval (PAIR) WEB site (http://pair.uspto.gov).

Any questions regarding the Patent Term Extension or Adjustment determination should be directed to the Office of Patent Legal Administration at (571)-272-7702. Questions relating to issue and publication fee payments should be directed to the Customer Service Center of the Office of Patent Publication at 1-(888)-786-0101 or (571)-272-4200.

PTOL-85 (Rev. 08/07) Approved for use through 08/31/2010.

Notice of Allowability	**Application No.** 11/440,924	**Applicant(s)** HUA ET AL.	
	Examiner Timothy Edwards, Jr.	**Art Unit** 2612	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address--

All claims being allowable, PROSECUTION ON THE MERITS IS (OR REMAINS) CLOSED in this application. If not included herewith (or previously mailed), a Notice of Allowance (PTOL-85) or other appropriate communication will be mailed in due course. **THIS NOTICE OF ALLOWABILITY IS NOT A GRANT OF PATENT RIGHTS.** This application is subject to withdrawal from issue at the initiative of the Office or upon petition by the applicant. See 37 CFR 1.313 and MPEP 1308.

1. ☒ This communication is responsive to *REMARKS filed April 20, 2010*.

2. ☒ The allowed claim(s) is/are *1-30*.

3. ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
   a) ☐ All b) ☐ Some* c) ☐ None of the:
   1. ☐ Certified copies of the priority documents have been received.
   2. ☐ Certified copies of the priority documents have been received in Application No. _____ .
   3. ☐ Copies of the certified copies of the priority documents have been received in this national stage application from the International Bureau (PCT Rule 17.2(a)).

   * Certified copies not received: _____.

Applicant has THREE MONTHS FROM THE "MAILING DATE" of this communication to file a reply complying with the requirements noted below. Failure to timely comply will result in ABANDONMENT of this application.
THIS THREE-MONTH PERIOD IS NOT EXTENDABLE.

4. ☐ A SUBSTITUTE OATH OR DECLARATION must be submitted. Note the attached EXAMINER'S AMENDMENT or NOTICE OF INFORMAL PATENT APPLICATION (PTO-152) which gives reason(s) why the oath or declaration is deficient.

5. ☐ CORRECTED DRAWINGS (as "replacement sheets") must be submitted.
   (a) ☐ including changes required by the Notice of Draftsperson's Patent Drawing Review (PTO-948) attached
   1) ☐ hereto or 2) ☐ to Paper No./Mail Date _____.
   (b) ☐ including changes required by the attached Examiner's Amendment / Comment or in the Office action of Paper No./Mail Date _____.

   Identifying indicia such as the application number (see 37 CFR 1.84(c)) should be written on the drawings in the front (not the back) of each sheet. Replacement sheet(s) should be labeled as such in the header according to 37 CFR 1.121(d).

6. ☐ DEPOSIT OF and/or INFORMATION about the deposit of BIOLOGICAL MATERIAL must be submitted. Note the attached Examiner's comment regarding REQUIREMENT FOR THE DEPOSIT OF BIOLOGICAL MATERIAL.

Attachment(s)
1. ☐ Notice of References Cited (PTO-892)
2. ☐ Notice of Draftperson's Patent Drawing Review (PTO-948)
3. ☐ Information Disclosure Statements (PTO/SB/08), Paper No./Mail Date _____
4. ☐ Examiner's Comment Regarding Requirement for Deposit of Biological Material
5. ☐ Notice of Informal Patent Application
6. ☐ Interview Summary (PTO-413), Paper No./Mail Date _____ .
7. ☐ Examiner's Amendment/Comment
8. ☒ Examiner's Statement of Reasons for Allowance
9. ☐ Other _____.

DETAILED ACTION

Allowable Subject Matter

1. Claims 1-30 are allowed.

2. The following is an examiner's statement of reasons for allowance: Applicant's argument is persuasive. Examiner withdraws rejections of last Office Action. Application is in condition for allowance.

Any comments considered necessary by applicant must be submitted no later than the payment of the issue fee and, to avoid processing delays, should preferably accompany the issue fee. Such submissions should be clearly labeled "Comments on Statement of Reasons for Allowance."

Conclusion

Any inquiry concerning this communication should be directed to Examiner Timothy Edwards, Jr. at telephone number (571) 272-3067. The examiner can normally be reached on Monday-Thursday, 8:00 a.m.-6:00 p.m. The examiner cannot be reached on Fridays.

If attempt to reach the Examiner by telephone are unsuccessful, the Examiner's Supervisor, Brian Zimmerman, can be reached at (571) 272-3059.

Any inquiry of a general nature or relating to the status of this application should be directed to the Group receptionist whose telephone number is (571) 272-4700, Mon-Fri., 8:30 a.m.-5:00 p.m.

Any response to this action should be fax to:

(571) 273-8300 (for formal communications intended for entry).

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http:/pair-direct.uspto.gov or contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

/Timothy Edwards, Jr. /
Primary Examiner, Art Unit 2612
July 12, 2010

Search Notes	Application/Control No.	Applicant(s)/Patent Under Reexamination
	11440924	HUA ET AL.
	Examiner	**Art Unit**
	Timothy Edwards, Jr.	2612

SEARCHED

Class	Subclass	Date	Examiner
341	22, 33	12/13/08	/TE/
345	156, 168, 173		
178	18.05, 18.06		
	UPDATED SEARCH	9/17/09	/TE/
324	658-668		
	UPDATED SEARCH	1/14/10	/TE/

SEARCH NOTES

Search Notes	Date	Examiner
EAST TEXT SEARCH	12/13/08	/TE/
UPDATED EAST TEXT SEARCH	9/17/09	/TE/
UPDATED EAST SEARCH	1/14/10	/TE/

INTERFERENCE SEARCH

Class	Subclass	Date	Examiner
341	33	7/4/10	/TE/
324	662		
178	18.05, 18.06		

Issue Classification	Application/Control No. 11/440,924	Applicant(s)/Patent under Reexamination HUA ET AL.	
	Examiner Timothy Edwards, Jr.	Art Unit 2612	

ISSUE CLASSIFICATION

ORIGINAL					CROSS REFERENCE(S)							
CLASS		SUBCLASS			CLASS	SUBCLASS (ONE SUBCLASS PER BLOCK)						
341		33			324	662						
INTERNATIONAL CLASSIFICATION					178	18.05	18.06					
H	0	3	K	17/96								
				/								
				/								
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N/A (Assistant Examiner) (Date)	/Timothy Edwards, Jr./ 7/4/10 (Primary Examiner) (Date)	Total Claims Allowed: 30	
(Legal Instruments Examiner) (Date)		O.G. Print Claim(s) 1	O.G. Print Fig. 5A

☒ Claims renumbered in the same order as presented by applicant ☐ CPA ☐ T.D. ☐ R.1.47

Final	Original	Final	Original	Final	Original	Final	Original	Final	Original	Final	Original	Final	Original
	1		31		61		91		121		151		181
	2		32		62		92		122		152		182
	3		33		63		93		123		153		183
	4		34		64		94		124		154		184
	5		35		65		95		125		155		185
	6		36		66		96		126		156		186
	7		37		67		97		127		157		187
	8		38		68		98		128		158		188
	9		39		69		99		129		159		189
	10		40		70		100		130		160		190
	11		41		71		101		131		161		191
	12		42		72		102		132		162		192
	13		43		73		103		133		163		193
	14		44		74		104		134		164		194
	15		45		75		105		135		165		195
	16		46		76		106		136		166		196
	17		47		77		107		137		167		197
	18		48		78		108		138		168		198
	19		49		79		109		139		169		199
	20		50		80		110		140		170		200
	21		51		81		111		141		171		201
	22		52		82		112		142		172		202
	23		53		83		113		143		173		203
	24		54		84		114		144		174		204
	25		55		85		115		145		175		205
	26		56		86		116		146		176		206
	27		57		87		117		147		177		207
	28		58		88		118		148		178		208
	29		59		89		119		149		179		209
	30		60		90		120		150		180		210

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In Re Patent Application of: Liu Hua, et al. Application No.: 11/440,924 Filed: May 25, 2006 Art unit: 2612 Examiner: Edwards Jr., Timothy For: CAPACITANCE SENSING MATRIX FOR KEYBOARD ARCHITECTURE	Confirmation No.: 9376

Mail Stop Amendment
Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

AMENDMENT AND RESPONSE TO OFFICE ACTION

Examiner:

Applicant respectfully requests that the Examiner consider the following remarks.

Remarks begin on page 10 of this paper.

REMARKS

Applicant appreciates the Examiner's consideration in discussing the current Office Action in light of the Notice of Allowance and RCE filed for an IDS submission. As of result of the discussion and resulting foregoing remarks, Applicant respectfully requests reconsideration and allowance of this application.

Status of the Claims

Claims 1-30 are pending and in condition for allowance. No claims are canceled. No claims are added. No new matter has been added.

Objections under 35 U.S.C. 132(a) and Rejection under 35 U.S.C. 112

The Examiner has objected to the claim language, "wherein at least one of the plurality of sensor elements corresponds to multiple pre-defined areas," found in claims 28 and 30, as not being supported in the specification; and rejected the same language from claim 30 under 35 U.S.C. 112, first paragraph.

Applicant respectfully directs the Examiner's attention to the embodiment described in paragraph 110 explaining one (of the at least one) sensor element corresponding to keys (more than one) assigned to pre-defined areas (more than one), "6A illustrates one embodiment of a single sensor element of a sensing device that has three keyboard keys assigned to pre-defined ***areas*** of the sensing device. Sensor element 601 is a diamond-shaped sensor element of a sensing device. Keyboard keys, A-C 603(1)-603(3), are assigned pre-defined areas of the sensing device." (Emphasis added). Thus one sensor element does correspond, via the keys, to multiple pre-defined areas. As shown in the embodiment of Figure 6B, there is an array of sensors (at least one of which) that include multiple keys assigned to each that have multiple pre-defined areas.

Thus Application respectfully asserts the claimed feature is supported in at least one of the embodiments described in the specification, and respectfully requests withdrawal of the objection and rejection to place the application in condition for allowance.

Non-Compliant Amendment

The Office Action has asserted claims 27-30 in the amendment of 12/18/09 should have been labeled as "New" instead of "Previously Presented." However, claims 27-30 were first presented as "New" in the amendment of 6/10/09. Thus, they were correctly labeled as "Previously Presented" in the amendment of 12/18/09.

CONCLUSION

It is respectfully submitted that in view of the amendments and remarks set forth herein, the rejections and objections have been overcome. If the Examiner believes a telephone interview would expedite the prosecution of this application, the Examiner is invited to contact Larry J. Johnson, by telephone at (408) 545-7194.

Please charge any additional fees under 37 CFR §§ 1.16, 1.17, 1.18, 1.20 and 1.21 that may be required to maintain pendency of the present application, or apply any credits to our PTO deposit account number: 50-3781.

Respectfully submitted,

Date: April 20, 2010 /Larry J. Johnson/
Larry J. Johnson
Reg. No. 56,861

Electronic Acknowledgement Receipt

EFS ID:	7453765
Application Number:	11440924
International Application Number:	
Confirmation Number:	9376
Title of Invention:	CAPACITANCE SENSING MATRIX FOR KEYBOARD ARCHITECTURE
First Named Inventor/Applicant Name:	Liu Hua
Customer Number:	60909
Filer:	Andrew J. Bateman/Hilary Link
Filer Authorized By:	Andrew J. Bateman
Attorney Docket Number:	CD06015
Receipt Date:	20-APR-2010
Filing Date:	25-MAY-2006
Time Stamp:	19:43:56
Application Type:	Utility under 35 USC 111(a)

Payment information:

Submitted with Payment	no

File Listing:

Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
1	Amendment/Req. Reconsideration-After Non-Final Reject	CD2006015nonfinalOApdfPDF.pdf	1674029 82e37f85d19ac4a08db3e83e9285ce26c2183a63	no	11

Warnings:

Information:

Total Files Size (in bytes):	1674029

This Acknowledgement Receipt evidences receipt on the noted date by the USPTO of the indicated documents, characterized by the applicant, and including page counts, where applicable. It serves as evidence of receipt similar to a Post Card, as described in MPEP 503.

<u>New Applications Under 35 U.S.C. 111</u>
If a new application is being filed and the application includes the necessary components for a filing date (see 37 CFR 1.53(b)-(d) and MPEP 506), a Filing Receipt (37 CFR 1.54) will be issued in due course and the date shown on this Acknowledgement Receipt will establish the filing date of the application.

<u>National Stage of an International Application under 35 U.S.C. 371</u>
If a timely submission to enter the national stage of an international application is compliant with the conditions of 35 U.S.C. 371 and other applicable requirements a Form PCT/DO/EO/903 indicating acceptance of the application as a national stage submission under 35 U.S.C. 371 will be issued in addition to the Filing Receipt, in due course.

<u>New International Application Filed with the USPTO as a Receiving Office</u>
If a new international application is being filed and the international application includes the necessary components for an international filing date (see PCT Article 11 and MPEP 1810), a Notification of the International Application Number and of the International Filing Date (Form PCT/RO/105) will be issued in due course, subject to prescriptions concerning national security, and the date shown on this Acknowledgement Receipt will establish the international filing date of the application.

Listing of Claims:

1. (Previously Presented) A method, comprising:

assigning a plurality of keyboard keys to correspond to pre-defined areas of a sensing surface of a sensing device having a plurality of sensor elements and a plurality of capacitance sensing pins to couple the plurality of sensor elements to a processing device, wherein the pre-defined areas are disposed adjacent to one another;

determining a position of a presence of the conductive object on the sensing device by measuring capacitance on the plurality of capacitance sensing pins; and

selecting a keyboard key of the plurality of keyboard keys when the position of the presence of the conductive object is determined to be within the pre-defined area of the sensing device corresponding to the keyboard key.

2. (Original) The method of claim 1, wherein selecting the keyboard key comprises comparing the position of the conductive object with the pre-defined areas.

3. (Original) The method of claim 1, further comprising outputting keyboard data corresponding to the selected key from the processing device to a component external to the processing device.

4. (Previously Presented) The method of claim 1, wherein the plurality of sensor elements are disposed in a capacitance sensor matrix comprising a plurality of rows of sensor elements and a plurality of columns of sensor elements, wherein each row and each column is coupled to one of the plurality of capacitance sensing pins, and wherein determining the position of the conductive object comprises:

measuring a capacitance of each row of sensor elements of the capacitance sensor matrix of the sensing device;

determining a first dimension position based on the measured capacitance of the rows of sensor elements;

measuring a capacitance of each column of sensor elements of the capacitance sensor matrix; and

determining a second dimension position based on the measured capacitance of the columns of sensor elements, wherein determining the position of the presence of the conductive object is determined using the first and second dimension positions.

5. (Original) The method of claim 2, wherein assigning the plurality of keyboard keys into pre-defined areas comprises defining a data structure comprising positional data of the pre-defined areas of the plurality of keyboard keys, wherein selecting the keyboard key comprises comparing the position of the conductive object with the positional data of the pre-defined areas of the data structure to determine a pressed key of the plurality of keyboard keys, and wherein outputting the keyboard data comprises outputting keyboard data that corresponds to the pressed key.

6. (Previously Presented) An apparatus, comprising:

a sensing device comprising a plurality of sensor elements to detect a presence of a conductive object on a sensing surface of the sensing device, wherein a plurality of keyboard keys are assigned to correspond to pre-defined areas of a sensing surface of the sensing device, wherein the pre-defined areas are disposed adjacent to one another; and a processing device coupled to the sensing device using capacitance sensing pins, wherein the processing device is operable to determine a position of the presence of the conductive object on the sensing device by measuring capacitance on the capacitance sensing pins, and to select a keyboard key of the plurality of keyboard keys when the position of the presence of the conductive object is determined to be within the pre-defined area of the sensing device corresponding to the keyboard key.

7. (Original) The apparatus of claim 5, wherein the plurality of keyboard keys are a personal computer (PC) keyboard, and wherein the processing device is coupled to the sensing device using less than 21 capacitance sensing pins.

8. (Original) The apparatus of claim 5, wherein the plurality of keyboard keys comprises approximately 48 keyboard keys, and wherein the processing device is coupled to the sensing device using 4 capacitance sensing pins.

9. (Original) The apparatus of claim 5, wherein the plurality of keyboard keys comprises approximately 101 keyboard keys, and wherein the processing device is coupled to the sensing device using less than 12 capacitance sensing pins.

10. (Original) The apparatus of claim 5, wherein the plurality of keyboard keys comprises approximately 107 keyboard keys, and wherein the processing device is coupled to the sensing device using less than 21 capacitance sensing pins.

11. (Original) The apparatus of claim 5, wherein the plurality of keyboard keys comprises approximately 107 keyboard keys, and wherein the processing device is coupled to the sensing device using less than 12 capacitance sensing pins.

12. (Original) The apparatus of claim 5, wherein a total surface area of the assigned keyboard keys is less than approximately 10 centimeters (cm) by 10 cm.

13. (Original) The apparatus of claim 5, wherein a total surface area of the assigned keyboard keys is approximately 3 centimeters (cm) by 3 cm.

14. (Previously Presented) The apparatus of claim 5, wherein the sensing device comprises a capacitance sensor matrix comprising the plurality of sensor elements configured in rows and columns to detect the presence of the conductive object on the sensing device, wherein each row and column is coupled to the processing device using one of the capacitance sensing pins, and wherein the plurality of keyboard keys are assigned to the pre-defined areas of the capacitance sensor matrix.

15. (Original) The apparatus of claim 13, wherein the processing device comprises one or more capacitance sensors coupled to the capacitance sensor matrix, wherein the one or more capacitance sensors are operable to measure a capacitance of each row of sensor elements of the capacitance sensor matrix, and to measure a capacitance of each column of sensor elements of the capacitance sensor matrix, and wherein the processing device is operable to determine the position of the presence of the keyboard key using the

measured capacitance of the rows and columns of sensor elements of the capacitance sensor matrix.

16. (Original) The apparatus of claim 14, wherein the one or more capacitance sensors are relaxation oscillators, wherein each relaxation oscillator comprises:

a current source to provide a charge current to the plurality of sensor elements;

a selection circuit coupled to the plurality of sensor elements and the current source, wherein the selection circuit is operable to sequentially select a sensor element of the plurality of sensor elements to provide the charge current and to measure the capacitance of each sensor element of the sensing device;

a comparator coupled to the current source and the selection circuit, wherein the comparator is operable to compare a voltage on the selected sensor element and a threshold voltage; and

a reset switch coupled to the comparator, current source, and selection circuit, wherein the reset switch is operable to reset the charge current on the selected sensor element, wherein the one or more capacitance sensors further comprise a digital counter coupled to the relaxation oscillator; wherein the digital counter is operable to count at least one of a frequency of an oscillator output or a period of the oscillator received from the relaxation oscillator.

17. (Original) The apparatus of claim 5, further comprising a component external to the processing device, wherein the processing device is operable to send keyboard data to the component that corresponds to the selected keyboard key.

18. (Original) The apparatus of claim 16, wherein the component external to the processing device is at least one of a processor, a driver of a processor, or an embedded controller.

19. (Original) The apparatus of claim 16, wherein the keyboard data comprises is at least one of a keyboard data signal, or a keyboard data command.

20. (Original) The apparatus of claim 5, wherein the sensing device is mounted on a mobile handset.

21. (Original) The apparatus of claim 5, wherein the processing device is coupled to an additional user input device, and wherein the additional input device is at least one of a cursor positioning device, a touch-sensor pad, a touch-sensor slider, a touch-sensor button, mouse, or a touch-screen display.

22. (Previously Presented) An apparatus, comprising:

a sensing device comprising a plurality of sensor elements to detect a presence of a conductive object on the sensing device, wherein a plurality of keyboard keys are assigned to correspond to pre-defined areas of a sensing surface of the sensing device, wherein the pre-defined areas are disposed adjacent to one another;

means for determining a position of the presence of the conductive object on the sensing device; and

means for selecting a keyboard key of the plurality of keyboard keys when the position of the presence of the conductive object is determined to be within the pre-defined area of the sensing device corresponding to the keyboard key.

23. (Previously Presented) The apparatus of claim 21, further comprising means for assigning the plurality of keyboard keys to correspond to the pre-defined areas of the sensing device.

24. (Original) The apparatus of claim 21, further comprising means for reducing a number of capacitance sensing pins used to connect the sensing device to the means for determining the position of the conductive object.

25. (Original) The apparatus of claim 21, further comprising means for reducing a total surface area of the sensing device while maintaining a number of keyboard keys on a device.

26. (Original) The apparatus of claim 21, further comprising means for outputting keyboard data based on the position of the presence of the keyboard key.

27. (Previously Presented) The method of claim 1, wherein the pre-defined areas of the plurality of keyboard keys are arranged into multiple rows on the sensing surface, wherein the plurality of sensor elements are arranged in a plurality of rows of sensor elements, and wherein at least one of the plurality of rows of sensor elements corresponds to a plurality of rows of the pre-defined areas.

28. (Previously Presented) The method of claim 1, wherein at least one of the plurality of sensor elements corresponds to multiple pre-defined areas.

29. (Previously Presented) The apparatus of claim 6, wherein the pre-defined areas of the plurality of keyboard keys are arranged into multiple rows on the sensing surface, wherein the plurality of sensor elements are arranged in a plurality of rows of sensor elements, and wherein at least one of the plurality of rows of sensor elements corresponds to a plurality of rows of the pre-defined areas.

30. (Previously Presented) The apparatus of claim 6, wherein at least one of the plurality of sensor elements corresponds to multiple pre-defined areas.

PTO/SB/06 (07-06)
Approved for use through 1/31/2007. OMB 0651-0032
U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE
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PATENT APPLICATION FEE DETERMINATION RECORD Substitute for Form PTO-875	Application or Docket Number 11/440,924	Filing Date 05/25/2006	☐ To be Mailed

APPLICATION AS FILED – PART I

FOR	(Column 1) NUMBER FILED	(Column 2) NUMBER EXTRA	SMALL ENTITY ☐ RATE ($)	FEE ($)	OR	OTHER THAN SMALL ENTITY RATE ($)	FEE ($)
☐ BASIC FEE (37 CFR 1.16(a), (b), or (c))	N/A	N/A	N/A			N/A	
☐ SEARCH FEE (37 CFR 1.16(k), (i), or (m))	N/A	N/A	N/A			N/A	
☐ EXAMINATION FEE (37 CFR 1.16(o), (p), or (q))	N/A	N/A	N/A			N/A	
TOTAL CLAIMS (37 CFR 1.16(i))	minus 20 =	*	X $ =		OR	X $ =	
INDEPENDENT CLAIMS (37 CFR 1.16(h))	minus 3 =	*	X $ =			X $ =	
☐ APPLICATION SIZE FEE (37 CFR 1.16(s))	If the specification and drawings exceed 100 sheets of paper, the application size fee due is $250 ($125 for small entity) for each additional 50 sheets or fraction thereof. See 35 U.S.C. 41(a)(1)(G) and 37 CFR 1.16(s).						
☐ MULTIPLE DEPENDENT CLAIM PRESENT (37 CFR 1.16(j))							
* If the difference in column 1 is less than zero, enter "0" in column 2.			TOTAL			TOTAL	

APPLICATION AS AMENDED – PART II

AMENDMENT	04/20/2010	(Column 1) CLAIMS REMAINING AFTER AMENDMENT		(Column 2) HIGHEST NUMBER PREVIOUSLY PAID FOR	(Column 3) PRESENT EXTRA	SMALL ENTITY RATE ($)	ADDITIONAL FEE ($)	OR	OTHER THAN SMALL ENTITY RATE ($)	ADDITIONAL FEE ($)
	Total (37 CFR 1.16(i))	* 30	Minus	** 30	= 0	X $ =		OR	X $52=	0
	Independent (37 CFR 1.16(h))	* 3	Minus	***3	= 0	X $ =		OR	X $220=	0
	☐ Application Size Fee (37 CFR 1.16(s))									
	☐ FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM (37 CFR 1.16(j))							OR		
						TOTAL ADD'L FEE		OR	TOTAL ADD'L FEE	**0**

AMENDMENT		(Column 1) CLAIMS REMAINING AFTER AMENDMENT		(Column 2) HIGHEST NUMBER PREVIOUSLY PAID FOR	(Column 3) PRESENT EXTRA	RATE ($)	ADDITIONAL FEE ($)		RATE ($)	ADDITIONAL FEE ($)
	Total (37 CFR 1.16(i))	*	Minus	**	=	X $ =		OR	X $ =	
	Independent (37 CFR 1.16(h))	*	Minus	***	=	X $ =		OR	X $ =	
	☐ Application Size Fee (37 CFR 1.16(s))									
	☐ FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM (37 CFR 1.16(j))							OR		
						TOTAL ADD'L FEE		OR	TOTAL ADD'L FEE	

* If the entry in column 1 is less than the entry in column 2, write "0" in column 3.
** If the "Highest Number Previously Paid For" IN THIS SPACE is less than 20, enter "20".
*** If the "Highest Number Previously Paid For" IN THIS SPACE is less than 3, enter "3".
The "Highest Number Previously Paid For" (Total or Independent) is the highest number found in the appropriate box in column 1.

Legal Instrument Examiner:
/AMANDA FORD/

This collection of information is required by 37 CFR 1.16. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.14. This collection is estimated to take 12 minutes to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. **SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.**

If you need assistance in completing the form, call 1-800-PTO-9199 and select option 2.

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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
11/440,924	05/25/2006	Liu Hua	CD06015	9376

60909 7590 01/20/2010
CYPRESS SEMICONDUCTOR CORPORATION
198 CHAMPION COURT
SAN JOSE, CA 95134-1709

EXAMINER	
EDWARDS JR, TIMOTHY	

ART UNIT	PAPER NUMBER
2612	

MAIL DATE	DELIVERY MODE
01/20/2010	PAPER

Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

PTOL-90A (Rev. 04/07)

Office Action Summary	Application No.	Applicant(s)	
	11/440,924	HUA ET AL.	
	Examiner	**Art Unit**	
	Timothy Edwards, Jr.	2612	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE _3_ MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on _RCE filed December 18, 2009_.
2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.
3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) _1-30_ is/are pending in the application.
4a) Of the above claim(s) _____ is/are withdrawn from consideration.
5)☐ Claim(s) _____ is/are allowed.
6)☒ Claim(s) _1-15,17-22 and 24-30_ is/are rejected.
7)☒ Claim(s) _16 and 23_ is/are objected to.
8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☒ The specification is objected to by the Examiner.
10)☒ The drawing(s) filed on _25 May 2006_ is/are: a)☒ accepted or b)☐ objected to by the Examiner.
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
a)☐ All b)☐ Some * c)☐ None of:
1.☐ Certified copies of the priority documents have been received.
2.☐ Certified copies of the priority documents have been received in Application No. _____.
3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).
* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☒ Information Disclosure Statement(s) (PTO/SB/08) Paper No(s)/Mail Date _____.
4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____ .
5) ☐ Notice of Informal Patent Application
6) ☐ Other: _____.

DETAILED ACTION

Specification

1. The amendment filed December 18, 2009 is objected to under 35 U.S.C. 132(a) because it introduces new matter into the disclosure. 35 U.S.C. 132(a) states that no amendment shall introduce new matter into the disclosure of the invention. The added material which is not supported by the original disclosure is as follows: "at least one of the plurality of sensor elements corresponds to multiple pre-defined areas".

Applicant is required to cancel the new matter in the reply to this Office Action.

2. Claim 30 is rejected under 35 U.S.C. 112, first paragraph, as failing to comply with the written description requirement. The claim(s) contains subject matter which was not described in the specification in such a way as to reasonably convey to one skilled in the relevant art that the inventor(s), at the time the application was filed, had possession of the claimed invention. Claim 30 recites "at least one of the plurality of sensor elements corresponds to multiple pre-defined areas".

Amendment to claims is Non-compliance because claims 27-30 were not presented in original claims filed May 25, 2006. Therefore these claims should have been labeled as "New".

Claim Rejections - 35 USC § 102

1. The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

> A person shall be entitled to a patent unless –
>
> (e) the invention was described in (1) an application for patent, published under section 122(b), by another filed in the United States before the invention by the applicant for patent or (2) a patent granted on an application for patent by another filed in the United States before the invention by the applicant for patent, except that an international application filed under the treaty defined in section 351(a) shall have the effects for purposes of this subsection of an application filed in the United States only if the international application designated the United States and was published under Article 21(2) of such treaty in the English language.

2. Claims 1-7, 20-22, 26-29 are rejected under 35 U.S.C. 102(e) as being anticipated by Sandbach et al US 2003/0011576 (hereafter Sandbach '576).

Considering (**amended**) claim 1, Sandbach discloses a method, comprising , **a**) assigning a plurality of keyboard keys into pre-defined areas of a sensing device having a plurality of sensor elements (see fig 1); **b**) a plurality of capacitance sensing pins couple the sensing device to a processing device (see paragraph 0113 and fig 5, item 502); **c**) the pre-defined areas are disposed adjacent to one another (see fig 1, item 106); **d**) determining the position of the presence of the conductive object on the sensing device by measuring the capacitance on the plurality of capacitance sensing pins (see paragraphs 0057-0060 and 0113); **e**) selecting a keyboard key of the plurality of keyboard keys based on the position of the presence of the conductive object and the pre-defined areas (see paragraph 0060).

Considering claim 2, Sandbach discloses the limitation of this claim (see paragraph 0006).

Considering claim 3, Sandbach discloses the limitation of this claim (see paragraph 0090 and fig 12, item 1202).

Considering claim 4, Sandbach discloses the limitation of this claim (see paragraphs 0006, 0026, 0029 and 0113).

Considering claim 5, Sandbach discloses the limitation of this claim (see paragraph 0073).

Considering claims 6, 22 the limitations of these claims are interpreted and rejected as stated in claim 1.

Considering claim 7, Sandbach discloses the limitation of this claim (see paragraph fig 5, item 502).

Considering claims 14, 15, Sandbach discloses the limitation of these claims (see paragraph 0005 and 0113)

Considering claim 20, Sandbach discloses the limitation of this claim (see fig 1, item 101 and fig 12).

Considering claim 21, Sandbach discloses the limitation of this claim (see paragraph 0092).

Considering claim 26, Sandbach discloses the limitation of this claim (see paragraph 0073).

Considering claims 27, 29 Sandbach discloses the limitation of these claims (see fig 1).

Considering claim 28, Sandbach discloses the limitation of this claim (see paragraph 0005).

Claim Rejections - 35 USC § 103

1. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

1. Claims 8-13, 17-19, 24, 25 are rejected under 35 U.S.C. 103(a) as being unpatentable over Sandbach et al ‘576, and further in view of Hargreaves et al US 2007/0046299 (previously cited).

Considering claims 8-11, Sandbach does not specifically recite the limitations of these claims. However, Sandbach teaches sensing key actuation on a keyboard using capacitance sensing pins on a processing device (see figs 8-11). One of ordinary skill in the art readily recognizes there are numerous devices with a variety of any number of keys associated with the device. Hargreaves teaches a processing device coupled via capacitance sensing pins that reduces the number of pins used to accomplish the task of sensing a plurality of keys on a keyboard (see paragraph 0051). Hargreaves teaches a method of introducing channels on a controller to allow the number of pins to be reduced (see paragraph 0060). Hargreaves suggests any number of pins maybe used because he teaches the number of pins used can be reduced. Therefore, it would have been obvious to one of ordinary skill in the art to implement the capacitance sensing as taught by Hargreaves in the Sandbach system because both systems are concern with using capacitance sensors pins in the determination of a key activation.

Considering claims 12, 13 Sandbach does not specifically recite the limitations of these claims. Hargreaves teaches the limitations of these claim (see paragraph 0103). Obviousness is as stated in claims 8-11.

Considering claim 17 Sandbach does not specifically recite the limitation of this claim. Hargreaves teaches the limitations of these claim (see paragraph 0108). Obviousness is as stated in claims 8-11.

Considering claim 18 Sandbach discloses the limitations of these claims (see fig 12).

Considering claim 19, Sandbach discloses the limitation of this claim (see paragraph 0060).

Considering claims 24, 25 the limitations of these claims are interpreted and rejected as stated in claims 7-11.

Allowable Subject Matter

1. Claims 16, 23 are objected to as being dependent upon a rejected base claim, but would be allowable if rewritten in independent form including all of the limitations of the base claim and any intervening claims.

Conclusion

2. The prior art made of record and not relied upon is considered pertinent to applicant's disclosure. See PTO-892.

If the claimed invention is amended, Applicant is respectfully requested to indicate the portion(s) of the specification, which dictate(s) the structure/description *relied upon to assist the Examiner in proper interpretation of the amended language and also to verify and ascertain the metes and bounds of the claimed invention.*

Any inquiry concerning this communication should be directed to Examiner Timothy Edwards, Jr. at telephone number (571) 272-3067. The examiner can normally be reached on Monday-Thursday, 8:00 a.m.-6:00 p.m. The examiner cannot be reached on Fridays.

If attempt to reach the Examiner by telephone are unsuccessful, the Examiner's Supervisor, Brian Zimmerman, can be reached at (571) 272-3059.

Any inquiry of a general nature or relating to the status of this application should be directed to the Group receptionist whose telephone number is (571) 272-4700, Mon-Fri., 8:30 a.m.-5:00 p.m.

Any response to this action should be fax to:

(571) 273-8300 (for formal communications intended for entry).

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http:/pair-direct.uspto.gov or contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

/Timothy Edwards, Jr./
Primary Examiner, Art Unit 2612
January 20, 2010

Notice of References Cited	Application/Control No. 11/440,924	Applicant(s)/Patent Under Reexamination HUA ET AL.	
	Examiner Timothy Edwards, Jr.	Art Unit 2612	Page 1 of 1

U.S. PATENT DOCUMENTS

*		Document Number Country Code-Number-Kind Code	Date MM-YYYY	Name	Classification
*	A	US-4,305,135 A	12-1981	Dahl et al.	341/33
*	B	US-4,495,485 A	01-1985	Smith, Peter H.	341/33
*	C	US-5,499,026 A	03-1996	Liao et al.	341/33
*	D	US-6,504,530 B1	01-2003	Wilson et al.	345/173
*	E	US-2003/0011576 A1	01-2003	Sandbach et al.	345/173
*	F	US-2004/0140993 A1	07-2004	Geaghan et al.	345/702
*	G	US-2007/0008299 A1	01-2007	Hristov, Luben	345/173
*	H	US-2007/0063876 A1	03-2007	Wong, Alex K.	341/034
*	I	US-2007/0229466 A1	10-2007	Peng et al.	345/173
*	J	US-2007/0236618 A1	10-2007	Maag et al.	349/012
	K	US-			
	L	US-			
	M	US-			

FOREIGN PATENT DOCUMENTS

*		Document Number Country Code-Number-Kind Code	Date MM-YYYY	Country	Name	Classification
	N					
	O					
	P					
	Q					
	R					
	S					
	T					

NON-PATENT DOCUMENTS

*		Include as applicable: Author, Title Date, Publisher, Edition or Volume, Pertinent Pages)
	U	
	V	
	W	
	X	

*A copy of this reference is not being furnished with this Office action. (See MPEP § 707.05(a).)
Dates in MM-YYYY format are publication dates. Classifications may be US or foreign.

Index of Claims	Application/Control No. 11440924	Applicant(s)/Patent Under Reexamination HUA ET AL.
	Examiner Timothy Edwards, Jr.	Art Unit 2612

✓	Rejected	-	Cancelled	N	Non-Elected	A	Appeal
=	Allowed	÷	Restricted	I	Interference	O	Objected

☐ Claims renumbered in the same order as presented by applicant ☐ CPA ☐ T.D. ☐ R.1.47

CLAIM		DATE									
Final	Original	03/09/2009	01/19/2010								
	1	✓	✓								
	2	✓	✓								
	3	✓	✓								
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	23	✓	O								
	24	✓	✓								
	25	✓	✓								
	26	✓	✓								
	27		✓								
	28		✓								
	29		✓								
	30		✓								

Search Notes	Application/Control No. 11440924	Applicant(s)/Patent Under Reexamination HUA ET AL.
	Examiner Timothy Edwards, Jr.	**Art Unit** 2612

SEARCHED

Class	Subclass	Date	Examiner
341	22, 33	12/13/08	/TE/
345	156, 168, 173		
178	18.05, 18.06		
	UPDATED SEARCH	9/17/09	/TE/
324	658-668		
	UPDATED SEARCH	1/14/10	/TE/

SEARCH NOTES

Search Notes	Date	Examiner
EAST TEXT SEARCH	12/13/08	/TE/
UPDATED EAST TEXT SEARCH	9/17/09	/TE/
UPDATED EAST SEARCH	1/14/10	/TE/

INTERFERENCE SEARCH

Class	Subclass	Date	Examiner

EAST Search History

EAST Search History (Prior Art)

Ref #	Hits	Search Query	DBs	Default Operator	Plurals	Time Stamp
L1	288	((keyboard keypad) same (capacit$6 near5 sens$4)) and pin	US-PGPUB; USPAT; EPO; JPO; DERWENT	OR	ON	2010/01/14 11:05
L2	103	1 and (select$5 near4 (key symbol character))	US-PGPUB; USPAT; EPO; JPO; DERWENT	OR	ON	2010/01/14 11:07
L3	32	2 and ((sens$4 input) near5 pin)	US-PGPUB; USPAT; EPO; JPO; DERWENT	OR	ON	2010/01/14 11:08

EAST Search History (Interference)

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1/14/10 11:21:46 AM
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OK TO ENTER: /TE/

AMENDMENTS

Amendments to the Title:

~~A LOW PIN COUNT SOLUTION USING~~ CAPACITANCE SENSING MATRIX FOR KEYBOARD ARCHITECTURE

INFORMATION DISCLOSURE STATEMENT BY APPLICANT (**Not for submission under 37 CFR 1.99)**		
	Application Number	11440924
	Filing Date	2006-05-25
	First Named Inventor	Liu Hua
	Art Unit	2612
	Examiner Name	Timothy Edwards, Jr.
	Attorney Docket Number	CD06015

U.S.PATENTS

Examiner Initial*	Cite No	Patent Number	Kind Code[1]	Issue Date	Name of Patentee or Applicant of cited Document	Pages,Columns,Lines where Relevant Passages or Relevant Figures Appear
	1	3696908	B1	1972-10-10	Gluck et al.	Entire Document
	2	3750113	B1	1973-07-31	Cencel, Arthur J.	Entire Document
	3	4157539	B1	1979-06-05	Hunts et al.	Entire Document
	4	4163222	B1	1979-07-31	Grove, Donald C.	Entire Document
	5	4175239	B1	1979-11-20	Sandler, Louis M.	Entire Document
	6	4235871	B1	1980-11-25	Papahadjopoulos et al.	Entire Document
	7	4405917	B1	1983-09-20	Chai, Thomas Y.	Entire Document
	8	4405918	B1	1983-09-20	Wall et al.	Entire Document

ALL REFERENCES CONSIDERED EXCEPT WHERE LINED THROUGH. /TE/

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	Filing Date	2006-05-25
	First Named Inventor	Liu Hua
	Art Unit	2612
	Examiner Name	Timothy Edwards, Jr.
	Attorney Docket Number	CD06015

	9	4727767	B1	1988-03-01	Aiki et al.	Entire Document
	10	4772874	B1	1988-09-20	Hasegawa, Hiroshi	Entire Document
	11	4954823	B1	1990-09-04	Binstead, Ronald P.	Entire Document
	12	5844506	B1	1998-12-01	Binstead, Ronald Peter	Entire Document
	13	7202855	B1	2007-04-10	Shigetaka et al.	Entire Document
	14	7202859	B1	2007-04-10	Speck et al.	Entire Document
	15	7362244	B1	2008-04-22	Sun, Ben-Chang	Entire Document

If you wish to add additional U.S. Patent citation information please click the Add button.

U.S.PATENT APPLICATION PUBLICATIONS

Examiner Initial*	Cite No	Publication Number	Kind Code1	Publication Date	Name of Patentee or Applicant of cited Document	Pages,Columns,Lines where Relevant Passages or Relevant Figures Appear
	1	20060192690				
	2	20080007434				

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ALL REFERENCES CONSIDERED EXCEPT WHERE LINED THROUGH. /TE/

INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)		
	Application Number	11440924
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	Art Unit	2612
	Examiner Name	Timothy Edwards, Jr.
	Attorney Docket Number	CD06015

FOREIGN PATENT DOCUMENTS

Examiner Initial*	Cite No	Foreign Document Number3	Country Code2 i	Kind Code4	Publication Date	Name of Patentee or Applicant of cited Document	Pages,Columns,Lines where Relevant Passages or Relevant Figures Appear	T5
	1							☐

If you wish to add additional Foreign Patent Document citation information please click the Add button

NON-PATENT LITERATURE DOCUMENTS

Examiner Initials*	Cite No	Include name of the author (in CAPITAL LETTERS), title of the article (when appropriate), title of the item (book, magazine, journal, serial, symposium, catalog, etc), date, pages(s), volume-issue number(s), publisher, city and/or country where published.	T5
	1		☐

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EXAMINER SIGNATURE

Examiner Signature	/Timothy Edwards Jr/	Date Considered	12/22/2009

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

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

INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)		
	Application Number	11440924
	Filing Date	2006-05-25
	First Named Inventor	Liu Hua
	Art Unit	2612
	Examiner Name	Timothy Edwards, Jr.
	Attorney Docket Number	CD06015

CERTIFICATION STATEMENT

Please see 37 CFR 1.97 and 1.98 to make the appropriate selection(s):

☐ That each item of information contained in the information disclosure statement was first cited in any communication from a foreign patent office in a counterpart foreign application not more than three months prior to the filing of the information disclosure statement. See 37 CFR 1.97(e)(1).

OR

☐ That no item of information contained in the information disclosure statement was cited in a communication from a foreign patent office in a counterpart foreign application, and, to the knowledge of the person signing the certification after making reasonable inquiry, no item of information contained in the information disclosure statement was known to any individual designated in 37 CFR 1.56(c) more than three months prior to the filing of the information disclosure statement. See 37 CFR 1.97(e)(2).

☐ See attached certification statement.

☐ Fee set forth in 37 CFR 1.17 (p) has been submitted herewith.

☒ None

SIGNATURE

A signature of the applicant or representative is required in accordance with CFR 1.33, 10.18. Please see CFR 1.4(d) for the form of the signature.

Signature	/Lucinda G. Price/	Date (YYYY-MM-DD)	2009-12-18
Name/Print	Lucinda G. Price	Registration Number	42270

Privacy Act Statement

The Privacy Act of 1974 (P.L. 93-579) requires that you be given certain information in connection with your submission of the attached form related to a patent application or patent. Accordingly, pursuant to the requirements of the Act, please be advised that: (1) the general authority for the collection of this information is 35 U.S.C. 2(b)(2); (2) furnishing of the information solicited is voluntary; and (3) the principal purpose for which the information is used by the U.S. Patent and Trademark Office is to process and/or examine your submission related to a patent application or patent. If you do not furnish the requested information, the U.S. Patent and Trademark Office may not be able to process and/or examine your submission, which may result in termination of proceedings or abandonment of the application or expiration of the patent.

The information provided by you in this form will be subject to the following routine uses:

1. The information on this form will be treated confidentially to the extent allowed under the Freedom of Information Act (5 U.S.C. 552) and the Privacy Act (5 U.S.C. 552a). Records from this system of records may be disclosed to the Department of Justice to determine whether the Freedom of Information Act requires disclosure of these record s.

2. A record from this system of records may be disclosed, as a routine use, in the course of presenting evidence to a court, magistrate, or administrative tribunal, including disclosures to opposing counsel in the course of settlement negotiations.

3. A record in this system of records may be disclosed, as a routine use, to a Member of Congress submitting a request involving an individual, to whom the record pertains, when the individual has requested assistance from the Member with respect to the subject matter of the record.

4. A record in this system of records may be disclosed, as a routine use, to a contractor of the Agency having need for the information in order to perform a contract. Recipients of information shall be required to comply with the requirements of the Privacy Act of 1974, as amended, pursuant to 5 U.S.C. 552a(m).

5. A record related to an International Application filed under the Patent Cooperation Treaty in this system of records may be disclosed, as a routine use, to the International Bureau of the World Intellectual Property Organization, pursuant to the Patent Cooperation Treaty.

6. A record in this system of records may be disclosed, as a routine use, to another federal agency for purposes of National Security review (35 U.S.C. 181) and for review pursuant to the Atomic Energy Act (42 U.S.C. 218(c)).

7. A record from this system of records may be disclosed, as a routine use, to the Administrator, General Services, or his/her designee, during an inspection of records conducted by GSA as part of that agency's responsibility to recommend improvements in records management practices and programs, under authority of 44 U.S.C. 2904 and 2906. Such disclosure shall be made in accordance with the GSA regulations governing inspection of records for this purpose, and any other relevant (i.e., GSA or Commerce) directive. Such disclosure shall not be used to make determinations about individuals.

8. A record from this system of records may be disclosed, as a routine use, to the public after either publication of the application pursuant to 35 U.S.C. 122(b) or issuance of a patent pursuant to 35 U.S.C. 151. Further, a record may be disclosed, subject to the limitations of 37 CFR 1.14, as a routine use, to the public if the record was filed in an application which became abandoned or in which the proceedings were terminated and which application is referenced by either a published application, an application open to public inspections or an issued patent.

9. A record from this system of records may be disclosed, as a routine use, to a Federal, State, or local law enforcement agency, if the USPTO becomes aware of a violation or potential violation of law or regulation.

EAST Search History

EAST Search History (Prior Art)

Ref #	Hits	Search Query	DBs	Default Operator	Plurals	Time Stamp
L1	2	"6947031"	US-PGPUB; USPAT; EPO; JPO; DERWENT	OR	ON	2010/01/14 07:23
L2	3011	("20060192690" | "20080007434" | "3696908" | "3750113" | "4157539" | "4163222" | "4175239" | "4235871" | "4405917" | "4405918" | "4727767" | "4772874" | "4954823" | "5844506" | "7202855" | "7202859" | "7362244")	US-PGPUB; USPAT; EPO; JPO; DERWENT	OR	ON	2010/01/14 07:33
L3	3	2 and ((capacit$7 sens $4) near5 pin) and matrix and touch	US-PGPUB; USPAT; EPO; JPO; DERWENT	OR	ON	2010/01/14 07:35
L4	0	2 and ((capacit$7 near5 sens$4) same pin) and matrix and (position near6 determin$5)	US-PGPUB; USPAT; EPO; JPO; DERWENT	OR	ON	2010/01/14 07:46
L5	0	2 and (capacit$7 near5 sens$4) and pin and matrix and (position near6 determin$5)	US-PGPUB; USPAT; EPO; JPO; DERWENT	OR	ON	2010/01/14 07:47
L6	30	2 and (capacit$7 near5 sens$4) and (position near6 determin$5)	US-PGPUB; USPAT; EPO; JPO; DERWENT	OR	ON	2010/01/14 07:48
L7	530	2 and pin	US-PGPUB; USPAT; EPO; JPO; DERWENT	OR	ON	2010/01/14 08:01
L8	6	7 and (capacit$7 near5 sens$4) and (position near6 determin$5)	US-PGPUB; USPAT; EPO; JPO; DERWENT	OR	ON	2010/01/14 08:02

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REQUEST FOR CONTINUED EXAMINATION(RCE)TRANSMITTAL
(Submitted Only via EFS-Web)

Application Number	11/440,924	Filing Date	2006-05-25	Docket Number (if applicable)	CD06015	Art Unit	2612
First Named Inventor	Liu Hua			Examiner Name	Edwards Jr., Timothy		

This is a Request for Continued Examination (RCE) under 37 CFR 1.114 of the above-identified application.
Request for Continued Examination (RCE) practice under 37 CFR 1.114 does not apply to any utility or plant application filed prior to June 8, 1995, or to any design application. The Instruction Sheet for this form is located at WWW.USPTO.GOV

SUBMISSION REQUIRED UNDER 37 CFR 1.114

Note: If the RCE is proper, any previously filed unentered amendments and amendments enclosed with the RCE will be entered in the order in which they were filed unless applicant instructs otherwise. If applicant does not wish to have any previously filed unentered amendment(s) entered, applicant must request non-entry of such amendment(s).

☐ Previously submitted. If a final Office action is outstanding, any amendments filed after the final Office action may be considered as a submission even if this box is not checked.

- ☐ Consider the arguments in the Appeal Brief or Reply Brief previously filed on ________
- ☐ Other ________

☒ Enclosed

- ☒ Amendment/Reply
- ☒ Information Disclosure Statement (IDS)
- ☐ Affidavit(s)/ Declaration(s)
- ☐ Other ________

MISCELLANEOUS

☐ Suspension of action on the above-identified application is requested under 37 CFR 1.103(c) for a period of months ________
(Period of suspension shall not exceed 3 months; Fee under 37 CFR 1.17(i) required)

☐ Other ________

FEES

The RCE fee under 37 CFR 1.17(e) is required by 37 CFR 1.114 when the RCE is filed.
☒ The Director is hereby authorized to charge any underpayment of fees, or credit any overpayments, to Deposit Account No 503781

SIGNATURE OF APPLICANT, ATTORNEY, OR AGENT REQUIRED

☒ Patent Practitioner Signature
☐ Applicant Signature

Signature of Registered U.S. Patent Practitioner			
Signature	/Lucinda G. Price/	Date (YYYY-MM-DD)	2009-12-18
Name	Lucinda G. Price	Registration Number	42270

Privacy Act Statement

The Privacy Act of 1974 (P.L. 93-579) requires that you be given certain information in connection with your submission of the attached form related to a patent application or patent. Accordingly, pursuant to the requirements of the Act, please be advised that: (1) the general authority for the collection of this information is 35 U.S.C. 2(b)(2); (2) furnishing of the information solicited is voluntary; and (3) the principal purpose for which the information is used by the U.S. Patent and Trademark Office is to process and/or examine your submission related to a patent application or patent. If you do not furnish the requested information, the U.S. Patent and Trademark Office may not be able to process and/or examine your submission, which may result in termination of proceedings or abandonment of the application or expiration of the patent.

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INFORMATION DISCLOSURE STATEMENT BY APPLICANT (**Not for submission under 37 CFR 1.99)**		
	Application Number	11440924
	Filing Date	2006-05-25
	First Named Inventor	Liu Hua
	Art Unit	2612
	Examiner Name	Timothy Edwards, Jr.
	Attorney Docket Number	CD06015

U.S.PATENTS

Examiner Initial*	Cite No	Patent Number	Kind Code[1]	Issue Date	Name of Patentee or Applicant of cited Document	Pages,Columns,Lines where Relevant Passages or Relevant Figures Appear
	1	3696908	B1	1972-10-10	Gluck et al.	Entire Document
	2	3750113	B1	1973-07-31	Cencel, Arthur J.	Entire Document
	3	4157539	B1	1979-06-05	Hunts et al.	Entire Document
	4	4163222	B1	1979-07-31	Grove, Donald C.	Entire Document
	5	4175239	B1	1979-11-20	Sandler, Louis M.	Entire Document
	6	4235871	B1	1980-11-25	Papahadjopoulos et al.	Entire Document
	7	4405917	B1	1983-09-20	Chai, Thomas Y.	Entire Document
	8	4405918	B1	1983-09-20	Wall et al.	Entire Document

INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)	Application Number		11440924
	Filing Date		2006-05-25
	First Named Inventor	Liu Hua	
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	13	7202855	B1	2007-04-10	Shigetaka et al.	Entire Document
	14	7202859	B1	2007-04-10	Speck et al.	Entire Document
	15	7362244	B1	2008-04-22	Sun, Ben-Chang	Entire Document

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U.S.PATENT APPLICATION PUBLICATIONS

Examiner Initial*	Cite No	Publication Number	Kind Code[1]	Publication Date	Name of Patentee or Applicant of cited Document	Pages,Columns,Lines where Relevant Passages or Relevant Figures Appear
	1	20060192690				
	2	20080007434				

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INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)	Application Number	11440924
	Filing Date	2006-05-25
	First Named Inventor	Liu Hua
	Art Unit	2612
	Examiner Name	Timothy Edwards, Jr.
	Attorney Docket Number	CD06015

FOREIGN PATENT DOCUMENTS

Examiner Initial*	Cite No	Foreign Document Number3	Country Code2 i	Kind Code4	Publication Date	Name of Patentee or Applicant of cited Document	Pages,Columns,Lines where Relevant Passages or Relevant Figures Appear	T5
	1							☐

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NON-PATENT LITERATURE DOCUMENTS

Examiner Initials*	Cite No	Include name of the author (in CAPITAL LETTERS), title of the article (when appropriate), title of the item (book, magazine, journal, serial, symposium, catalog, etc), date, pages(s), volume-issue number(s), publisher, city and/or country where published.	T5
	1		☐

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EXAMINER SIGNATURE

Examiner Signature		Date Considered	

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

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

INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)		
	Application Number	11440924
	Filing Date	2006-05-25
	First Named Inventor	Liu Hua
	Art Unit	2612
	Examiner Name	Timothy Edwards, Jr.
	Attorney Docket Number	CD06015

CERTIFICATION STATEMENT

Please see 37 CFR 1.97 and 1.98 to make the appropriate selection(s):

☐ That each item of information contained in the information disclosure statement was first cited in any communication from a foreign patent office in a counterpart foreign application not more than three months prior to the filing of the information disclosure statement. See 37 CFR 1.97(e)(1).

OR

☐ That no item of information contained in the information disclosure statement was cited in a communication from a foreign patent office in a counterpart foreign application, and, to the knowledge of the person signing the certification after making reasonable inquiry, no item of information contained in the information disclosure statement was known to any individual designated in 37 CFR 1.56(c) more than three months prior to the filing of the information disclosure statement. See 37 CFR 1.97(e)(2).

☐ See attached certification statement.

☐ Fee set forth in 37 CFR 1.17 (p) has been submitted herewith.

☒ None

SIGNATURE

A signature of the applicant or representative is required in accordance with CFR 1.33, 10.18. Please see CFR 1.4(d) for the form of the signature.

Signature	/Lucinda G. Price/	Date (YYYY-MM-DD)	2009-12-18
Name/Print	Lucinda G. Price	Registration Number	42270

Privacy Act Statement

The Privacy Act of 1974 (P.L. 93-579) requires that you be given certain information in connection with your submission of the attached form related to a patent application or patent. Accordingly, pursuant to the requirements of the Act, please be advised that: (1) the general authority for the collection of this information is 35 U.S.C. 2(b)(2); (2) furnishing of the information solicited is voluntary; and (3) the principal purpose for which the information is used by the U.S. Patent and Trademark Office is to process and/or examine your submission related to a patent application or patent. If you do not furnish the requested information, the U.S. Patent and Trademark Office may not be able to process and/or examine your submission, which may result in termination of proceedings or abandonment of the application or expiration of the patent.

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1. The information on this form will be treated confidentially to the extent allowed under the Freedom of Information Act (5 U.S.C. 552) and the Privacy Act (5 U.S.C. 552a). Records from this system of records may be disclosed to the Department of Justice to determine whether the Freedom of Information Act requires disclosure of these record s.

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6. A record in this system of records may be disclosed, as a routine use, to another federal agency for purposes of National Security review (35 U.S.C. 181) and for review pursuant to the Atomic Energy Act (42 U.S.C. 218(c)).

7. A record from this system of records may be disclosed, as a routine use, to the Administrator, General Services, or his/her designee, during an inspection of records conducted by GSA as part of that agency's responsibility to recommend improvements in records management practices and programs, under authority of 44 U.S.C. 2904 and 2906. Such disclosure shall be made in accordance with the GSA regulations governing inspection of records for this purpose, and any other relevant (i.e., GSA or Commerce) directive. Such disclosure shall not be used to make determinations about individuals.

8. A record from this system of records may be disclosed, as a routine use, to the public after either publication of the application pursuant to 35 U.S.C. 122(b) or issuance of a patent pursuant to 35 U.S.C. 151. Further, a record may be disclosed, subject to the limitations of 37 CFR 1.14, as a routine use, to the public if the record was filed in an application which became abandoned or in which the proceedings were terminated and which application is referenced by either a published application, an application open to public inspections or an issued patent.

9. A record from this system of records may be disclosed, as a routine use, to a Federal, State, or local law enforcement agency, if the USPTO becomes aware of a violation or potential violation of law or regulation.

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In Re Patent Application of:

Liu Hua, et al.

Application No.: 11/440,924

Filed: May 25, 2006

Art unit: 2612

Examiner: Edwards Jr., Timothy

For: CAPACITANCE SENSING MATRIX FOR KEYBOARD ARCHITECTURE

Confirmation No.: 9376

Mail Stop Amendment
Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

AMENDMENT AND RESPONSE TO OFFICE ACTION

Examiner:

Applicant respectfully requests that the Examiner enter the following amendments and consider the following remarks.

Amendments to the Claims are reflected in the listing of claims that begins on page 2 of this paper.

Amendments to the Claims are reflected in the listing of claims that begins on page 3 of this paper.

Remarks begin on page 11 of this paper.

REMARKS

Applicant respectfully requests reconsideration of this application in view of the following remarks.

Status of the Claims

Claims 1-30 are pending and in condition for allowance. Claim 1 is currently amended. No claims are canceled. No claims are added. No new matter has been added.

CONCLUSION

It is respectfully submitted that in view of the amendments and remarks set forth herein, the rejections and objections have been overcome. If the Examiner believes a telephone interview would expedite the prosecution of this application, the Examiner is invited to contact Lucinda G. Price, by telephone at (408) 545-7194.

Please charge any additional fees under 37 CFR §§ 1.16, 1.17, 1.18, 1.20 and 1.21 that may be required to maintain pendency of the present application, or apply any credits to our PTO deposit account number: 50-3781.

Respectfully submitted,

Date: December 18, 2009 /Lucinda G. Price/
Lucinda G. Price
Reg. No. 42,270

Electronic Patent Application Fee Transmittal				
Application Number:	11440924			
Filing Date:	25-May-2006			
Title of Invention:	LOW PIN COUNT SOLUTION USING CAPACITANCE SENSING MATRIX FOR KEYBOARD ARCHITECTURE			
First Named Inventor/Applicant Name:	Liu Hua			
Filer:	Andrew J. Bateman/Hilary Link			
Attorney Docket Number:	CD06015			
Filed as Large Entity				
Utility under 35 USC 111(a) Filing Fees				
Description	**Fee Code**	**Quantity**	**Amount**	**Sub-Total in USD($)**
Basic Filing:				
Pages:				
Claims:				
Miscellaneous-Filing:				
Petition:				
Patent-Appeals-and-Interference:				
Post-Allowance-and-Post-Issuance:				
Extension-of-Time:				

Description	Fee Code	Quantity	Amount	Sub-Total in USD($)
Miscellaneous:				
Request for continued examination	1801	1	810	810
		Total in USD ($)		**810**

Electronic Acknowledgement Receipt

EFS ID:	6674188
Application Number:	11440924
International Application Number:	
Confirmation Number:	9376
Title of Invention:	LOW PIN COUNT SOLUTION USING CAPACITANCE SENSING MATRIX FOR KEYBOARD ARCHITECTURE
First Named Inventor/Applicant Name:	Liu Hua
Customer Number:	60909
Filer:	Andrew J. Bateman/Hilary Link
Filer Authorized By:	Andrew J. Bateman
Attorney Docket Number:	CD06015
Receipt Date:	18-DEC-2009
Filing Date:	25-MAY-2006
Time Stamp:	20:15:49
Application Type:	Utility under 35 USC 111(a)

Payment information:

Submitted with Payment	yes
Payment Type	Deposit Account
Payment was successfully received in RAM	$810
RAM confirmation Number	5882
Deposit Account	503781
Authorized User	

The Director of the USPTO is hereby authorized to charge indicated fees and credit any overpayment as follows:

Charge any Additional Fees required under 37 C.F.R. Section 1.16 (National application filing, search, and examination fees)

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Charge any Additional Fees required under 37 C.F.R. Section 1.19 (Document supply fees)

Charge any Additional Fees required under 37 C.F.R. Section 1.20 (Post Issuance fees)

Charge any Additional Fees required under 37 C.F.R. Section 1.21 (Miscellaneous fees and charges)

File Listing:

Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
1	Transmittal Letter	CD06015transmittalletter.pdf	50241 881665a4c52f3bdcfc32ea1750118e443d55207f	no	2
Warnings:					
Information:					
2	Request for Continued Examination (RCE)	CD06015RCEpdf.pdf	131092 aca029f28ce391be8608a72e1d05168f854cfb81	no	3
Warnings:					
This is not a USPTO supplied RCE SB30 form.					
Information:					
3	Information Disclosure Statement (IDS) Filed (SB/08)	CD06015IDSformPDF.pdf	927463 e24595757e8656321d69079df2914cbd74da653e	no	5
Warnings:					
Information:					
This is not an USPTO supplied IDS fillable form					
4	Preliminary Amendment	CD06015amendmentafterallowancePDF.pdf	1536664 0777659cfedb0c09ffec8a67feb85a44e61eb946	no	11
Warnings:					
Information:					
5	Fee Worksheet (PTO-875)	fee-info.pdf	30807 1babda9f769021525c75c54b83e71cf53cfc0e7a	no	2
Warnings:					
Information:					
		Total Files Size (in bytes):	2676267		

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If a new application is being filed and the application includes the necessary components for a filing date (see 37 CFR 1.53(b)-(d) and MPEP 506), a Filing Receipt (37 CFR 1.54) will be issued in due course and the date shown on this Acknowledgement Receipt will establish the filing date of the application.

<u>National Stage of an International Application under 35 U.S.C. 371</u>
If a timely submission to enter the national stage of an international application is compliant with the conditions of 35 U.S.C. 371 and other applicable requirements a Form PCT/DO/EO/903 indicating acceptance of the application as a national stage submission under 35 U.S.C. 371 will be issued in addition to the Filing Receipt, in due course.

<u>New International Application Filed with the USPTO as a Receiving Office</u>
If a new international application is being filed and the international application includes the necessary components for an international filing date (see PCT Article 11 and MPEP 1810), a Notification of the International Application Number and of the International Filing Date (Form PCT/RO/105) will be issued in due course, subject to prescriptions concerning national security, and the date shown on this Acknowledgement Receipt will establish the international filing date of the application.

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Application of:	)	
	)	Examiner: Edwards Jr., Timothy
Liu Hua, et al.	)	
	)	Group Art Unit: 2612
Application No.: 11/440,924	)	
	)	Confirmation No.: 9376
Filed: May 25, 2006	)	
	)	
For: CAPACITANCE SENSING MATRIX	)	
FOR KEYBOARD ARCHITECTURE	)	Date: December 18, 2009

REQUEST FOR CONTINUED EXAMINATION AND INFORMATION DISCLOSURE STATEMENT

Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Sir:

Applicant hereby submits the Request for Continued Examination to be considered with the IDS for the above referenced application. In compliance with the duty of disclosure under 37 CFR § 1.56 and in accordance with the practice under 37 CFR §§ 1.97 and 1.98, the Examiner's attention is directed to the documents listed on the enclosed PTO-1449.

In accordance with 37 CFR § 1.97(h), this Information Disclosure Statement is not to be construed as an admission that the information cited is or is considered to be material to patentability as defined in 37 CFR § 1.56(b), nor as an admission that the information constitutes prior art within the meaning of 35 USC §§ 102 and/or 103.

It is respectfully requested that the information listed on the PTO-1449 be considered by the Examiner, and that an initialed copy of the PTO-1449 be returned indicating that such information was considered.

Customer No.: 60909

The Commissioner is hereby authorized to charge any appropriate fees under 37 C.F.R. §§ 1.16, 1.17, 1.18, 1.20 and 1.21 that may be required to maintain pendency of the present application, and to credit any overpayments, to Deposit Account No. 50-3781.

Should the Patent Office have any questions regarding this submission or the application in general, the Patent Office is urged to contact the Applicant's attorney, Lucinda G. Price, by telephone at (408) 545-7194. All correspondence should continue to be directed to the address given below.

/

/

Respectfully submitted,

By: ______________________
Lucinda G. Price
Attorney for Applicant
Registration No. 42,270

Cypress Semiconductor Corporation
198 Champion Court
San Jose, CA 95134
Facsimile: (408) 545-6911
Customer No.: 60909

PATENT APPLICATION FEE DETERMINATION RECORD Substitute for Form PTO-875	Application or Docket Number 11/440,924	Filing Date 05/25/2006	☐ To be Mailed

APPLICATION AS FILED – PART I

FOR	NUMBER FILED (Column 1)	NUMBER EXTRA (Column 2)	SMALL ENTITY ☐ RATE ($)	FEE ($)	OR	OTHER THAN SMALL ENTITY RATE ($)	FEE ($)
☐ BASIC FEE (37 CFR 1.16(a), (b), or (c))	N/A	N/A	N/A			N/A	
☐ SEARCH FEE (37 CFR 1.16(k), (i), or (m))	N/A	N/A	N/A			N/A	
☐ EXAMINATION FEE (37 CFR 1.16(o), (p), or (q))	N/A	N/A	N/A			N/A	
TOTAL CLAIMS (37 CFR 1.16(i))	minus 20 =	*	X $ =		OR	X $ =	
INDEPENDENT CLAIMS (37 CFR 1.16(h))	minus 3 =	*	X $ =			X $ =	
☐ APPLICATION SIZE FEE (37 CFR 1.16(s))	If the specification and drawings exceed 100 sheets of paper, the application size fee due is $250 ($125 for small entity) for each additional 50 sheets or fraction thereof. See 35 U.S.C. 41(a)(1)(G) and 37 CFR 1.16(s).						
☐ MULTIPLE DEPENDENT CLAIM PRESENT (37 CFR 1.16(j))							
			TOTAL			TOTAL	

* If the difference in column 1 is less than zero, enter "0" in column 2.

APPLICATION AS AMENDED – PART II

AMENDMENT	CLAIMS REMAINING AFTER AMENDMENT (Column 1)		HIGHEST NUMBER PREVIOUSLY PAID FOR (Column 2)	PRESENT EXTRA (Column 3)	SMALL ENTITY RATE ($)	ADDITIONAL FEE ($)	OR	OTHER THAN SMALL ENTITY RATE ($)	ADDITIONAL FEE ($)
12/18/2009									
Total (37 CFR 1.16(i))	* 30	Minus	** 30	= 0	X $ =		OR	X $52=	0
Independent (37 CFR 1.16(h))	* 3	Minus	***3	= 0	X $ =		OR	X $220=	0
☐ Application Size Fee (37 CFR 1.16(s))									
☐ FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM (37 CFR 1.16(j))							OR		
					TOTAL ADD'L FEE		OR	TOTAL ADD'L FEE	**0**

AMENDMENT	CLAIMS REMAINING AFTER AMENDMENT (Column 1)		HIGHEST NUMBER PREVIOUSLY PAID FOR (Column 2)	PRESENT EXTRA (Column 3)	RATE ($)	ADDITIONAL FEE ($)		RATE ($)	ADDITIONAL FEE ($)
Total (37 CFR 1.16(i))	*	Minus	**	=	X $ =		OR	X $ =	
Independent (37 CFR 1.16(h))	*	Minus	***	=	X $ =		OR	X $ =	
☐ Application Size Fee (37 CFR 1.16(s))									
☐ FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM (37 CFR 1.16(j))							OR		
					TOTAL ADD'L FEE		OR	TOTAL ADD'L FEE	

* If the entry in column 1 is less than the entry in column 2, write "0" in column 3.
** If the "Highest Number Previously Paid For" IN THIS SPACE is less than 20, enter "20".
*** If the "Highest Number Previously Paid For" IN THIS SPACE is less than 3, enter "3".
The "Highest Number Previously Paid For" (Total or Independent) is the highest number found in the appropriate box in column 1.

Legal Instrument Examiner:
/MARQUETTA MCGEE/

AMENDMENTS

<u>Amendments to the Title</u>:

~~A LOW PIN COUNT SOLUTION USING~~ CAPACITANCE SENSING MATRIX FOR KEYBOARD ARCHITECTURE

Amendments to the Claims:

This listing of claims will replace all prior versions, and listings, of the claims in the application:

Listing of Claims:

1. (Currently amended) A method, comprising:

assigning a plurality of keyboard keys to correspond to pre-defined areas of a sensing surface of a sensing device having a plurality of sensor elements and a plurality of capacitance sensing pins to couple the plurality of sensor elements to a processing device, wherein the pre-defined areas are disposed adjacent to one another; ~~wherein at least one of the plurality of sensor elements corresponds~~

determining a position of a presence of the conductive object on the sensing device by measuring capacitance on the plurality of capacitance sensing pins; and

selecting a keyboard key of the plurality of keyboard keys when the position of the presence of the conductive object is determined to be within the pre-defined area of the sensing device corresponding to the keyboard key.

2. (Original) The method of claim 1, wherein selecting the keyboard key comprises comparing the position of the conductive object with the pre-defined areas.

3. (Original) The method of claim 1, further comprising outputting keyboard data corresponding to the selected key from the processing device to a component external to the processing device.

4. (Previously Presented) The method of claim 1, wherein the plurality of sensor elements are disposed in a capacitance sensor matrix comprising a plurality of rows of sensor elements and a plurality of columns of sensor elements, wherein each row and each column is coupled to one of the plurality of capacitance sensing pins, and wherein determining the position of the conductive object comprises:

measuring a capacitance of each row of sensor elements of the capacitance sensor matrix of the sensing device;

determining a first dimension position based on the measured capacitance of the rows of sensor elements;

measuring a capacitance of each column of sensor elements of the capacitance sensor matrix; and

determining a second dimension position based on the measured capacitance of the columns of sensor elements, wherein determining the position of the presence of the conductive object is determined using the first and second dimension positions.

5. (Original) The method of claim 3, wherein assigning the plurality of keyboard keys into pre-defined areas comprises defining a data structure comprising positional data of the pre-defined areas of the plurality of keyboard keys, wherein selecting the keyboard key comprises comparing the position of the conductive object with the positional data of the pre-defined areas of the data structure to determine a pressed key of the plurality of keyboard keys, and wherein outputting the keyboard data comprises outputting keyboard data that corresponds to the pressed key.

6. (Previously Presented) An apparatus, comprising:

a sensing device comprising a plurality of sensor elements to detect a presence of a conductive object on a sensing surface of the sensing device, wherein a plurality of keyboard keys are assigned to correspond to pre-defined areas of a sensing surface of the sensing device, wherein the pre-defined areas are disposed adjacent to one another; and

a processing device coupled to the sensing device using capacitance sensing pins, wherein the processing device is operable to determine a position of the presence of the conductive object on the sensing device by measuring capacitance on the capacitance sensing pins, and to select a keyboard key of the plurality of keyboard keys when the position of the presence of the conductive object is determined to be within the pre-defined area of the sensing device corresponding to the keyboard key.

7. (Original) The apparatus of claim 6, wherein the plurality of keyboard keys are a personal computer (PC) keyboard, and wherein the processing device is coupled to the sensing device using less than 21 capacitance sensing pins.

8. (Original) The apparatus of claim 6, wherein the plurality of keyboard keys comprises approximately 48 keyboard keys, and wherein the processing device is coupled to the sensing device using 4 capacitance sensing pins.

9. (Original) The apparatus of claim 6, wherein the plurality of keyboard keys comprises approximately 101 keyboard keys, and wherein the processing device is coupled to the sensing device using less than 12 capacitance sensing pins.

10. (Original) The apparatus of claim 6, wherein the plurality of keyboard keys comprises approximately 107 keyboard keys, and wherein the processing device is coupled to the sensing device using less than 21 capacitance sensing pins.

11. (Original) The apparatus of claim 6, wherein the plurality of keyboard keys comprises approximately 107 keyboard keys, and wherein the processing device is coupled to the sensing device using less than 12 capacitance sensing pins.

12. (Original) The apparatus of claim 6, wherein a total surface area of the assigned keyboard keys is less than approximately 10 centimeters (cm) by 10 cm.

13. (Original) The apparatus of claim 6, wherein a total surface area of the assigned keyboard keys is approximately 3 centimeters (cm) by 3 cm.

14. (Previously Presented) The apparatus of claim 6, wherein the sensing device comprises a capacitance sensor matrix comprising the plurality of sensor elements configured in rows and columns to detect the presence of the conductive object on the sensing device, wherein each row and column is coupled to the processing device using one of the capacitance sensing pins, and wherein the plurality of keyboard keys are assigned to the pre-defined areas of the capacitance sensor matrix.

15. (Original) The apparatus of claim 14, wherein the processing device comprises one or more capacitance sensors coupled to the capacitance sensor matrix, wherein the one or more capacitance sensors are operable to measure a capacitance of each row of sensor elements of the capacitance sensor matrix, and to measure a capacitance of each

column of sensor elements of the capacitance sensor matrix, and wherein the processing device is operable to determine the position of the presence of the keyboard key using the measured capacitance of the rows and columns of sensor elements of the capacitance sensor matrix.

16. (Original) The apparatus of claim 15, wherein the one or more capacitance sensors are relaxation oscillators, wherein each relaxation oscillator comprises:

a current source to provide a charge current to the plurality of sensor elements;

a selection circuit coupled to the plurality of sensor elements and the current source, wherein the selection circuit is operable to sequentially select a sensor element of the plurality of sensor elements to provide the charge current and to measure the capacitance of each sensor element of the sensing device;

a comparator coupled to the current source and the selection circuit, wherein the comparator is operable to compare a voltage on the selected sensor element and a threshold voltage; and

a reset switch coupled to the comparator, current source, and selection circuit, wherein the reset switch is operable to reset the charge current on the selected sensor element, wherein the one or more capacitance sensors further comprise a digital counter coupled to the relaxation oscillator, wherein the digital counter is operable to count at least one of a frequency of an oscillator output or a period of the oscillator received from the relaxation oscillator.

17. (Original) The apparatus of claim 6, further comprising a component external to the processing device, wherein the processing device is operable to send keyboard data to the component that corresponds to the selected keyboard key.

18. (Original) The apparatus of claim 17, wherein the component external to the processing device is at least one of a processor, a driver of a processor, or an embedded controller.

19. (Original) The apparatus of claim 17, wherein the keyboard data comprises is at least one of a keyboard data signal, or a keyboard data command.

20. (Original) The apparatus of claim 6, wherein the sensing device is mounted on a mobile handset.

21. (Original) The apparatus of claim 6, wherein the processing device is coupled to an additional user input device, and wherein the additional input device is at least one of a cursor positioning device, a touch-sensor pad, a touch-sensor slider, a touch-sensor button, mouse, or a touch-screen display.

22. (Previously Presented) An apparatus, comprising:

a sensing device comprising a plurality of sensor elements to detect a presence of a conductive object on the sensing device, wherein a plurality of keyboard keys are assigned to correspond to pre-defined areas of a sensing surface of the sensing device, wherein the pre-defined areas are disposed adjacent to one another;

means for determining a position of the presence of the conductive object on the sensing device; and

means for selecting a keyboard key of the plurality of keyboard keys when the position of the presence of the conductive object is determined to be within the pre-defined area of the sensing device corresponding to the keyboard key.

23. (Previously Presented) The apparatus of claim 22, further comprising means for assigning the plurality of keyboard keys to correspond to the pre-defined areas of the sensing device.

24. (Original) The apparatus of claim 22, further comprising means for reducing a number of capacitance sensing pins used to connect the sensing device to the means for determining the position of the conductive object.

25. (Original) The apparatus of claim 22, further comprising means for reducing a total surface area of the sensing device while maintaining a number of keyboard keys on a device.

26. (Original) The apparatus of claim 22, further comprising means for outputting keyboard data based on the position of the presence of the keyboard key.

27. (Previously Presented) The method of claim 1, wherein the pre-defined areas of the plurality of keyboard keys are arranged into multiple rows on the sensing surface, wherein the plurality of sensor elements are arranged in a plurality of rows of

sensor elements, and wherein at least one of the plurality of rows of sensor elements corresponds to a plurality of rows of the pre-defined areas.

28. (Previously Presented) The method of claim 1, wherein at least one of the plurality of sensor elements corresponds to multiple pre-defined areas.

29. (Previously Presented) The apparatus of claim 6, wherein the pre-defined areas of the plurality of keyboard keys are arranged into multiple rows on the sensing surface, wherein the plurality of sensor elements are arranged in a plurality of rows of sensor elements, and wherein at least one of the plurality of rows of sensor elements corresponds to a plurality of rows of the pre-defined areas.

30. (Previously Presented) The apparatus of claim 6, wherein at least one of the plurality of sensor elements corresponds to multiple pre-defined areas.

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NOTICE OF ALLOWANCE AND FEE(S) DUE

60909 7590 09/23/2009

CYPRESS SEMICONDUCTOR CORPORATION
198 CHAMPION COURT
SAN JOSE, CA 95134-1709

EXAMINER	
EDWARDS JR, TIMOTHY	
ART UNIT	PAPER NUMBER
2612	

DATE MAILED: 09/23/2009

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
11/440,924	05/25/2006	Liu Hua	CD06015	9376

TITLE OF INVENTION: LOW PIN COUNT SOLUTION USING CAPACITANCE SENSING MATRIX FOR KEYBOARD ARCHITECTURE

APPLN. TYPE	SMALL ENTITY	ISSUE FEE DUE	PUBLICATION FEE DUE	PREV. PAID ISSUE FEE	TOTAL FEE(S) DUE	DATE DUE
nonprovisional	NO	$1510	$300	$0	$1810	12/23/2009

THE APPLICATION IDENTIFIED ABOVE HAS BEEN EXAMINED AND IS ALLOWED FOR ISSUANCE AS A PATENT. PROSECUTION ON THE MERITS IS CLOSED. THIS NOTICE OF ALLOWANCE IS NOT A GRANT OF PATENT RIGHTS. THIS APPLICATION IS SUBJECT TO WITHDRAWAL FROM ISSUE AT THE INITIATIVE OF THE OFFICE OR UPON PETITION BY THE APPLICANT. SEE 37 CFR 1.313 AND MPEP 1308.

THE ISSUE FEE AND PUBLICATION FEE (IF REQUIRED) MUST BE PAID WITHIN THREE MONTHS FROM THE MAILING DATE OF THIS NOTICE OR THIS APPLICATION SHALL BE REGARDED AS ABANDONED. THIS STATUTORY PERIOD CANNOT BE EXTENDED. SEE 35 U.S.C. 151. THE ISSUE FEE DUE INDICATED ABOVE DOES NOT REFLECT A CREDIT FOR ANY PREVIOUSLY PAID ISSUE FEE IN THIS APPLICATION. IF AN ISSUE FEE HAS PREVIOUSLY BEEN PAID IN THIS APPLICATION (AS SHOWN ABOVE), THE RETURN OF PART B OF THIS FORM WILL BE CONSIDERED A REQUEST TO REAPPLY THE PREVIOUSLY PAID ISSUE FEE TOWARD THE ISSUE FEE NOW DUE.

HOW TO REPLY TO THIS NOTICE:

I. Review the SMALL ENTITY status shown above.

If the SMALL ENTITY is shown as YES, verify your current SMALL ENTITY status:

A. If the status is the same, pay the TOTAL FEE(S) DUE shown above.

B. If the status above is to be removed, check box 5b on Part B - Fee(s) Transmittal and pay the PUBLICATION FEE (if required) and twice the amount of the ISSUE FEE shown above, or

If the SMALL ENTITY is shown as NO:

A. Pay TOTAL FEE(S) DUE shown above, or

B. If applicant claimed SMALL ENTITY status before, or is now claiming SMALL ENTITY status, check box 5a on Part B - Fee(s) Transmittal and pay the PUBLICATION FEE (if required) and 1/2 the ISSUE FEE shown above.

II. PART B - FEE(S) TRANSMITTAL, or its equivalent, must be completed and returned to the United States Patent and Trademark Office (USPTO) with your ISSUE FEE and PUBLICATION FEE (if required). If you are charging the fee(s) to your deposit account, section "4b" of Part B - Fee(s) Transmittal should be completed and an extra copy of the form should be submitted. If an equivalent of Part B is filed, a request to reapply a previously paid issue fee must be clearly made, and delays in processing may occur due to the difficulty in recognizing the paper as an equivalent of Part B.

III. All communications regarding this application must give the application number. Please direct all communications prior to issuance to Mail Stop ISSUE FEE unless advised to the contrary.

IMPORTANT REMINDER: Utility patents issuing on applications filed on or after Dec. 12, 1980 may require payment of maintenance fees. It is patentee's responsibility to ensure timely payment of maintenance fees when due.

PTOL-85 (Rev. 08/07) Approved for use through 08/31/2010.

PART B - FEE(S) TRANSMITTAL

Complete and send this form, together with applicable fee(s), to: Mail **Mail Stop ISSUE FEE**
Commissioner for Patents
P.O. Box 1450
Alexandria, Virginia 22313-1450
or Fax (571)-273-2885

INSTRUCTIONS: This form should be used for transmitting the ISSUE FEE and PUBLICATION FEE (if required). Blocks 1 through 5 should be completed where appropriate. All further correspondence including the Patent, advance orders and notification of maintenance fees will be mailed to the current correspondence address as indicated unless corrected below or directed otherwise in Block 1, by (a) specifying a new correspondence address; and/or (b) indicating a separate "FEE ADDRESS" for maintenance fee notifications.

CURRENT CORRESPONDENCE ADDRESS (Note: Use Block 1 for any change of address)

60909 7590 09/23/2009

CYPRESS SEMICONDUCTOR CORPORATION
198 CHAMPION COURT
SAN JOSE, CA 95134-1709

Note: A certificate of mailing can only be used for domestic mailings of the Fee(s) Transmittal. This certificate cannot be used for any other accompanying papers. Each additional paper, such as an assignment or formal drawing, must have its own certificate of mailing or transmission.

Certificate of Mailing or Transmission

I hereby certify that this Fee(s) Transmittal is being deposited with the United States Postal Service with sufficient postage for first class mail in an envelope addressed to the Mail Stop ISSUE FEE address above, or being facsimile transmitted to the USPTO (571) 273-2885, on the date indicated below.

(Depositor's name)

(Signature)

(Date)

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
11/440,924	05/25/2006	Liu Hua	CD06015	9376

TITLE OF INVENTION: LOW PIN COUNT SOLUTION USING CAPACITANCE SENSING MATRIX FOR KEYBOARD ARCHITECTURE

APPLN. TYPE	SMALL ENTITY	ISSUE FEE DUE	PUBLICATION FEE DUE	PREV. PAID ISSUE FEE	TOTAL FEE(S) DUE	DATE DUE
nonprovisional	NO	$1510	$300	$0	$1810	12/23/2009

EXAMINER	ART UNIT	CLASS-SUBCLASS
EDWARDS JR, TIMOTHY	2612	341-033000

1. Change of correspondence address or indication of "Fee Address" (37 CFR 1.363).
   - ❑ Change of correspondence address (or Change of Correspondence Address form PTO/SB/122) attached.
   - ❑ "Fee Address" indication (or "Fee Address" Indication form PTO/SB/47; Rev 03-02 or more recent) attached. **Use of a Customer Number is required.**

2. For printing on the patent front page, list
   (1) the names of up to 3 registered patent attorneys or agents OR, alternatively,
   (2) the name of a single firm (having as a member a registered attorney or agent) and the names of up to 2 registered patent attorneys or agents. If no name is listed, no name will be printed.
   1 ____________________
   2 ____________________
   3 ____________________

3. ASSIGNEE NAME AND RESIDENCE DATA TO BE PRINTED ON THE PATENT (print or type)

PLEASE NOTE: Unless an assignee is identified below, no assignee data will appear on the patent. If an assignee is identified below, the document has been filed for recordation as set forth in 37 CFR 3.11. Completion of this form is NOT a substitute for filing an assignment.

(A) NAME OF ASSIGNEE

(B) RESIDENCE: (CITY and STATE OR COUNTRY)

Please check the appropriate assignee category or categories (will not be printed on the patent) : ❑ Individual ❑ Corporation or other private group entity ❑ Government

4a. The following fee(s) are submitted:
- ❑ Issue Fee
- ❑ Publication Fee (No small entity discount permitted)
- ❑ Advance Order - # of Copies ____________________

4b. Payment of Fee(s): **(Please first reapply any previously paid issue fee shown above)**
- ❑ A check is enclosed.
- ❑ Payment by credit card. Form PTO-2038 is attached.
- ❑ The Director is hereby authorized to charge the required fee(s), any deficiency, or credit any overpayment, to Deposit Account Number ____________ (enclose an extra copy of this form).

5. **Change in Entity Status** (from status indicated above)
   - ❑ a. Applicant claims SMALL ENTITY status. See 37 CFR 1.27.
   - ❑ b. Applicant is no longer claiming SMALL ENTITY status. See 37 CFR 1.27(g)(2).

NOTE: The Issue Fee and Publication Fee (if required) will not be accepted from anyone other than the applicant; a registered attorney or agent; or the assignee or other party in interest as shown by the records of the United States Patent and Trademark Office.

Authorized Signature ______________________________ Date ______________________________

Typed or printed name ______________________________ Registration No. ______________________________

UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
Address: COMMISSIONER FOR PATENTS
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Alexandria, Virginia 22313-1450
www.uspto.gov

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
11/440,924	05/25/2006	Liu Hua	CD06015	9376

60909 7590 09/23/2009

CYPRESS SEMICONDUCTOR CORPORATION
198 CHAMPION COURT
SAN JOSE, CA 95134-1709

EXAMINER	
EDWARDS JR, TIMOTHY	
ART UNIT	PAPER NUMBER
2612	

DATE MAILED: 09/23/2009

Determination of Patent Term Adjustment under 35 U.S.C. 154 (b)
(application filed on or after May 29, 2000)

The Patent Term Adjustment to date is 594 day(s). If the issue fee is paid on the date that is three months after the mailing date of this notice and the patent issues on the Tuesday before the date that is 28 weeks (six and a half months) after the mailing date of this notice, the Patent Term Adjustment will be 594 day(s).

If a Continued Prosecution Application (CPA) was filed in the above-identified application, the filing date that determines Patent Term Adjustment is the filing date of the most recent CPA.

Applicant will be able to obtain more detailed information by accessing the Patent Application Information Retrieval (PAIR) WEB site (http://pair.uspto.gov).

Any questions regarding the Patent Term Extension or Adjustment determination should be directed to the Office of Patent Legal Administration at (571)-272-7702. Questions relating to issue and publication fee payments should be directed to the Customer Service Center of the Office of Patent Publication at 1-(888)-786-0101 or (571)-272-4200.

PTOL-85 (Rev. 08/07) Approved for use through 08/31/2010.

Notice of Allowability	**Application No.** 11/440,924	**Applicant(s)** HUA ET AL.	
	Examiner Timothy Edwards, Jr.	**Art Unit** 2612	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address--

All claims being allowable, PROSECUTION ON THE MERITS IS (OR REMAINS) CLOSED in this application. If not included herewith (or previously mailed), a Notice of Allowance (PTOL-85) or other appropriate communication will be mailed in due course. **THIS NOTICE OF ALLOWABILITY IS NOT A GRANT OF PATENT RIGHTS.** This application is subject to withdrawal from issue at the initiative of the Office or upon petition by the applicant. See 37 CFR 1.313 and MPEP 1308.

1. ☒ This communication is responsive to *Amendment filed June 10, 2009*.
2. ☒ The allowed claim(s) is/are *1-30*.
3. ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
   a) ☐ All b) ☐ Some* c) ☐ None of the:
   1. ☐ Certified copies of the priority documents have been received.
   2. ☐ Certified copies of the priority documents have been received in Application No. _____ .
   3. ☐ Copies of the certified copies of the priority documents have been received in this national stage application from the International Bureau (PCT Rule 17.2(a)).

   * Certified copies not received: _____.

Applicant has THREE MONTHS FROM THE "MAILING DATE" of this communication to file a reply complying with the requirements noted below. Failure to timely comply will result in ABANDONMENT of this application.
THIS THREE-MONTH PERIOD IS NOT EXTENDABLE.

4. ☐ A SUBSTITUTE OATH OR DECLARATION must be submitted. Note the attached EXAMINER'S AMENDMENT or NOTICE OF INFORMAL PATENT APPLICATION (PTO-152) which gives reason(s) why the oath or declaration is deficient.
5. ☐ CORRECTED DRAWINGS (as "replacement sheets") must be submitted.
   (a) ☐ including changes required by the Notice of Draftsperson's Patent Drawing Review (PTO-948) attached
   1) ☐ hereto or 2) ☐ to Paper No./Mail Date _____.
   (b) ☐ including changes required by the attached Examiner's Amendment / Comment or in the Office action of Paper No./Mail Date _____.

   Identifying indicia such as the application number (see 37 CFR 1.84(c)) should be written on the drawings in the front (not the back) of each sheet. Replacement sheet(s) should be labeled as such in the header according to 37 CFR 1.121(d).
6. ☐ DEPOSIT OF and/or INFORMATION about the deposit of BIOLOGICAL MATERIAL must be submitted. Note the attached Examiner's comment regarding REQUIREMENT FOR THE DEPOSIT OF BIOLOGICAL MATERIAL.

Attachment(s)

1. ☒ Notice of References Cited (PTO-892)
2. ☐ Notice of Draftperson's Patent Drawing Review (PTO-948)
3. ☐ Information Disclosure Statements (PTO/SB/08), Paper No./Mail Date _____
4. ☐ Examiner's Comment Regarding Requirement for Deposit of Biological Material
5. ☐ Notice of Informal Patent Application
6. ☐ Interview Summary (PTO-413), Paper No./Mail Date _____ .
7. ☐ Examiner's Amendment/Comment
8. ☒ Examiner's Statement of Reasons for Allowance
9. ☐ Other _____.

DETAILED ACTION

Allowable Subject Matter

1. Claims 1-30 are allowed.

2. The following is an examiner's statement of reasons for allowance: the closes prior art Deangelis et al US 7,301,351 fails to teach or suggest, a method of assigning keys to a keyboard comprising assigning a plurality of keys to a pre-defined area, determining a position of a presence of a conductive object on the sensing device by measuring capacitance on a plurality of capacitance sensing pins.

Any comments considered necessary by applicant must be submitted no later than the payment of the issue fee and, to avoid processing delays, should preferably accompany the issue fee. Such submissions should be clearly labeled "Comments on Statement of Reasons for Allowance."

Conclusion

3. The prior art made of record and not relied upon is considered pertinent to applicant's disclosure. See PTO-892.

Any inquiry concerning this communication should be directed to Examiner Timothy Edwards, Jr. at telephone number (571) 272-3067. The examiner can normally be reached on Monday-Thursday, 8:00 a.m.-6:00 p.m. The examiner cannot be reached on Fridays.

If attempt to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Brian Zimmerman, can be reached at (571) 272-3059.

Any inquiry of a general nature or relating to the status of this application should be directed to the Group receptionist whose telephone number is (571) 272-4700, Mon-Fri., 8:30 a.m.-5:00 p.m.

Any response to this action should be fax to:

(571) 273-8300 (for formal communications intended for entry).

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http:/pair-direct.uspto.gov or contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

/Timothy Edwards, Jr./
Primary Examiner, Art Unit 2612
September 23, 2009

Notice of References Cited	Application/Control No. 11/440,924	Applicant(s)/Patent Under Reexamination HUA ET AL.	
	Examiner Timothy Edwards, Jr.	Art Unit 2612	Page 1 of 1

U.S. PATENT DOCUMENTS

*		Document Number Country Code-Number-Kind Code	Date MM-YYYY	Name	Classification
*	A	US-5,508,700	04-1996	Taylor et al.	341/33
*	B	US-5,463,388	10-1995	Boie et al.	341/33
*	C	US-6,025,726	02-2000	Gershenfeld et al.	324/671
*	D	US-4,550,221	10-1985	Mabusth, Scott	178/18.06
*	E	US-7,301,351	11-2007	Deangelis et al.	324/687
*	F	US-2008/0278178	11-2008	Philipp, Harald	324/662
*	G	US-4,737,768	04-1988	Lewiner et al.	341/26
	H	US-			
	I	US-			
	J	US-			
	K	US-			
	L	US-			
	M	US-			

FOREIGN PATENT DOCUMENTS

*		Document Number Country Code-Number-Kind Code	Date MM-YYYY	Country	Name	Classification
	N					
	O					
	P					
	Q					
	R					
	S					
	T					

NON-PATENT DOCUMENTS

*		Include as applicable: Author, Title Date, Publisher, Edition or Volume, Pertinent Pages)
	U	
	V	
	W	
	X	

*A copy of this reference is not being furnished with this Office action. (See MPEP § 707.05(a).)
Dates in MM-YYYY format are publication dates. Classifications may be US or foreign.

Search Notes	Application/Control No. 11440924	Applicant(s)/Patent Under Reexamination HUA ET AL.
	Examiner Timothy Edwards, Jr.	**Art Unit** 2612

SEARCHED

Class	Subclass	Date	Examiner
341	22, 33	12/13/08	/TE/
345	156, 168, 173		
178	18.05, 18.06		
	UPDATED SEARCH	9/17/09	/TE/
324	658-668		

SEARCH NOTES

Search Notes	Date	Examiner
EAST TEXT SEARCH	12/13/08	/TE/
UPDATED EAST TEXT SEARCH	9/17/09	/TE/

INTERFERENCE SEARCH

Class	Subclass	Date	Examiner
341	33	9/17/09	/TE/
324	662		

Issue Classification	Application/Control No.	Applicant(s)/Patent under Reexamination	
	11/440,924	HUA ET AL.	
	Examiner	**Art Unit**	
	Timothy Edwards, Jr.	2612	

ISSUE CLASSIFICATION

ORIGINAL					CROSS REFERENCE(S)							
CLASS		SUBCLASS			CLASS	SUBCLASS (ONE SUBCLASS PER BLOCK)						
341		33			324	662						
INTERNATIONAL CLASSIFICATION												
H	0	3	K	17/96								
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				/								
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				/								

(Assistant Examiner) (Date)	/TIMOTHY EDWARDS, JR/ 9/17/09	**Total Claims Allowed: 30**	
(Legal Instruments Examiner) (Date)	(Primary Examiner) (Date)	O.G. Print Claim(s)	O.G. Print Fig.
		1	5A

☒ **Claims renumbered in the same order as presented by applicant** ☐ CPA ☐ T.D. ☐ R.1.47

Final	Original	Final	Original	Final	Original	Final	Original	Final	Original	Final	Original	Final	Original
	1		31		61		91		121		151		181
	2		32		62		92		122		152		182
	3		33		63		93		123		153		183
	4		34		64		94		124		154		184
	5		35		65		95		125		155		185
	6		36		66		96		126		156		186
	7		37		67		97		127		157		187
	8		38		68		98		128		158		188
	9		39		69		99		129		159		189
	10		40		70		100		130		160		190
	11		41		71		101		131		161		191
	12		42		72		102		132		162		192
	13		43		73		103		133		163		193
	14		44		74		104		134		164		194
	15		45		75		105		135		165		195
	16		46		76		106		136		166		196
	17		47		77		107		137		167		197
	18		48		78		108		138		168		198
	19		49		79		109		139		169		199
	20		50		80		110		140		170		200
	21		51		81		111		141		171		201
	22		52		82		112		142		172		202
	23		53		83		113		143		173		203
	24		54		84		114		144		174		204
	25		55		85		115		145		175		205
	26		56		86		116		146		176		206
	27		57		87		117		147		177		207
	28		58		88		118		148		178		208
	29		59		89		119		149		179		209
	30		60		90		120		150		180		210

EAST Search History

EAST Search History (Prior Art)

Ref #	Hits	Search Query	DBs	Default Operator	Plurals	Time Stamp
L1	27	("4737768" "5508700")	US-PGPUB; USPAT; EPO; JPO; DERWENT	OR	ON	2009/09/17 08:42
L2	3	1 and pin and (determin$6 near5 position$4)	US-PGPUB; USPAT; EPO; JPO; DERWENT	OR	ON	2009/09/17 08:43
L3	183	(defin$7 near5 (area space key)) and (capacit$6 near6 pin) and (determin$6 near5 position$4)	US-PGPUB; USPAT; EPO; JPO; DERWENT	OR	ON	2009/09/17 08:46
L4	0	3 and (keyboard keypad) and $5process and deminsion$4	US-PGPUB; USPAT; EPO; JPO; DERWENT	OR	ON	2009/09/17 08:49
L5	99	3 and (keyboard keypad) and $5process and dimension$4	US-PGPUB; USPAT; EPO; JPO; DERWENT	OR	ON	2009/09/17 08:49
L6	224	324/658-688.ccls. and (keyboard keypad)	US-PGPUB; USPAT; EPO; JPO; DERWENT	OR	ON	2009/09/17 10:41
L7	104	6 and $5process and dimension$4	US-PGPUB; USPAT; EPO; JPO; DERWENT	OR	ON	2009/09/17 10:42
L8	18	7 and (defin$7 near5 (area space key)) and (determin$6 near5 position$4)	US-PGPUB; USPAT; EPO; JPO; DERWENT	OR	ON	2009/09/17 10:43
S1	6	"20010029455" "20020188670"	US-PGPUB; USPAT; EPO; JPO; DERWENT	OR	ON	2009/06/09 14:22

EAST Search History (Interference)

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EAST Search History

EAST Search History (Prior Art)

Ref #	Hits	Search Query	DBs	Default Operator	Plurals	Time Stamp
L1	45	((defined near5 (area key)) same (sens$4 near5 capacit$5)) and (keyboard keypad) and dimens$6	US-PGPUB; USPAT; EPO; JPO; DERWENT	OR	ON	2009/09/17 13:58
L2	14	1 and (capacit$6 near5 pin)	US-PGPUB; USPAT; EPO; JPO; DERWENT	OR	ON	2009/09/17 13:58
S1	6	"20010029455" "20020188670"	US-PGPUB; USPAT; EPO; JPO; DERWENT	OR	ON	2009/06/09 14:22

EAST Search History (Interference)

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9/17/09 2:08:18 PM
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IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In Re Patent Application of:

Liu Hua, et al.

Application No.: 11/440,924

Filed: May 25, 2006

Art unit: 2612

Examiner: Edwards Jr., Timothy

For: A LOW PIN COUNT SOLUTION USING CAPACITANCE SENSING MATRIX FOR KEYBOARD ARCHITECTURE

Confirmation No.: 9376

CERTIFICATE OF TRANSMISSION
I hereby certify that this correspondence is being submitted electronically via EFS Web on the date shown below.

/Kevin O. Grange/ 6/10/2009

Kevin O. Grange ***Date***

Mail Stop Amendment
Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

AMENDMENT AND RESPONSE TO OFFICE ACTION

Examiner:

In response to the Office Action mailed on March 10, 2009, Applicant respectfully requests that the Examiner enter the following amendments and consider the following remarks.

Amendments to the Claims are reflected in the listing of claims that begins on page 2 of this paper.

Remarks begin on page 10 of this paper.

AMENDMENTS

Amendments to the Claims:

This listing of claims will replace all prior versions, and listings, of the claims in the application:

Listing of Claims:

1. (Currently amended) A method, comprising:

assigning a plurality of keyboard keys ~~into~~to correspond to pre-defined areas of a sensing surface of a sensing device having a plurality of sensor elements and a plurality of capacitance sensing pins to couple the ~~sensing device~~ plurality of sensor elements to a processing device, wherein the pre-defined areas are disposed adjacent to one another; wherein at least one of the plurality of sensor elements corresponds

~~detecting a presence of a conductive object on the sensing device;~~

determining a position of ~~the~~a presence of the conductive object on the sensing device by measuring capacitance on the plurality of capacitance sensing pins; and

selecting a keyboard key of the plurality of keyboard keys ~~based on~~when the position of the presence of the conductive object ~~and~~is determined to be within the pre-defined ~~areas~~area of the sensing device corresponding to the keyboard key.

2. (Original) The method of claim 1, wherein selecting the keyboard key comprises comparing the position of the conductive object with the pre-defined areas.

3. (Original) The method of claim 1, further comprising outputting keyboard data corresponding to the selected key from the processing device to a component external to the processing device.

4. (Currently amended) The method of claim 1, wherein the plurality of sensor elements are disposed in a capacitance sensor matrix comprising a plurality of rows of sensor elements and a plurality of columns of sensor elements, wherein each row and each column is coupled to one of the plurality of capacitance sensing pins, and wherein determining the position of the conductive object comprises:

measuring a capacitance of each row of sensor elements of ~~a~~the capacitance sensor matrix of the sensing device;

determining a first dimension position based on the measured capacitance of the rows of sensor elements;

measuring a capacitance of each column of sensor elements of the capacitance sensor matrix; and

determining a second dimension position based on the measured capacitance of the columns of sensor elements, wherein determining the position of the ~~detected~~ presence of the conductive object is determined using the first and second dimension positions.

5. (Original) The method of claim 3, wherein assigning the plurality of keyboard keys into pre-defined areas comprises defining a data structure comprising positional data of the pre-defined areas of the plurality of keyboard keys, wherein selecting the keyboard key comprises comparing the position of the conductive object with the positional data of the pre-defined areas of the data structure to determine a pressed key of the plurality of keyboard keys, and wherein outputting the keyboard data comprises outputting keyboard data that corresponds to the pressed key.

6. (Currently amended) An apparatus, comprising:

a sensing device comprising a plurality of sensor elements to detect a presence of a conductive object on a sensing surface of the sensing device, wherein a plurality of keyboard keys are assigned to correspond to pre-defined areas of a sensing surface of the sensing device, wherein the pre-defined areas are disposed adjacent to one another; and

a processing device coupled to the sensing device using capacitance sensing pins, wherein the processing device is operable to determine a position of the presence of the conductive object on the sensing device by measuring capacitance on the capacitance sensing pins, and to select a keyboard key of the plurality of keyboard keys ~~based on~~when the position of the presence of the conductive object ~~and~~is determined to be within the pre-defined ~~areas~~area of the sensing device corresponding to the keyboard key.

7. (Original) The apparatus of claim 6, wherein the plurality of keyboard keys are a personal computer (PC) keyboard, and wherein the processing device is coupled to the sensing device using less than 21 capacitance sensing pins.

8. (Original) The apparatus of claim 6, wherein the plurality of keyboard keys comprises approximately 48 keyboard keys, and wherein the processing device is coupled to the sensing device using 4 capacitance sensing pins.

9. (Original) The apparatus of claim 6, wherein the plurality of keyboard keys comprises approximately 101 keyboard keys, and wherein the processing device is coupled to the sensing device using less than 12 capacitance sensing pins.

10. (Original) The apparatus of claim 6, wherein the plurality of keyboard keys comprises approximately 107 keyboard keys, and wherein the processing device is coupled to the sensing device using less than 21 capacitance sensing pins.

11. (Original) The apparatus of claim 6, wherein the plurality of keyboard keys comprises approximately 107 keyboard keys, and wherein the processing device is coupled to the sensing device using less than 12 capacitance sensing pins.

12. (Original) The apparatus of claim 6, wherein a total surface area of the assigned keyboard keys is less than approximately 10 centimeters (cm) by 10 cm.

13. (Original) The apparatus of claim 6, wherein a total surface area of the assigned keyboard keys is approximately 3 centimeters (cm) by 3 cm.

14. (Currently amended) The apparatus of claim 6, wherein the sensing device comprises a capacitance sensor matrix comprising the plurality of sensor elements configured in rows and columns to detect the presence of the conductive object on the sensing device<u>, wherein each row and column is coupled to the processing device using one of the capacitance sensing pins</u>, and wherein the plurality of keyboard keys are assigned to the pre-defined areas of the capacitance sensor matrix.

15. (Original) The apparatus of claim 14, wherein the processing device comprises one or more capacitance sensors coupled to the capacitance sensor matrix, wherein the one or more capacitance sensors are operable to measure a capacitance of each row of

sensor elements of the capacitance sensor matrix, and to measure a capacitance of each column of sensor elements of the capacitance sensor matrix, and wherein the processing device is operable to determine the position of the presence of the keyboard key using the measured capacitance of the rows and columns of sensor elements of the capacitance sensor matrix.

16. (Original) The apparatus of claim 15, wherein the one or more capacitance sensors are relaxation oscillators, wherein each relaxation oscillator comprises:

a current source to provide a charge current to the plurality of sensor elements;

a selection circuit coupled to the plurality of sensor elements and the current source, wherein the selection circuit is operable to sequentially select a sensor element of the plurality of sensor elements to provide the charge current and to measure the capacitance of each sensor element of the sensing device;

a comparator coupled to the current source and the selection circuit, wherein the comparator is operable to compare a voltage on the selected sensor element and a threshold voltage; and

a reset switch coupled to the comparator, current source, and selection circuit, wherein the reset switch is operable to reset the charge current on the selected sensor element, wherein the one or more capacitance sensors further comprise a digital counter coupled to the relaxation oscillator, wherein the digital counter is operable to count at least one of a frequency of an oscillator output or a period of the oscillator received from the relaxation oscillator.

17. (Original) The apparatus of claim 6, further comprising a component external to the processing device, wherein the processing device is operable to send keyboard data to the component that corresponds to the selected keyboard key.

18. (Original) The apparatus of claim 17, wherein the component external to the processing device is at least one of a processor, a driver of a processor, or an embedded controller.

19. (Original) The apparatus of claim 17, wherein the keyboard data comprises is at least one of a keyboard data signal, or a keyboard data command.

20. (Original) The apparatus of claim 6, wherein the sensing device is mounted on a mobile handset.

21. (Original) The apparatus of claim 6, wherein the processing device is coupled to an additional user input device, and wherein the additional input device is at least one of a cursor positioning device, a touch-sensor pad, a touch-sensor slider, a touch-sensor button, mouse, or a touch-screen display.

22. (Currently amended) An apparatus, comprising:

a sensing device comprising a plurality of sensor elements to detect a presence of a conductive object on the sensing device, wherein a plurality of keyboard keys are assigned to correspond to pre-defined areas of a sensing surface of the sensing device, wherein the pre-defined areas are disposed adjacent to one another;

means for determining a position of the presence of the conductive object on the sensing device; and

means for selecting a keyboard key of the plurality of keyboard keys ~~based on~~when the position of the presence of the conductive object ~~and~~is determined to be within the pre-defined ~~areas~~area of the sensing device corresponding to the keyboard key.

23. (Currently amended) The apparatus of claim 22, further comprising means for assigning the plurality of keyboard keys ~~into~~to correspond to the pre-defined areas of the sensing device.

24. (Original) The apparatus of claim 22, further comprising means for reducing a number of capacitance sensing pins used to connect the sensing device to the means for determining the position of the conductive object.

25. (Original) The apparatus of claim 22, further comprising means for reducing a total surface area of the sensing device while maintaining a number of keyboard keys on a device.

26. (Original) The apparatus of claim 22, further comprising means for outputting keyboard data based on the position of the presence of the keyboard key.

27. (New) The method of claim 1, wherein the pre-defined areas of the plurality of keyboard keys are arranged into multiple rows on the sensing surface, wherein the plurality of sensor elements are arranged in a plurality of rows of sensor elements, and

wherein at least one of the plurality of rows of sensor elements corresponds to a plurality of rows of the pre-defined areas.

28. (New) The method of claim 1, wherein at least one of the plurality of sensor elements corresponds to multiple pre-defined areas.

29. (New) The apparatus of claim 6, wherein the pre-defined areas of the plurality of keyboard keys are arranged into multiple rows on the sensing surface, wherein the plurality of sensor elements are arranged in a plurality of rows of sensor elements, and wherein at least one of the plurality of rows of sensor elements corresponds to a plurality of rows of the pre-defined areas.

30. (New) The apparatus of claim 6, wherein at least one of the plurality of sensor elements corresponds to multiple pre-defined areas.

REMARKS

Applicant respectfully requests reconsideration of this application in view of the following remarks. For the Examiner's convenience and reference, Applicant's remarks are presented in substantially the same order in which the corresponding issues were raised in the Office Action.

Status of the Claims

Claims 1-30 are pending. Claims 1, 4, 6, 14, 22, and 23 are currently amended. No claims are canceled. No claims are added. No new matter has been added as the specification provides support for the amendments, for example, at pages 37-39, paragraphs 110-117, and Figures 6A-6C.

Summary of the Office Action

Claim 16 stands objected to as depending from a rejected independent claim, but would be allowable if rewritten in independent form to include all intervening claim features.

Claims 1-3, 5, 6, 20, 22, 23 and 26 stand rejected under 35 U.S.C. § 102(e) as allegedly being anticipated by U.S. Patent No. 6,947,031 to Sandbach et al. (hereinafter "Sandbach").

Claims 4, 7-13, 17-19, 21, 24 and 25 stand rejected under 35 U.S.C. § 103(a) as allegedly being unpatentable over Sandbach and further in view of U.S. Patent Publication No. 2007/0046299 to Hargreaves et al. (hereinafter "Hargreaves").

Response to Rejections under 35 U.S.C. § 102(e)

The Examiner rejected claims 1-3, 5, 6, 20, 22, 23 and 26 under 35 U.S.C. § 102(e) as allegedly being anticipated by Sandbach. Applicant respectfully submits that independent claims 1, 6, and 22 have been amended to recite "wherein the pre-defined areas are disposed adjacent to one another." Applicant respectfully submits that the cited reference fails to teach at least this feature of the claim.

Sandbach describes a replacement keyboard that can be used in conjunction with a hand held computer. The replacement keyboard of Sandbach has an XY position sensor having two conductive layers separated by a non-conducting layer that allows the conductive layers to become electronically connected at the location of a key, when that key is pressed. Sandbach, col. 2, line 65 to col. 3, line 3. During operation, interface circuitry applies a voltage across a first conductive layer and when a user presses an individual key, the interface circuitry measures voltages appearing on a second conductive layer to determine an x-coordinate of the key being pressed. *Id.* at col. 3, lines 31-36. The interface circuitry then applies a voltage across the second conducting layer and measures voltage appearing on the first conductive layer to determine a Y-coordinate of the key being pressed. *Id.* at lines 36-39. Sandbach, however, specifically describes a masking layer between the two conductive layers that has a series of circular holes 315 corresponding to the locations of the keys. *Id.* at col. 5, lines 11-20, Figure 3. The masking layer prevents electrical contact except at the locations of the holes. The locations of the holes have gaps between them, and consequently, the keys of Sandbach have gaps between each of the keys so that "accidental compression of the keyboard at locations between the keys does not affect the operation of the keyboard." *Id.* at Figures 1-3, and col. 5, lines 18-20. Because there are gaps between the keys of Sandbach, Sandbach fails to disclose at least that the claimed feature of "wherein the pre-defined areas are disposed to one another."

Given that the cited reference fails to disclose all of the features of the claim, Applicant respectfully submits that independent claims 1, 6, and 22 are patentable over the cited reference. Accordingly, Applicant requests that the rejection of claims 1, 6, and 22 under 35 U.S.C. § 102(e) be withdrawn.

Given that claims 2-5, 7-21, and 23-30 depend from independent claims 1, 6, and 22, which are patentable over the cited reference, Applicant respectfully submits that dependent claims 2-5, 7-21, and 23-30 are also patentable over the cited reference. Accordingly, Applicant requests that the rejection of claims 2-3, 5, 20, 23, and 26 under 35 U.S.C. § 102(e) and the rejection of claims 4, 7-13, 17-19, 21, 24, and 25 under 35 U.S.C. § 103(a) be withdrawn. Applicant also respectfully requests that the objection of claim 16 be withdrawn.

CONCLUSION

It is respectfully submitted that in view of the amendments and remarks set forth herein, the rejections and objections have been overcome. If the Examiner believes a telephone interview would expedite the prosecution of this application, the Examiner is invited to contact Lucinda G. Price, by telephone at (408) 545-7194.

Please charge any additional fees under 37 CFR §§ 1.16, 1.17, 1.18, 1.20 and 1.21 that may be required to maintain pendency of the present application, or apply any credits to our PTO deposit account number: 50-3781.

Respectfully submitted,

BLAKELY, SOKOLOFF, TAYLOR & ZAFMAN LLP

Date: June 10, 2009

/Kevin O. Grange/
Kevin O. Grange
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Electronic Patent Application Fee Transmittal

Application Number:	11440924
Filing Date:	25-May-2006
Title of Invention:	Low pin count solution using capacitance sensing matrix for keyboard architecture
First Named Inventor/Applicant Name:	Liu Hua
Filer:	Kevin Grange/Leslie Rogan
Attorney Docket Number:	CD06015

Filed as Large Entity

Utility under 35 USC 111(a) Filing Fees

Description	Fee Code	Quantity	Amount	Sub-Total in USD($)
Basic Filing:				
Pages:				
Claims:				
Claims in excess of 20	1202	4	52	208
Miscellaneous-Filing:				
Petition:				
Patent-Appeals-and-Interference:				
Post-Allowance-and-Post-Issuance:				
Extension-of-Time:				

Description	Fee Code	Quantity	Amount	Sub-Total in USD($)
Miscellaneous:				
		Total in USD ($)		**208**

Electronic Acknowledgement Receipt

EFS ID:	5494493
Application Number:	11440924
International Application Number:	
Confirmation Number:	9376
Title of Invention:	Low pin count solution using capacitance sensing matrix for keyboard architecture
First Named Inventor/Applicant Name:	Liu Hua
Customer Number:	60909
Filer:	Kevin Grange/Leslie Rogan
Filer Authorized By:	Kevin Grange
Attorney Docket Number:	CD06015
Receipt Date:	10-JUN-2009
Filing Date:	25-MAY-2006
Time Stamp:	20:44:39
Application Type:	Utility under 35 USC 111(a)

Payment information:

Submitted with Payment	yes
Payment Type	Deposit Account
Payment was successfully received in RAM	$ 208
RAM confirmation Number	16464
Deposit Account	503781
Authorized User	

The Director of the USPTO is hereby authorized to charge indicated fees and credit any overpayment as follows:

Charge any Additional Fees required under 37 C.F.R. Section 1.16 (National application filing, search, and examination fees)

Charge any Additional Fees required under 37 C.F.R. Section 1.17 (Patent application and reexamination processing fees)

Charge any Additional Fees required under 37 C.F.R. Section 1.19 (Document supply fees)

Charge any Additional Fees required under 37 C.F.R. Section 1.20 (Post Issuance fees)

Charge any Additional Fees required under 37 C.F.R. Section 1.21 (Miscellaneous fees and charges)

File Listing:

Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
1		CD2006015_P442_Resp_to_OA .pdf	52907 a18ce694c05fb2baa8ff92e9794dcf12eb21945c	yes	12

Multipart Description/PDF files in .zip description

Document Description	Start	End
Amendment/Req. Reconsideration-After Non-Final Reject	1	1
Claims	2	9
Applicant Arguments/Remarks Made in an Amendment	10	12

Warnings:

Information:

Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
2	Fee Worksheet (PTO-875)	fee-info.pdf	30098 d04a904a67dbc3c89599bfb751ac0c1afb8e035b	no	2

Warnings:

Information:

Total Files Size (in bytes):	83005

This Acknowledgement Receipt evidences receipt on the noted date by the USPTO of the indicated documents, characterized by the applicant, and including page counts, where applicable. It serves as evidence of receipt similar to a Post Card, as described in MPEP 503.

<u>New Applications Under 35 U.S.C. 111</u>
If a new application is being filed and the application includes the necessary components for a filing date (see 37 CFR 1.53(b)-(d) and MPEP 506), a Filing Receipt (37 CFR 1.54) will be issued in due course and the date shown on this Acknowledgement Receipt will establish the filing date of the application.

<u>National Stage of an International Application under 35 U.S.C. 371</u>
If a timely submission to enter the national stage of an international application is compliant with the conditions of 35 U.S.C. 371 and other applicable requirements a Form PCT/DO/EO/903 indicating acceptance of the application as a national stage submission under 35 U.S.C. 371 will be issued in addition to the Filing Receipt, in due course.

<u>New International Application Filed with the USPTO as a Receiving Office</u>
If a new international application is being filed and the international application includes the necessary components for an international filing date (see PCT Article 11 and MPEP 1810), a Notification of the International Application Number and of the International Filing Date (Form PCT/RO/105) will be issued in due course, subject to prescriptions concerning national security, and the date shown on this Acknowledgement Receipt will establish the international filing date of the application.

PTO/SB/06 (07-06)
Approved for use through 1/31/2007. OMB 0651-0032
U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE

PATENT APPLICATION FEE DETERMINATION RECORD Substitute for Form PTO-875	Application or Docket Number 11/440,924	Filing Date 05/25/2006	☒ To be Mailed

APPLICATION AS FILED – PART I

FOR	NUMBER FILED (Column 1)	NUMBER EXTRA (Column 2)	SMALL ENTITY ☐ RATE ($)	FEE ($)	OR	OTHER THAN SMALL ENTITY RATE ($)	FEE ($)
☐ BASIC FEE (37 CFR 1.16(a), (b), or (c))	N/A	N/A	N/A			N/A	
☐ SEARCH FEE (37 CFR 1.16(k), (i), or (m))	N/A	N/A	N/A			N/A	
☐ EXAMINATION FEE (37 CFR 1.16(o), (p), or (q))	N/A	N/A	N/A			N/A	
TOTAL CLAIMS (37 CFR 1.16(i))	minus 20 =	*	X $ =		OR	X $ =	
INDEPENDENT CLAIMS (37 CFR 1.16(h))	minus 3 =	*	X $ =			X $ =	
☐ APPLICATION SIZE FEE (37 CFR 1.16(s))	If the specification and drawings exceed 100 sheets of paper, the application size fee due is $250 ($125 for small entity) for each additional 50 sheets or fraction thereof. See 35 U.S.C. 41(a)(1)(G) and 37 CFR 1.16(s).						
☐ MULTIPLE DEPENDENT CLAIM PRESENT (37 CFR 1.16(j))							
* If the difference in column 1 is less than zero, enter "0" in column 2.			TOTAL			TOTAL	

APPLICATION AS AMENDED – PART II

AMENDMENT	06/10/2009	CLAIMS REMAINING AFTER AMENDMENT (Column 1)		HIGHEST NUMBER PREVIOUSLY PAID FOR (Column 2)	PRESENT EXTRA (Column 3)	SMALL ENTITY RATE ($)	ADDITIONAL FEE ($)	OR	OTHER THAN SMALL ENTITY RATE ($)	ADDITIONAL FEE ($)
	Total (37 CFR 1.16(i))	* 30	Minus	** 26	= 4	X $ =		OR	X $52=	208
	Independent (37 CFR 1.16(h))	* 3	Minus	***3	= 0	X $ =		OR	X $220=	0
	☐ Application Size Fee (37 CFR 1.16(s))									
	☐ FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM (37 CFR 1.16(j))							OR		
						TOTAL ADD'L FEE		OR	TOTAL ADD'L FEE	**208**

AMENDMENT		CLAIMS REMAINING AFTER AMENDMENT (Column 1)		HIGHEST NUMBER PREVIOUSLY PAID FOR (Column 2)	PRESENT EXTRA (Column 3)	RATE ($)	ADDITIONAL FEE ($)		RATE ($)	ADDITIONAL FEE ($)
	Total (37 CFR 1.16(i))	*	Minus	**	=	X $ =		OR	X $ =	
	Independent (37 CFR 1.16(h))	*	Minus	***	=	X $ =		OR	X $ =	
	☐ Application Size Fee (37 CFR 1.16(s))									
	☐ FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM (37 CFR 1.16(j))							OR		
						TOTAL ADD'L FEE		OR	TOTAL ADD'L FEE	

* If the entry in column 1 is less than the entry in column 2, write "0" in column 3.
** If the "Highest Number Previously Paid For" IN THIS SPACE is less than 20, enter "20".
*** If the "Highest Number Previously Paid For" IN THIS SPACE is less than 3, enter "3".
The "Highest Number Previously Paid For" (Total or Independent) is the highest number found in the appropriate box in column 1.

Legal Instrument Examiner:
/NICHELE PETERSON/

UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
Address: COMMISSIONER FOR PATENTS
P.O. Box 1450
Alexandria, Virginia 22313-1450
www.uspto.gov

APPLICATION NUMBER	FILING OR 371(C) DATE	FIRST NAMED APPLICANT	ATTY. DOCKET NO./TITLE
11/440,924	05/25/2006	Liu Hua	CD06015

CONFIRMATION NO. 9376

POA ACCEPTANCE LETTER

OC000000035222482

60909
CYPRESS SEMICONDUCTOR CORPORATION
198 CHAMPION COURT
SAN JOSE, CA 95134-1709

Date Mailed: 03/31/2009

NOTICE OF ACCEPTANCE OF POWER OF ATTORNEY

This is in response to the Power of Attorney filed 03/23/2009.

The Power of Attorney in this application is accepted. Correspondence in this application will be mailed to the above address as provided by 37 CFR 1.33.

/lchau/

Office of Data Management, Application Assistance Unit (571) 272-4000, or (571) 272-4200, or 1-888-786-0101

UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
Address: COMMISSIONER FOR PATENTS
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Alexandria, Virginia 22313-1450
www.uspto.gov

APPLICATION NUMBER	FILING OR 371(C) DATE	FIRST NAMED APPLICANT	ATTY. DOCKET NO./TITLE
11/440,924	05/25/2006	Liu Hua	16820P442

CONFIRMATION NO. 9376

POWER OF ATTORNEY NOTICE

OC000000035222437

75405
CYPRESS/BLAKELY
Blakely Sokoloff Taylor & Zafman LLP
1279 Oakmead Parkway
SUNNYVALE, CA 94085-4040

Date Mailed: 03/31/2009

NOTICE REGARDING CHANGE OF POWER OF ATTORNEY

This is in response to the Power of Attorney filed 03/23/2009.

- The Power of Attorney to you in this application has been revoked by the assignee who has intervened as provided by 37 CFR 3.71. Future correspondence will be mailed to the new address of record(37 CFR 1.33).

/lchau/

Office of Data Management, Application Assistance Unit (571) 272-4000, or (571) 272-4200, or 1-888-786-0101

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MAR 2 3 2009

CYPRESS SEMICONDUCTOR CORPORATION

FACSIMILE TRANSMITTAL SHEET

TO: EXAMINER TIMOTHY EDWARDS JR.	FROM: ANDREW J. BATEMAN, REG. NO. 45,573
FAX NUMBER: 571-273-8300	DATE: MARCH 19, 2009
COMPANY: U.S. PATENT AND TRADEMARK OFFICE	TOTAL NO. OF PAGES INCLUDING COVER: 3
PHONE NUMBER: (571)272-3067	SENDER'S REFERENCE NUMBER: CD06015
RE: REVOCATION AND NEW POWER OF ATTORNEY	USPTO APPLICATION NUMBER: 11/440,924

☐ URGENT ☐ FOR REVIEW ☐ PLEASE COMMENT ☐ PLEASE REPLY ☐ PLEASE RECYCLE

NOTES/COMMENTS:

Application No.: 11/440,924
Filing Date: 05/25/2006
First Named Inventor: Liu Hua
Art Unit: 2312
Confirmation No.: 9376
Examiner Name: Timothy Edwards Jr.
Attorney Docket No.: CD06015

Attached are the following documents being submitted in connection with the above-identified patent application:

REVOCATION AND NEW POWER OF ATTORNEY (1 page)
STATEMENT UNDER 37 CFR 3.73(b) (1 page)

If there are any questions regarding this submission, please contact Applicant's attorney, Andrew J. Bateman, by telephone at 408-943-6878.

Respectfully submitted,

Andrew J. Bateman

Andrew J. Bateman
Attorney for Applicant
Reg. No. 45,573
Customer No. 60909

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MAR 2 3 2009

PTO/SB/82 (01-06)
Approved for use through 12/31/2008. OMB 0651-0035
U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE
Under the Paperwork Reduction Act of 1995, no persons are required to respond to a collection of information unless it displays a valid OMB control number.

REVOCATION OF POWER OF ATTORNEY WITH NEW POWER OF ATTORNEY AND CHANGE OF CORRESPONDENCE ADDRESS

Application Number	11/440,924
Filing Date	05/25/2006
First Named Inventor	Liu Hua
Art Unit	2612
Examiner Name	Timothy Edwards Jr.
Attorney Docket Number	CD06015

I hereby revoke all previous powers of attorney given in the above-identified application.

☐ A Power of Attorney is submitted herewith.

OR

☑ I hereby appoint the practitioners associated with the Customer Number: 60909

☑ Please change the correspondence address for the above-identified application to:

☑ The address associated with Customer Number: 60909

OR

☐ Firm *or* Individual Name					
Address					
City		State		Zip	
Country					
Telephone		Email			

I am the:

☐ Applicant/Inventor.

☑ Assignee of record of the entire interest. See 37 CFR 3.71.
Statement under 37 CFR 3.73(b) is enclosed. (Form PTO/SB/96)

SIGNATURE of Applicant or Assignee of Record			
Signature			
Name	Victoria Tidwell, Vice President of Legal Affairs and Associate General Counsel		
Date	03/19/2009	Telephone	408-943-2979

NOTE: Signatures of all the inventors or assignees of record of the entire interest or their representative(s) are required. Submit multiple forms if more than one signature is required, see below*.

☑ *Total of 1 forms are submitted.

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MAR 2 3 2009

PTO/SB/96 (01-08)
Approved for use through 01/31/2008. OMB 0651-0031
U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE

STATEMENT UNDER 37 CFR 3.73(b)

Applicant/Patent Owner: Liu Hua

Application No./Patent No.: 11/440,924 Filed/Issue Date: May 25, 1006

Entitled: LOW PIN COUNT SOLUTION USING CAPACITANCE SENSING MATRIX FOR KEYBOARD ARCHITECTURE

Cypress Semiconductor Corporation, a Corporation
(Name of Assignee) (Type of Assignee, e.g., corporation, partnership, university, government agency, etc.)

states that it is:

1. ☑ the assignee of the entire right, title, and interest; or
2. ☐ an assignee of less than the entire right, title and interest (The extent (by percentage) of its ownership interest is ______ %)

in the patent application/patent identified above by virtue of either:

A. ☑ An assignment from the inventor(s) of the patent application/patent identified above. The assignment was recorded in the United States Patent and Trademark Office at Reel 017941, Frame 0892, or for which a copy thereof is attached.

OR

B. ☐ A chain of title from the inventor(s), of the patent application/patent identified above, to the current assignee as follows:

1. From: ______ To: ______
The document was recorded in the United States Patent and Trademark Office at Reel ______, Frame ______, or for which a copy thereof is attached.

2. From: ______ To: ______
The document was recorded in the United States Patent and Trademark Office at Reel ______, Frame ______, or for which a copy thereof is attached.

3. From: ______ To: ______
The document was recorded in the United States Patent and Trademark Office at Reel ______, Frame ______, or for which a copy thereof is attached.

☐ Additional documents in the chain of title are listed on a supplemental sheet.

☑ As required by 37 CFR 3.73(b)(1)(i), the documentary evidence of the chain of title from the original owner to the assignee was, or concurrently is being, submitted for recordation pursuant to 37 CFR 3.11.

[NOTE: A separate copy (*i.e.*, a true copy of the original assignment document(s)) must be submitted to Assignment Division in accordance with 37 CFR Part 3, to record the assignment in the records of the USPTO. See MPEP 302.08]

The undersigned (whose title is supplied below) is authorized to act on behalf of the assignee.

Andrew J. Bateman
Signature

March 19, 2009
Date

Andrew J. Bateman, Reg. No. 45,573
Printed or Typed Name

408-943-6878
Telephone Number

Attorney of Record
Title

UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
Address: COMMISSIONER FOR PATENTS
P.O. Box 1450
Alexandria, Virginia 22313-1450
www.uspto.gov

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
11/440,924	05/25/2006	Liu Hua	16820P442	9376

75405 7590 03/10/2009
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1279 Oakmead Parkway
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EXAMINER
EDWARDS JR, TIMOTHY

ART UNIT	PAPER NUMBER
2612	

MAIL DATE	DELIVERY MODE
03/10/2009	PAPER

Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

PTOL-90A (Rev. 04/07)

Office Action Summary	Application No.	Applicant(s)
	11/440,924	HUA ET AL.
	Examiner	Art Unit
	Timothy Edwards, Jr.	2612

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on 25 May 2006.

2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) 1-26 is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) 1-15 and 17-26 is/are rejected.

7)☐ Claim(s) 16 is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☒ The drawing(s) filed on 25 May 2006 is/are: a)☒ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☒ Information Disclosure Statement(s) (PTO/SB/08) Paper No(s)/Mail Date _____.
4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____ .
5) ☐ Notice of Informal Patent Application
6) ☐ Other: _____.

DETAILED ACTION

Claim Rejections - 35 USC § 102

1. The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

> A person shall be entitled to a patent unless –
>
> (e) the invention was described in (1) an application for patent, published under section 122(b), by another filed in the United States before the invention by the applicant for patent or (2) a patent granted on an application for patent by another filed in the United States before the invention by the applicant for patent, except that an international application filed under the treaty defined in section 351(a) shall have the effects for purposes of this subsection of an application filed in the United States only if the international application designated the United States and was published under Article 21(2) of such treaty in the English language.

2. Claims 1-3, 5, 6, 20, 22, 23, 26 are rejected under 35 U.S.C. 102(e) as being anticipated by Sandbach et al US 6,947,031.

Considering claim 1, Sandbach discloses a method, comprising , **a**) assigning a plurality of keyboard keys into pre-defined areas of a sensing device having a plurality of sensor elements (see col 1, lines 50-56); **b**) a plurality of capacitance sensing pins couple the sensing device to a processing device (see col 6, line 56 to col 7, line 15); **c**) detecting a presence of a conductive object on the sensing device (see col 3, lines 31-42); **d**) determining the position of the presence of the conductive object on the sensing device (see col 7, lines 31-37); **e**) selecting a keyboard key of the plurality of keyboard keys based on the position of the presence of the conductive object and the pre-defined areas (see col 7, lines 39-48).

Considering claim 2, Sandbach discloses the limitation of this claim (see col 9, lines 39-48).

Considering claim 3, Sandbach discloses the limitation of this claim (see col 9, lines 60-64).

Considering claim 5, Sandbach discloses the limitation of this claim (see col 9, lines 49-64).

Considering claims 6, 22 the limitations of these claims are interpreted and rejected as stated in claim 1.

Considering claim 20, Sandbach discloses the limitation of this claim (see col 14, lines 4-9).

Considering claim 23, Sandbach discloses the limitation of this claim (see col 2, lines 4-9).

Considering claim 26, Sandbach discloses the limitation of this claim (see col 9, lines 49-64).

Claim Rejections - 35 USC § 103

3. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

1. Claims 4, 7-13, 17-19, 21, 24, 25 are rejected under 35 U.S.C. 103(a) as being unpatentable over Sandbach et al US 6,947,031, and further in view of Hargreaves et al US 2007/0046299.

Considering claim 4, Sandbach does not specifically recite this limitation. However, Sandbach teaches determining the X/Y value co-ordinates of a key being pressed and the two values relate to the two dimensional position of the sensor (see col 1, lines 50-56 and col 3, lines 31-42). Hargreaves teaches a method of providing key actuation data by providing one and two dimensional position information using a capacitance sensing means (see paragraph 105). Therefore, it would have been obvious to one of ordinary skill in the art to use the dimensional position information determining method as taught by Hargreaves in the Sandbach system because Sandbach discloses providing two values relate to the two dimensional position of the sensor and both system are concern with the determination of positional activation of a key on a keyboard using capacitance sensors.

Considering claims 7-11, Sandbach does not specifically recite the limitations of these claims. However, Sandbach teaches sensing key actuation on a keyboard using capacitance sensing pins on a processing device (see fig 8). One of ordinary skill in the art readily recognizes there are numerous devices with a variety of any number of keys associated with the device. Hargreaves teaches a processing device coupled via capacitance sensing pins that reduces the number of pins used to accomplish the task of sensing a plurality of keys on a keyboard (see paragraph 0051). Hargreaves teaches a method of introducing channels on a controller to allow the number of pins to be reduced (see paragraph 0060). Hargreaves suggests any number of pins maybe used because he teaches the number of pins used can be reduced. Therefore, it would have been obvious to one of ordinary skill in the art to implement the capacitance sensing as taught by Hargreaves in the Sandbach system because both systems are concern with using capacitance sensors pins in the determination of a key activation.

Considering claims 12, 13 Sandbach does not specifically recite the limitations of these claims. Hargreaves teaches the limitations of these claim (see paragraph 0103). Obviousness is as stated in claims 7-11.

Considering claim 17 Sandbach does not specifically recite the limitation of this claim. Hargreaves teaches the limitations of these claim (see paragraph 0108). Obviousness is as stated in claims 7-11.

Considering claims 18, 19 Sandbach discloses the limitations of these claims (see col 7, lines 31-42).

Considering claim 21 Sandbach does not specifically recite the limitation of this claim. Hargreaves teaches the limitations of these claim (see paragraph 0108). Obviousness is as stated in claims 7-11.

Considering claims 24, 25 the limitations of these claims are interpreted and rejected as stated in claims 7-11.

2. Claims 14, 15 are rejected under 35 U.S.C. 103(a) as being unpatentable over Sandbach ‘031.

Considering claims 14, 15 Sandbach does not specifically recite these limitations. However, Examiner takes Official Notice the limitations of these claims are well known in the art.

Allowable Subject Matter

1. Claim 16 is objected to as being dependent upon a rejected base claim, but would be allowable if rewritten in independent form including all of the limitations of the base claim and any intervening claims.

Conclusion

If the claimed invention is amended, Applicant is respectfully requested to indicate the portion(s) of the specification, which dictate(s) the structure/description relied upon to assist the Examiner in proper interpretation of the amended language and also to verify and ascertain the metes and bounds of the claimed invention.

Any inquiry concerning this communication should be directed to Examiner Timothy Edwards, Jr. at telephone number (571) 272-3067. The examiner can normally be reached on Monday-Thursday, 8:00 a.m.-6:00 p.m. The examiner cannot be reached on Fridays.

If attempt to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Brian Zimmerman, can be reached at (571) 272-3059.

Any inquiry of a general nature or relating to the status of this application should be directed to the Group receptionist whose telephone number is (571) 272-4700, Mon-Fri., 8:30 a.m.-5:00 p.m.

Any response to this action should be fax to:

(571) 273-8300 (for formal communications intended for entry).

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http:/pair-direct.uspto.gov or contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

/Timothy Edwards, Jr./
Primary Examiner, Art Unit 2612
March 11, 2009

Notice of References Cited	Application/Control No. 11/440,924	Applicant(s)/Patent Under Reexamination HUA ET AL.	
	Examiner Timothy Edwards, Jr.	Art Unit 2612	Page 1 of 1

U.S. PATENT DOCUMENTS

*		Document Number Country Code-Number-Kind Code	Date MM-YYYY	Name	Classification
	A	US-			
*	B	US-2007/0046299	03-2007	Hargreaves et al.	324/678
*	C	US-6,947,031 B2	09-2005	Sandbach et al.	345/168
	D	US-			
	E	US-			
	F	US-			
	G	US-			
	H	US-			
	I	US-			
	J	US-			
	K	US-			
	L	US-			
	M	US-			

FOREIGN PATENT DOCUMENTS

*		Document Number Country Code-Number-Kind Code	Date MM-YYYY	Country	Name	Classification
	N					
	O					
	P					
	Q					
	R					
	S					
	T					

NON-PATENT DOCUMENTS

*		Include as applicable: Author, Title Date, Publisher, Edition or Volume, Pertinent Pages)
	U	
	V	
	W	
	X	

*A copy of this reference is not being furnished with this Office action. (See MPEP § 707.05(a).)
Dates in MM-YYYY format are publication dates. Classifications may be US or foreign.

Index of Claims	Application/Control No. 11440924	Applicant(s)/Patent Under Reexamination HUA ET AL.
	Examiner Timothy Edwards, Jr.	**Art Unit** 2612

✓	Rejected		-	Cancelled		N	Non-Elected		A	Appeal
=	Allowed		÷	Restricted		I	Interference		O	Objected

☐ **Claims renumbered in the same order as presented by applicant** ☐ **CPA** ☐ **T.D.** ☐ **R.1.47**

CLAIM		DATE								
Final	Original	03/09/2009								
	1	✓								
	2	✓								
	3	✓								
	4	✓								
	5	✓								
	6	✓								
	7	✓								
	8	✓								
	9	✓								
	10	✓								
	11	✓								
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	14	✓								
	15	✓								
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	17	✓								
	18	✓								
	19	✓								
	20	✓								
	21	✓								
	22	✓								
	23	✓								
	24	✓								
	25	✓								
	26	✓								

Search Notes	Application/Control No. 11440924	Applicant(s)/Patent Under Reexamination HUA ET AL.
	Examiner Timothy Edwards, Jr.	Art Unit 2612

SEARCHED

Class	Subclass	Date	Examiner
341	22, 33	12/13/08	/TE/
345	156, 168, 173		
178	18.05, 18.06		

SEARCH NOTES

Search Notes	Date	Examiner
EAST TEXT SEARCH	12/13/08	/TE/

INTERFERENCE SEARCH

Class	Subclass	Date	Examiner

UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
Address: COMMISSIONER FOR PATENTS
P.O. Box 1450
Alexandria, Virginia 22313-1450
www.uspto.gov

BIB DATA SHEET

CONFIRMATION NO. 9376

SERIAL NUMBER	FILING or 371(c) DATE	CLASS	GROUP ART UNIT	ATTORNEY DOCKET NO.
11/440,924	05/25/2006 **RULE**	236	2612	16820P442

APPLICANTS

Liu Hua, Shanghai, CHINA;
Jiang XiaoPing, Shanghai, CHINA;

** **CONTINUING DATA** *************************

** **FOREIGN APPLICATIONS** *************************

** **IF REQUIRED, FOREIGN FILING LICENSE GRANTED** **
06/16/2006

		STATE OR COUNTRY	SHEETS DRAWINGS	TOTAL CLAIMS	INDEPENDENT CLAIMS
Foreign Priority claimed ❑ Yes ☑ No 35 USC 119(a-d) conditions met ❑ Yes ☑ No Verified and Acknowledged /TIMOTHY EDWARDS JR/ Examiner's Signature	❑ Met after Allowance Initials	CHINA	14	26	3

ADDRESS

CYPRESS/BLAKELY
Blakely Sokoloff Taylor & Zafman LLP
1279 Oakmead Parkway
SUNNYVALE, CA 94085-4040
UNITED STATES

TITLE

Low pin count solution using capacitance sensing matrix for keyboard architecture

FILING FEE RECEIVED	FEES: Authority has been given in Paper	
1300	No.____________ to charge/credit DEPOSIT ACCOUNT No.____________ for following:	❑ All Fees ❑ 1.16 Fees (Filing) ❑ 1.17 Fees (Processing Ext. of time) ❑ 1.18 Fees (Issue) ❑ Other ________________ ❑ Credit

BIB (Rev. 05/07).

EAST Search History

Ref #	Hits	Search Query	DBs	Default Operator	Plurals	Time Stamp
L1	425	("4103252" | "4736191" | "5305017" | "5543590" | "6037929" | "6188391" | "6262717" | "6380931" | "6498720" | "6574095" | "6704005")	US-PGPUB; USPAT; EPO; JPO; DERWENT	OR	ON	2009/03/04 14:24
L2	10	1 AND ((SENS$4 near4 pin) same capacit$7)	US-PGPUB; USPAT; EPO; JPO; DERWENT	OR	ON	2009/03/04 14:25
L3	239	1 AND (SENS$4 near4 capacit$7)	US-PGPUB; USPAT; EPO; JPO; DERWENT	OR	ON	2009/03/04 14:35
L4	208	(keyboard keypad) AND ((SENS$4 near4 pin) same capacit $7)	US-PGPUB; USPAT; EPO; JPO; DERWENT	OR	ON	2009/03/04 14:36
L5	16	4 and (compar$6 near7 position $4)	US-PGPUB; USPAT; EPO; JPO; DERWENT	OR	ON	2009/03/04 14:37

3/ 4/ 09 3:55:19 PM
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EAST Search History

Ref #	Hits	Search Query	DBs	Default Operator	Plurals	Time Stamp
L1	74	((capacit$7 near5 sens$4) near5 pin) and (keyboard keypad)	US-PGPUB; USPAT; EPO; JPO; DERWENT	OR	ON	2009/03/04 16:39
L2	56	1 and ((determin$4 detect$6) near4 position $4)	US-PGPUB; USPAT; EPO; JPO; DERWENT	OR	ON	2009/03/04 16:42

3/4/09 5:02:08 PM
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EAST Search History

Ref #	Hits	Search Query	DBs	Default Operator	Plurals	Time Stamp
L1	401	("4103252" | "4736191" | "5305017" | "5543590" | "6037929" | "6188391" | "6262717" | "6380931" | "6498720" | "6574095" | "6704005")	US-PGPUB; USPAT; EPO; JPO; DERWENT	OR	ON	2008/07/31 07:39
L2	2	1 and ((defined near4 (area space key)) same (sens$4 near4 capacit $7))	US-PGPUB; USPAT; EPO; JPO; DERWENT	OR	ON	2008/07/31 07:41
L3	53	1 and (defined near4 (area space key)) and ((sens$4 near4 capacit$7) same ((sens$4 determin$4 detect$5) neaa4 position))	US-PGPUB; USPAT; EPO; JPO; DERWENT	OR	ON	2008/07/31 07:45
L4	240	(select$5 near4 key) and (defined near4 (area space key)) and ((sens $4 near4 capacit $7) same ((sens $4 determin$4 detect$5) neaa4 position))	US-PGPUB; USPAT; EPO; JPO; DERWENT	OR	ON	2008/07/31 08:46
L5	4	4 and ((key near4 press$4) same (output$4 near5 (code data)))	US-PGPUB; USPAT; EPO; JPO; DERWENT	OR	ON	2008/07/31 08:50

7/ 31/ 08 8:57:49 AM
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IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In Re the Application of:

LIU HUA, ET AL.

Application No.:

Filed:

For: **A LOW PIN COUNT SOLUTION USING CAPACITANCE SENSING MATRIX FOR KEYBOARD ARCHITECTURE**

Art Group:

Examiner:

INFORMATION DISCLOSURE STATEMENT UNDER 37 C.F.R. §1.97

Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

In accordance with the duty of disclosure, enclosed is a copy of IDS Citation Form PTO/SB/08 or PTO-1449, together with copies of the documents cited on that form, except for copies not required to be submitted (e.g., copies of U.S. patents and U.S. published patent applications need not be enclosed). This IDS and IDS Citation Form are being submitted concurrently with the Utility Application. It is respectfully requested that the cited references be considered and that the enclosed copy of PTO/SB/08 be initialed by the Examiner to indicate such consideration and a copy thereof returned to applicant(s).

The submission of this Information Disclosure Statement is not to be construed as a representation that a search has been made in the subject application and is not to be construed as an admission that the information cited in this statement is material to patentability.

Please charge any fees due to Deposit Account 02-2666. A duplicate copy of the Fee Transmittal (PTO/SB/17) is enclosed for this purpose.

Respectfully submitted,

BLAKELY, SOKOLOFF, TAYLOR & ZAFMAN LLP

Date: 5/24/06

Daniel E. Ovanezian, Reg. No. 41,236

12400 Wilshire Boulevard, 7th Floor
Los Angeles, CA 90025
Telephone: (408) 720-8300

I hereby certify that this correspondence is being deposited with the United States Postal Service on the date shown below with sufficient postage as first class mail in an envelope addressed to: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.

Sarah M. Montgomery 5/24/06 *Date*

Substitute for form 1449A/PTO

INFORMATION DISCLOSURE STATEMENT BY APPLICANT

(use as many sheets as necessary)

Sheet	1	of	2

Complete If Known	
Application Number	
Filing Date	
First Named Inventor	Liu Hua
Art Unit	
Examiner Name	
Attorney Docket Number	16820P442

U.S. PATENT DOCUMENTS

Examiner Initials*	Cite No.[1]	Document Number: Number - Kind Code[2] *(if known)*	Publication Date Issue Date MM-DD-YYYY	Name of Patentee or Applicant of Cited Document	Pages, Columns, Lines, Where Relevant Passages or Relevant Figures Appear
		US-6,380,931	04-30-2002	Gillespie et al.	
		US-5,305,017	04-19-1994	Gerpheide	
		US-6,188,391	02-13-2001	Seely et al.	
		US-6,498,720 B2	12-24-2002	Glad	
		US-6,574,095 B2	06-03-2003	Suzuki	
		US-6,037,929	03-14-2000	Ogura et al.	
		US-4,103,252	07-25-1978	Bobick	
		US-4,736,191	04-05-1988	Matzke et al.	
		US-5,543,590	08-06-1996	Gillespie et al.	
		US-6,704,005 B2	03-09-2004	Kato et al.	
		US-6,262,717 B1	07-17-2001	Donohue et al.	
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FOREIGN PATENT DOCUMENTS

Examiner Initials*	Cite No.[1]	Foreign Patent Document: Country Code[3] - Number[4] - Kind Code[5] *(if known)*	Publication Date MM-DD-YYYY	Name of Patentee or Applicant of Cited Document	Pages, Columns, Lines, Where Relevant Passages or Relevant Figures Appear	T[6]
		WO 00/02188 A1	01-13-2000	Cirque Corporation		
		EP 0 574 213	06-07-1993	Synaptics, Incorporated		

Examiner Signature		Date Considered	

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

[1]Applicant's unique citation designation number (optional). [2]See Kinds Codes of USPTO Patent Documents at www.uspto.gov or MPEP 901.04. [3]Enter Office that issued the document, by the two-letter code (WIPO Standard ST.3). [4]For Japanese patent documents, the indication of the year of reign of the Emperor must precede the serial number of the patent document. [5]Kind of document by the appropriate symbols as indicated on the document under WIPO Standard ST. 16 if possible. [6]Applicant is to place a check mark here if English language Translation is attached.

Based on PTO/SB/08A (08-03) as modified by Blakely, Sokoloff, Taylor & Zafman (wlr) 08/11/2003.

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ALL REFERENCES CONSIDERED EXCEPT WHERE LINED THROUGH. /TE/

Substitute for form 1449A/PTO				Complete if Known	
INFORMATION DISCLOSURE STATEMENT BY APPLICANT				Application Number	
				Filing Date	
				First Named Inventor	Liu Hua
				Art Unit	
				Examiner Name	
Sheet	2	**of**	2	Attorney Docket Number	16820P442

NON PATENT LITERATURE DOCUMENTS

Examiner Initials*	Cite No.[1]	Include name of the author (in CAPITAL LETTERS), title of the article (when appropriate), title of the item (book, magazine, journal, serial, symposium, catalog, etc.), date, page(s), volume-issue number(s), publisher, city and/or country where published.	T[2]
		Chapweske, Adam, "The PS/2 Mouse Interface", PS/2 Mouse Interfacing, 2001, 10 pages.	
		"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, 4 pages, dowloaded April 13, 2006.	
		"CY8C21x34 Data Sheet", Cypress Semiconductore Corporation, CSR User Module, CSR v1.0, October 6, 2005, pgs. 1-36.	
		"IBM PC keyboard", Wikipedia, the free encyclopedia, 3 pages, http://en.wikipedia.org/wiki/PC_keyboard	

Examiner Signature	/Timothy Edwards Jr/	Date Considered	03/04/2009

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

[1]Applicant's unique citation designation number. [2]Applicant is to place a check mark here if English language Translation is attached.

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Attorney's Docket No. 16820P442 PATENT

Confirmation No.: 9376

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In Re Application of:

Liu Hua

Application No.: 11/440,924

Filed: May 25, 2006

For: A LOW PIN COUNT SOLUTION USING CAPACITANCE SENSING MATRIX FOR KEYBOARD ARCHITECTURE

Examiner: Not yet assigned

Art Unit: 3744

Mail Stop Amendment
Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

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I hereby certify that this correspondence is being deposited with the United States Postal Service as first class mail with sufficient postage in an envelope addressed to Mail Stop Amendment, Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450 on August 11, 2006
(Date of Deposit)

Dianne Neathery
(Typed or printed name of person mailing correspondence)

Dianne Neathery 8-11-06
(Signature of person mailing correspondence)

Pursuant to 37 C.F.R. § 1.97, the submission of this Information Disclosure Statement is not to be construed as a representation that a search has been made and is not to be construed as an admission that the information cited in this statement is material to patentability.

Pursuant to 37 C.F.R. § 1.97, this Information Disclosure Statement is being submitted under one of the following (as indicated by an "X" to the left of the appropriate paragraph):

__X__ 37 C.F.R. §1.97(b).

______ 37 C.F.R. §1.97(c). If so, then enclosed with this Information Disclosure Statement is one of the following:

____ A statement pursuant to 37 C.F.R. §1.97(e) or

____ A check for $180.00 for the fee under 37 C.F.R. § 1.17(p).

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(1) A statement pursuant to 37 C.F.R. §1.97(e); and

(2) A check for $180.00 for the fee under 37 C.F.R. §1.17(p) for submission of the Information Disclosure Statement.

If there are any additional charges, please charge Deposit Account No. 02-2666.

Respectfully submitted,

BLAKELY, SOKOLOFF, TAYLOR & ZAFMAN LLP

Dated: August 11, 2006

Daniel E. Ovanezian
Reg. No. 41,236

12400 Wilshire Blvd.
Seventh Floor
Los Angeles, CA 90025
(408) 720-8300

Substitute for Form 1449/PTO

INFORMATION DISCLOSURE STATEMENT BY APPLICANT

(use as many sheets as necessary)

Complete if Known	
Application Number	11/440,924
Filing Date	May 25, 2006
First Named Inventor:	Liu Hua
Art Unit	3744
Examiner Name	Not yet assigned
Attorney Docket Number	16820P442

Sheet 1 **of** 1

NON PATENT LITERATURE DOCUMENTS

Examiner Initials*	Cite No[1]	Include name of the author (in CAPITAL LETTERS), title of the article (when appropriate), title of the item (book, magazine, journal, serial, symposium, catalog, etc.), date, page(s), volume-issue number(s), publisher, city and/or country where published	T[2]
		RYAN SEGUINE, et al., "Layout Guidelines for PSoC™ CapSense™", Cypress Application Note AN2292, Revision B, October 31, 2005, pages 1-15.	
		DENNIS SEGUINE, "Capacitive Switch Scan", Cypress Application Note AN2233a, Revision B, April 14, 2005, pages 1-6.	

Examiner Signature	/Timothy Edwards Jr/	Date Considered	03/04/2009

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

[1]Applicant's unique citation designation number (optional). [2]Applicant is to place a check mark here if English Translation is attached.

ALL REFERENCES CONSIDERED EXCEPT WHERE LINED THROUGH. /TE/

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APPLICATION NUMBER	PATENT NUMBER	GROUP ART UNIT	FILE WRAPPER LOCATION
11/440,924		2612	

Correspondence Address / Fee Address Change

The following fields have been set to Customer Number 75405 on 04/07/2008

- Correspondence Address
- Maintenance Fee Address

The address of record for Customer Number 75405 is:
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APPLICATION NUMBER	PATENT NUMBER	GROUP ART UNIT	FILE WRAPPER LOCATION
11/440,924		2612	

Correspondence Address / Fee Address Change

The following fields have been set to Customer Number 75405 on 03/03/2008

- Maintenance Fee Address

The address of record for Customer Number 75405 is:
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APPLICATION NUMBER	FILING OR 371(c) DATE	FIRST NAMED APPLICANT	ATTY. DOCKET NO./TITLE
11/440,924	05/25/2006	Liu Hua	16820P442

CONFIRMATION NO. 9376

8791
BLAKELY SOKOLOFF TAYLOR & ZAFMAN
1279 OAKMEAD PARKWAY
SUNNYVALE, CA94085-4040

Title: Low pin count solution using capacitance sensing matrix for keyboard architecture

Publication No. US-2007-0273560-A1
Publication Date: 11/29/2007

NOTICE OF PUBLICATION OF APPLICATION

The above-identified application will be electronically published as a patent application publication pursuant to 37 CFR 1.211, et seq. The patent application publication number and publication date are set forth above.

The publication may be accessed through the USPTO's publically available Searchable Databases via the Internet at www.uspto.gov. The direct link to access the publication is currently http://www.uspto.gov/patft/.

The publication process established by the Office does not provide for mailing a copy of the publication to applicant. A copy of the publication may be obtained from the Office upon payment of the appropriate fee set forth in 37 CFR 1.19(a)(1). Orders for copies of patent application publications are handled by the USPTO's Office of Public Records. The Office of Public Records can be reached by telephone at (703) 308-9726 or (800) 972-6382, by facsimile at (703) 305-8759, by mail addressed to the United States Patent and Trademark Office, Office of Public Records, Alexandria, VA 22313-1450 or via the Internet.

In addition, information on the status of the application, including the mailing date of Office actions and the dates of receipt of correspondence filed in the Office, may also be accessed via the Internet through the Patent Electronic Business Center at www.uspto.gov using the public side of the Patent Application Information and Retrieval (PAIR) system. The direct link to access this status information is currently http://pair.uspto.gov/. Prior to publication, such status information is confidential and may only be obtained by applicant using the private side of PAIR.

Further assistance in electronically accessing the publication, or about PAIR, is available by calling the Patent Electronic Business Center at 1-866-217-9197.

Pre-Grant Publication Division, 703-605-4283

Attorney's Docket No. 16820P442 PATENT
Confirmation No.: 9376

OIPE IAP65 AUG 1 4 2006 PATENT & TRADEMARK OFFICE

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In Re Application of: Liu Hua Application No.: 11/440,924 Filed: May 25, 2006 For: A LOW PIN COUNT SOLUTION USING CAPACITANCE SENSING MATRIX FOR KEYBOARD ARCHITECTURE	Examiner: Not yet assigned Art Unit: 3744

Mail Stop Amendment
Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

INFORMATION DISCLOSURE STATEMENT

Sir:

Enclosed is a copy of Information Disclosure Citation Form PTO-1449 or PTO/SB/08 together with copies of the documents cited on that form, except for copies not required to be submitted (e.g., copies of U.S. patents and U.S. published patent applications). It is respectfully requested that the cited documents be considered and that the enclosed copy of Information Disclosure Citation Form PTO-1449 or PTO/SB/08 be initialed by the Examiner to indicate such consideration and a copy thereof returned to applicant(s).

I hereby certify that this correspondence is being deposited with the United States Postal Service as first class mail with sufficient postage in an envelope addressed to Mail Stop Amendment, Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450 on August 11, 2006
(Date of Deposit)

Dianne Neathery
(Typed or printed name of person mailing correspondence)

Dianne Neathery 8-11-06
(Signature of person mailing correspondence)

Pursuant to 37 C.F.R. § 1.97, the submission of this Information Disclosure Statement is not to be construed as a representation that a search has been made and is not to be construed as an admission that the information cited in this statement is material to patentability.

Pursuant to 37 C.F.R. § 1.97, this Information Disclosure Statement is being submitted under one of the following (as indicated by an "X" to the left of the appropriate paragraph):

__X__ 37 C.F.R. §1.97(b).

_____ 37 C.F.R. §1.97(c). If so, then enclosed with this Information Disclosure Statement is one of the following:

____ A statement pursuant to 37 C.F.R. §1.97(e) or

____ A check for $180.00 for the fee under 37 C.F.R. § 1.17(p).

_____ 37 C.F.R. §1.97(d). If so, then enclosed with this Information Disclosure Statement are the following:

(1) A statement pursuant to 37 C.F.R. §1.97(e); and

(2) A check for $180.00 for the fee under 37 C.F.R. §1.17(p) for submission of the Information Disclosure Statement.

If there are any additional charges, please charge Deposit Account No. 02-2666.

Respectfully submitted,

BLAKELY, SOKOLOFF, TAYLOR & ZAFMAN LLP

Dated: August 11, 2006

Daniel E. Ovanezian
Reg. No. 41,236

12400 Wilshire Blvd.
Seventh Floor
Los Angeles, CA 90025
(408) 720-8300

AUG 1 4 2006

PATENT & TRADEMARK OFFICE

Substitute for Form 1449/PTO				Complete if Known	
INFORMATION DISCLOSURE STATEMENT BY APPLICANT *(use as many sheets as necessary)*				Application Number	11/440,924
				Filing Date	May 25, 2006
				First Named Inventor:	Liu Hua
				Art Unit	3744
				Examiner Name	Not yet assigned
Sheet	1	**of**	1	Attorney Docket Number	16820P442

NON PATENT LITERATURE DOCUMENTS

Examiner Initials*	Cite No[1]	Include name of the author (in CAPITAL LETTERS), title of the article (when appropriate), title of the item (book, magazine, journal, serial, symposium, catalog, etc.), date, page(s), volume-issue number(s), publisher, city and/or country where published	T[2]
		RYAN SEGUINE, et al., "Layout Guidelines for PSoC™ CapSense™", Cypress Application Note AN2292, Revision B, October 31, 2005, pages 1-15.	
		DENNIS SEGUINE, "Capacitive Switch Scan", Cypress Application Note AN2233a, Revision B, April 14, 2005, pages 1-6.	

Examiner Signature		Date Considered	

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

[1]Applicant's unique citation designation number (optional). [2]Applicant is to place a check mark here if English Translation is attached.
This collection of information is required by 37 CFR 1.98. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.14. This collection is estimated to take 2 hours to complete including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SENT FEES OR COMPLETED FORMS TO THIS ADDRESS. **SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, Virginia 22313-1450.**
If you need assistance in completing the form, call 1-800-PTO-9199 (1-800-786-9199) and select option 2.

Based on Form PTO/SB/08A (08-03) as modified by BLAKELY, SOKOLOFF, TAYLOR & ZAFMAN LLP on 09/10/03.

JFW

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APPLICATION NUMBER	FILING OR 371 (c) DATE	FIRST NAMED APPLICANT	ATTORNEY DOCKET NUMBER
11/440,924	05/25/2006	Liu Hua	16820P442

CONFIRMATION NO. 9376

FORMALITIES LETTER

08791
BLAKELY SOKOLOFF TAYLOR & ZAFMAN
12400 WILSHIRE BOULEVARD
SEVENTH FLOOR
LOS ANGELES, CA 90025-1030

Date Mailed: 06/19/2006

NOTICE TO FILE CORRECTED APPLICATION PAPERS

Filing Date Granted

An application number and filing date have been accorded to this application. The application is informal since it does not comply with the regulations for the reason(s) indicated below. Applicant is given TWO MONTHS from the date of this Notice within which to correct the informalities indicated below. Extensions of time may be obtained by filing a petition accompanied by the extension fee under the provisions of 37 CFR 1.136(a).

The required item(s) identified below must be timely submitted to avoid abandonment:

- Replacement drawings in compliance with 37 CFR 1.84 and 37 CFR 1.121(d) are required. The drawings submitted are not acceptable because:
    - More than one figure is present and each figure is not labeled "Fig." with a consecutive Arabic numeral (1, 2, etc.) or an Arabic numeral and capital letter in the English alphabet (A, B, etc.)(see 37 CFR 1.84(u)(1)). See Figure(s) 6D. A brief description of the several views of the drawings (see 37 CFR 1.74) should be added or amended to correspond to the corrected numbering of the figures. See also 37 CFR 1.77(b)(7).

Applicant is cautioned that correction of the above items may cause the specification and drawings page count to exceed 100 pages. If the specification and drawings exceed 100 pages, applicant will need to submit the required application size fee.

Replies should be mailed to: Mail Stop Missing Parts
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A copy of this notice MUST be returned with the reply.

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PART 2 - COPY TO BE RETURNED WITH RESPONSE

O.I.P.E. IAP21
JUL 0 3 2006
PATENT & TRADEMARK OFFICE

ATTORNEY DOCKET NO.: 16820P442

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re the Application of: LIU HUA, ET AL. Application No.: 11/440,924 Filed: May 25, 2006 For: **A LOW PIN COUNT SOLUTION USING CAPACITANCE SENSING MATRIX FOR KEYBOARD ARCHITECTURE**	Art Group: 3744 Examiner:

Mail Stop Missing Parts
Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

RESPONSE TO NOTICE TO FILE CORRECTED APPLICATION PAPERS

Sir:

In response to the Notice to File Corrected Application Papers mailed June 19, 2006, please find enclosed:

- substitute drawing(s) in compliance with 37 CFR § 1.84;

and

- copy of the Notice to File Corrected Application Papers.

If any additional fee is required, please charge Deposit Account No. 02-2666. An extra copy of the Fee Transmittal is enclosed for deposit account charging purposes.

Respectfully submitted,

BLAKELY, SOKOLOFF, TAYLOR & ZAFMAN LLP

Date: 6/26/06

Daniel E. Ovanezian, Reg. No. 41,236

12400 Wilshire Boulevard, 7th Floor
Los Angeles, CA 90025
Telephone: (408) 720-8300

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Sarah M. Montgomery 6/26/06 *Date*

OIPE IAP21
JUL 0 3 2006
PATENT & TRADEMARK OFFICE

TRANSMITTAL FORM

(to be used for all correspondence after initial filing)

Application No.	11/440,924
Filing Date	May 25, 2006
First Named Inventor	Liu Hua
Art Unit	3744
Examiner Name	
Attorney Docket Number	16820P442
Total Number of Pages in This Submission	18

ENCLOSURES *(check all that apply)*

- [ ] Fee Transmittal Form
  - [ ] Fee Attached
- [ ] Amendment / Response
  - [ ] After Final
  - [ ] Affidavits/declaration(s)
- [ ] Extension of Time Request
- [ ] Express Abandonment Request
- [ ] Information Disclosure Statement
  - [ ] PTO/SB/08
- [ ] Certified Copy of Priority Document(s)
- [x] Response to Missing Parts/ Incomplete Application
  - [ ] Basic Filing Fee
  - [ ] Declaration/POA
  - [ ] Response to Missing Parts under 37 CFR 1.52 or 1.53
- [x] Drawing(s); Replacement Sheets
- [ ] Licensing-related Papers
- [ ] Petition
- [ ] Petition to Convert a Provisional Application
- [ ] Power of Attorney, Revocation Change of Correspondence Address
- [ ] Terminal Disclaimer
- [ ] Request for Refund
- [ ] CD, Number of CD(s)
  - [ ] Landscape Table on CD
- [ ] After Allowance Communication to TC
- [ ] Appeal Communication to Board of Appeals and Interferences
- [ ] Appeal Communication to TC (Appeal Notice, Brief, Reply Brief)
- [ ] Proprietary Information
- [ ] Status Letter
- [x] Other Enclosure(s) *(please identify below)*:

Copy of Notice to File Corrected Application Papers; Return Receipt Postcard.

Remarks

SIGNATURE OF APPLICANT, ATTORNEY, OR AGENT

Firm *or* Individual name	Daniel E. Ovanezian, Reg. No. 41,236 BLAKELY, SOKOLOFF, TAYLOR & ZAFMAN LLP
Signature	[signature]
Date	6/26/06

CERTIFICATE OF MAILING/TRANSMISSION

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Typed or printed name	Sarah M. Montgomery		
Signature	[signature]	Date	6/26/06

Based on PTO/SB/21 (09-04) as modified by Blakely, Sokoloff, Taylor & Zafman (wlr) 11/30/2005.
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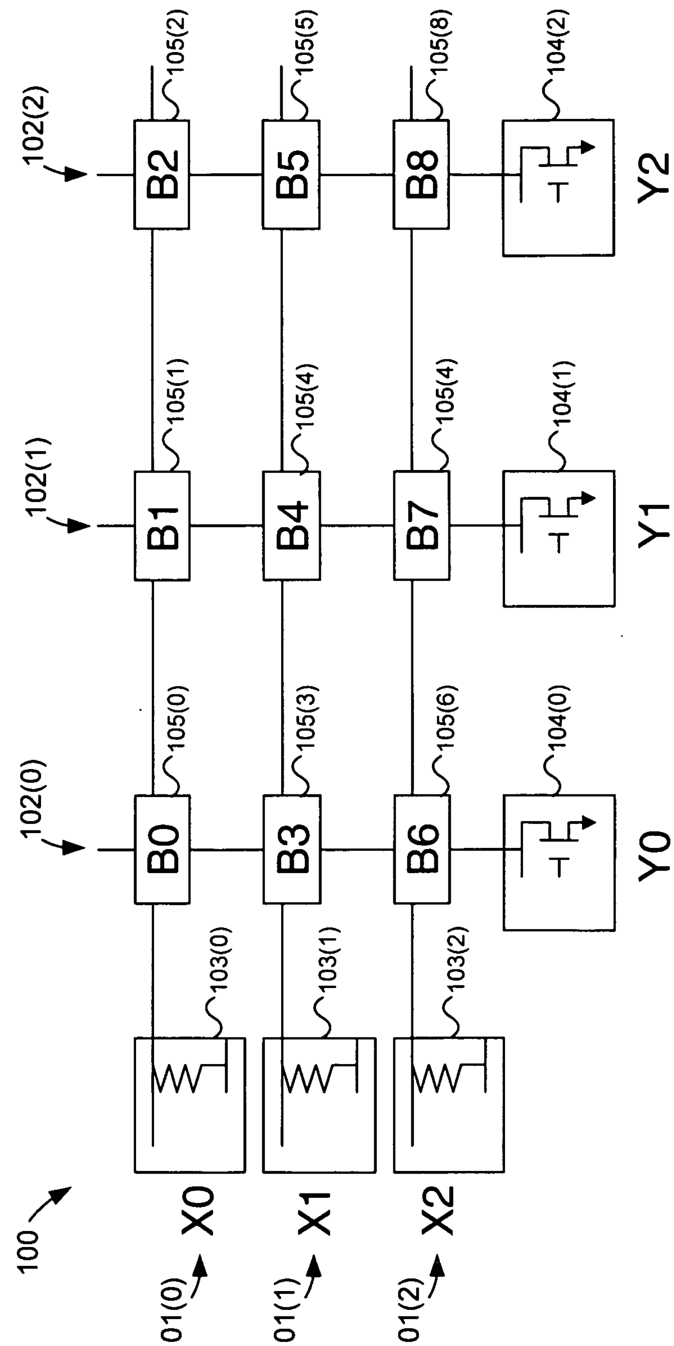

100
101(0)
101(1)
101(2)
X0
X1
X2
103(0)
103(1)
103(2)
102(0)
102(1)
102(2)
B0
B1
B2
B3
B4
B5
B6
B7
B8
105(0)
105(1)
105(2)
105(3)
105(4)
105(5)
105(6)
105(4)
105(8)
104(0)
104(1)
104(2)
Y0
Y1
Y2

FIG. 1A

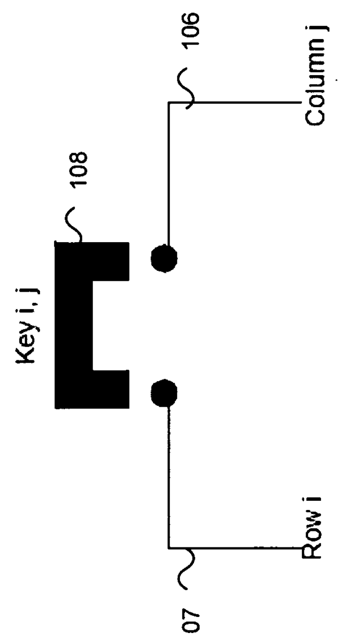
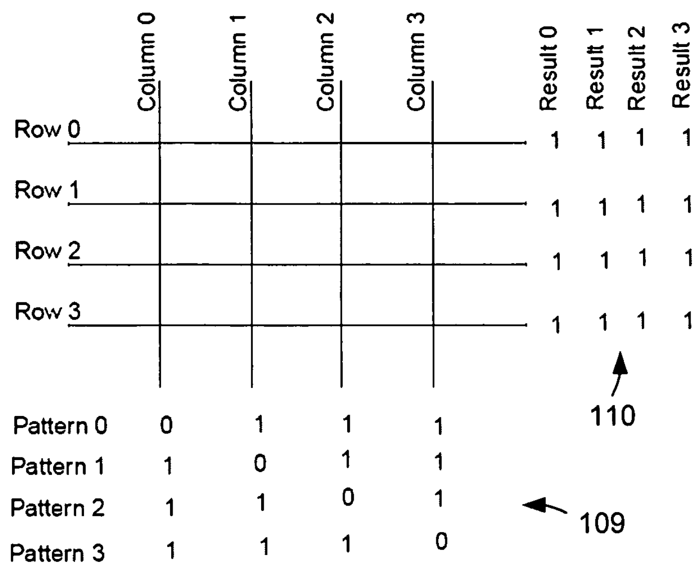
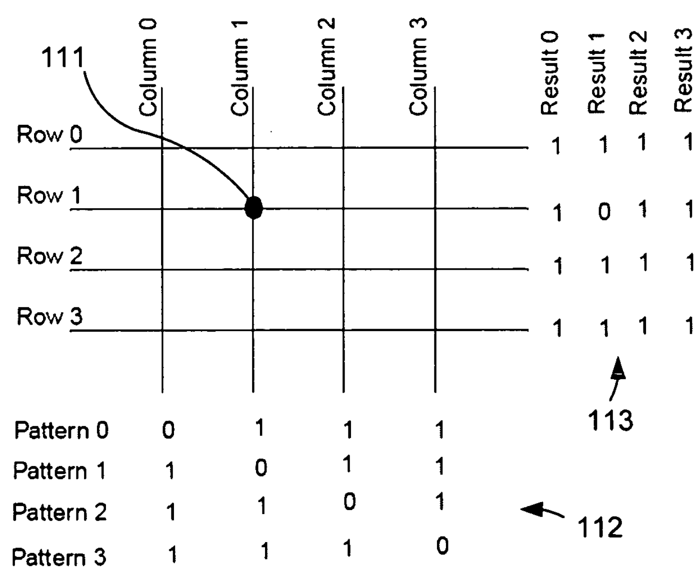

Key i, j
108
106
Column j
107
Row i

FIG. 1B



. Scan Results For No Key Press

FIG. 1C



Scan Results for Key $_{1,1}$ Pressed

FIG. 1D

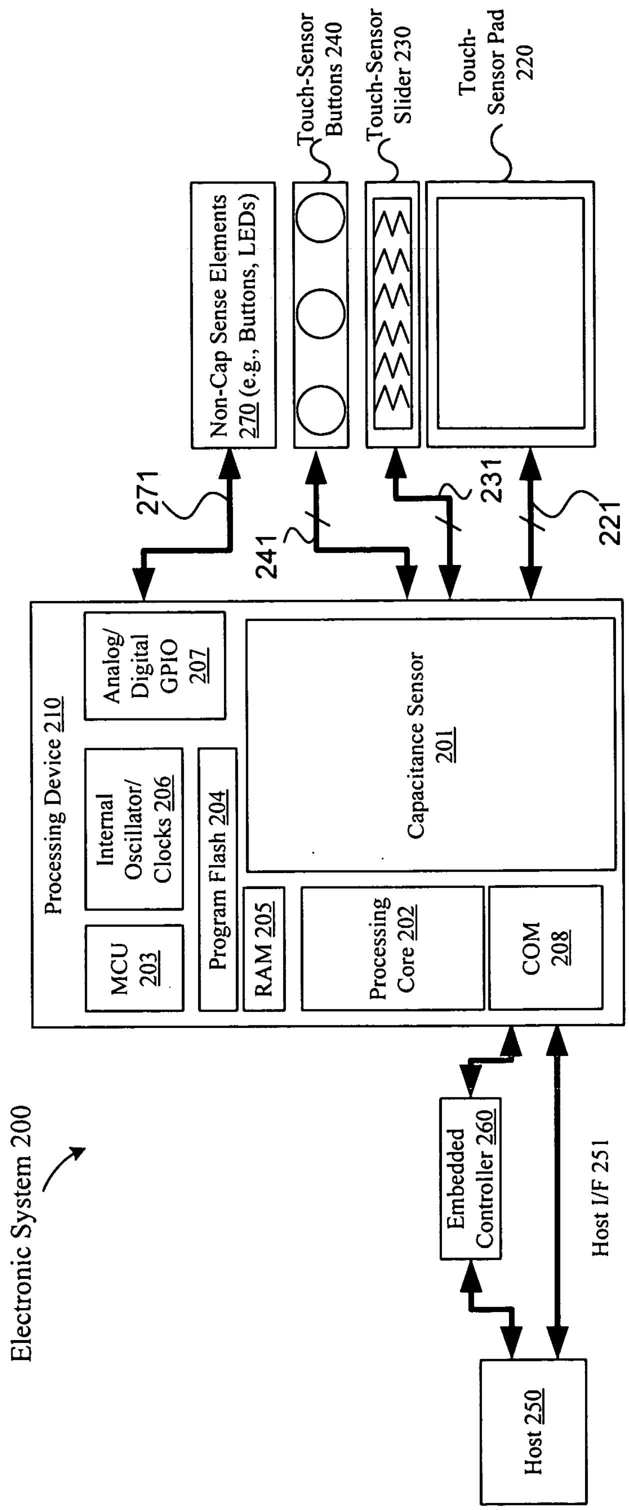

Electronic System 200
Processing Device 210
MCU 203
Internal Oscillator/ Clocks 206
Analog/ Digital GPIO 207
Program Flash 204
RAM 205
Processing Core 202
COM 208
Capacitance Sensor 201
Non-Cap Sense Elements 270 (e.g., Buttons, LEDs)
Touch-Sensor Buttons 240
Touch-Sensor Slider 230
Touch-Sensor Pad 220
271
241
231
221
Embedded Controller 260
Host I/F 251
Host 250

FIG. 2

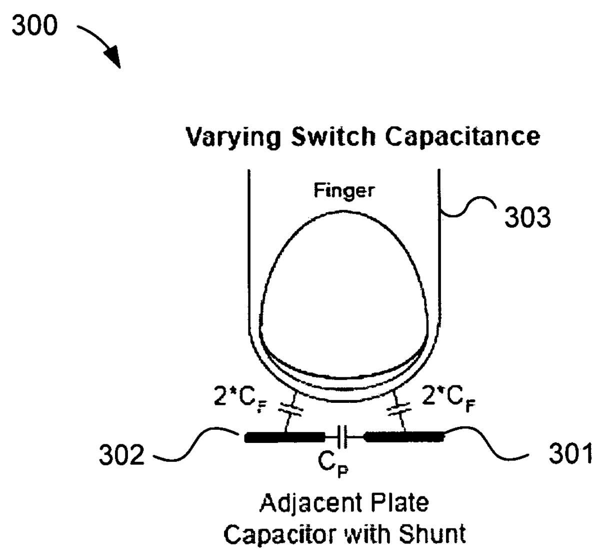

300
Varying Switch Capacitance
Finger
303
2*C_F
2*C_F
302
C_P
301
Adjacent Plate
Capacitor with Shunt

FIG. 3A

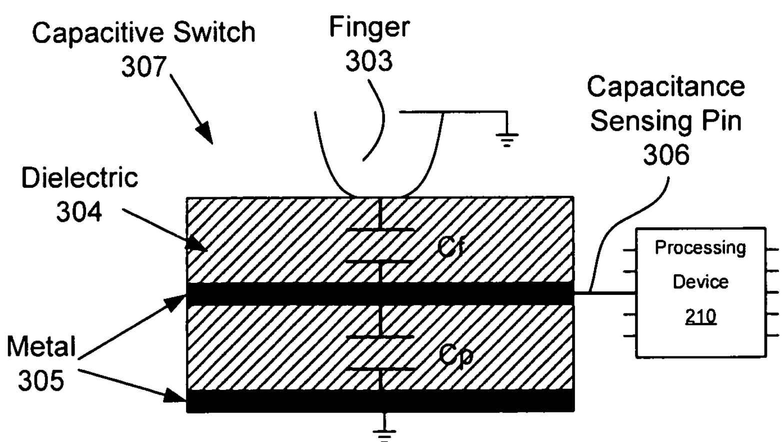

Capacitive Switch
307
Finger
303
Capacitance
Sensing Pin
306
Dielectric
304
Cf
Processing
Device
210
Metal
305
Cp

FIG. 3B

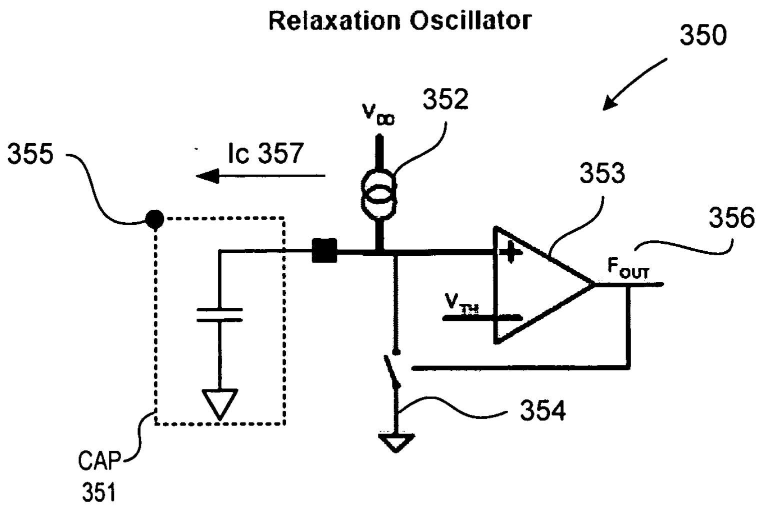

Relaxation Oscillator
350
352
V_{DD}
355
Ic 357
353
356
F_{OUT}
V_{TH}
354
CAP
351

FIG. 3C

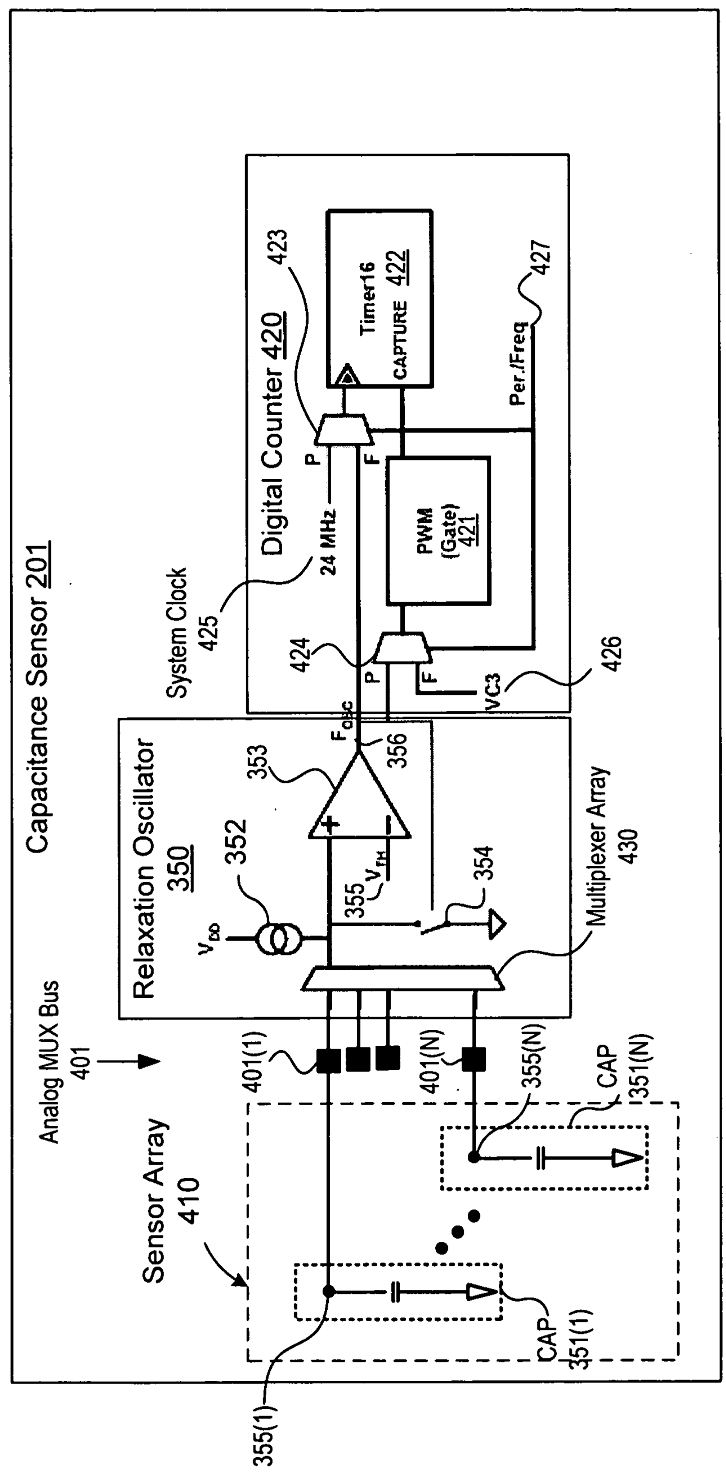

Capacitance Sensor 201
Analog MUX Bus 401
Sensor Array 410
Relaxation Oscillator 350
Digital Counter 420
System Clock 425
24 MHz
P
F
423
Timer16
CAPTURE 422
427
Per./Freq
PWM (Gate) 421
424
VC3
426
F_{OSC}
356
353
352
V_{DD}
355
V_{TH}
354
Multiplexer Array 430
401(1)
401(N)
355(N)
CAP 351(N)
CAP 351(1)
355(1)

FIG. 4

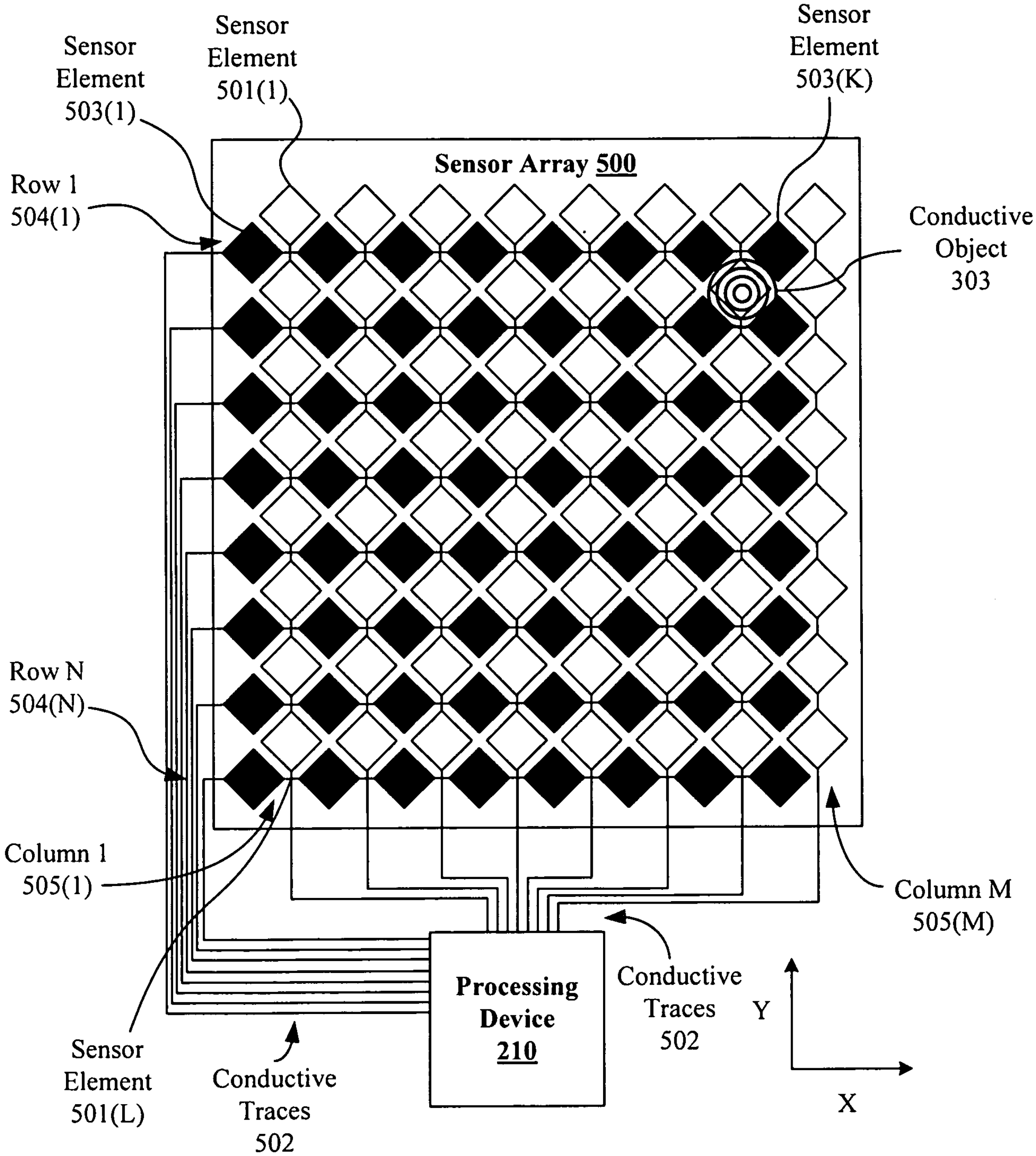

Sensor Element 503(1)
Sensor Element 501(1)
Sensor Element 503(K)
Sensor Array 500
Row 1 504(1)
Conductive Object 303
Row N 504(N)
Column 1 505(1)
Column M 505(M)
Processing Device 210
Conductive Traces 502
Y
X
Sensor Element 501(L)
Conductive Traces 502

FIG. 5A

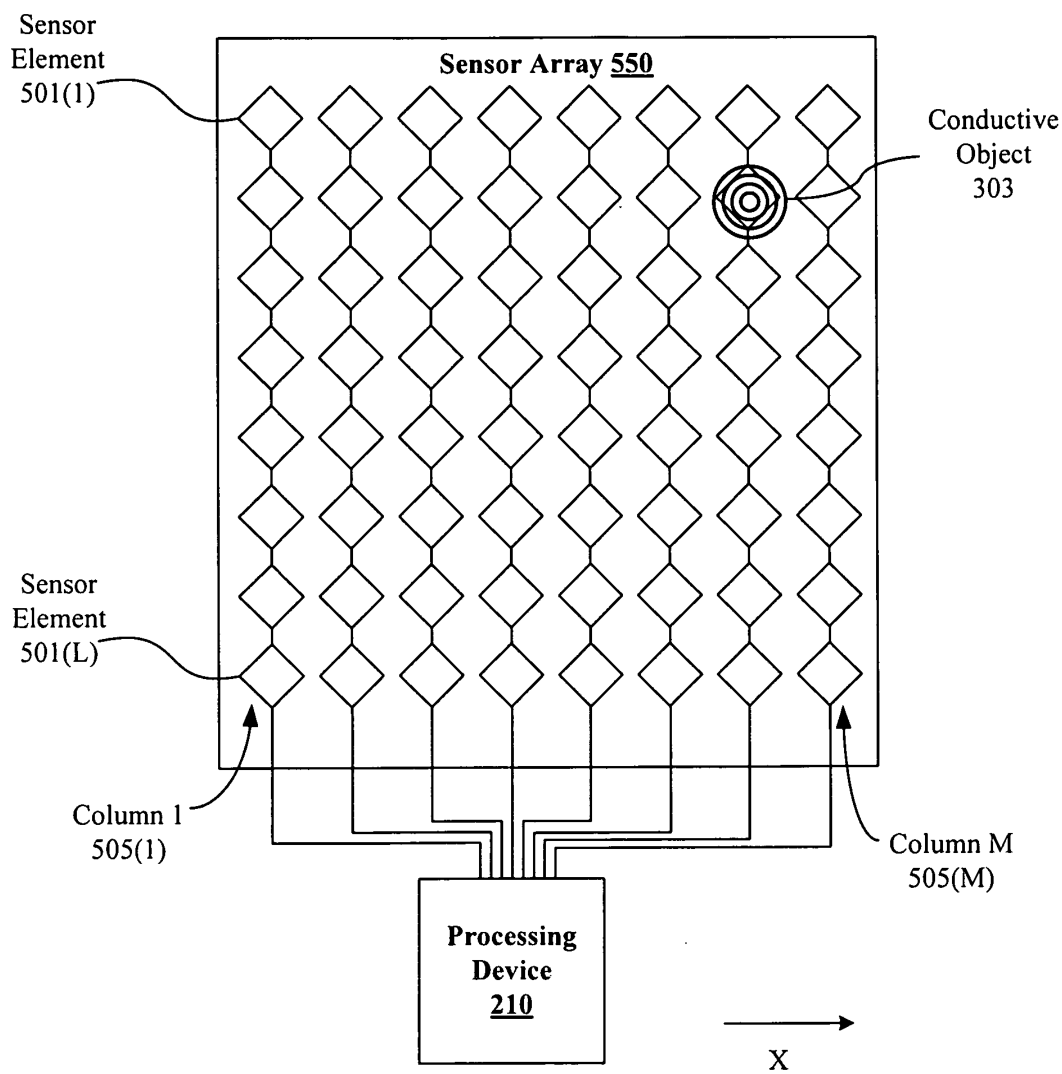

Sensor Element 501(1)
Sensor Array 550
Conductive Object 303
Sensor Element 501(L)
Column 1 505(1)
Column M 505(M)
Processing Device 210
X

FIG. 5B

TOP-VIEW of 2-Layer Touch-Sensor Pad 220

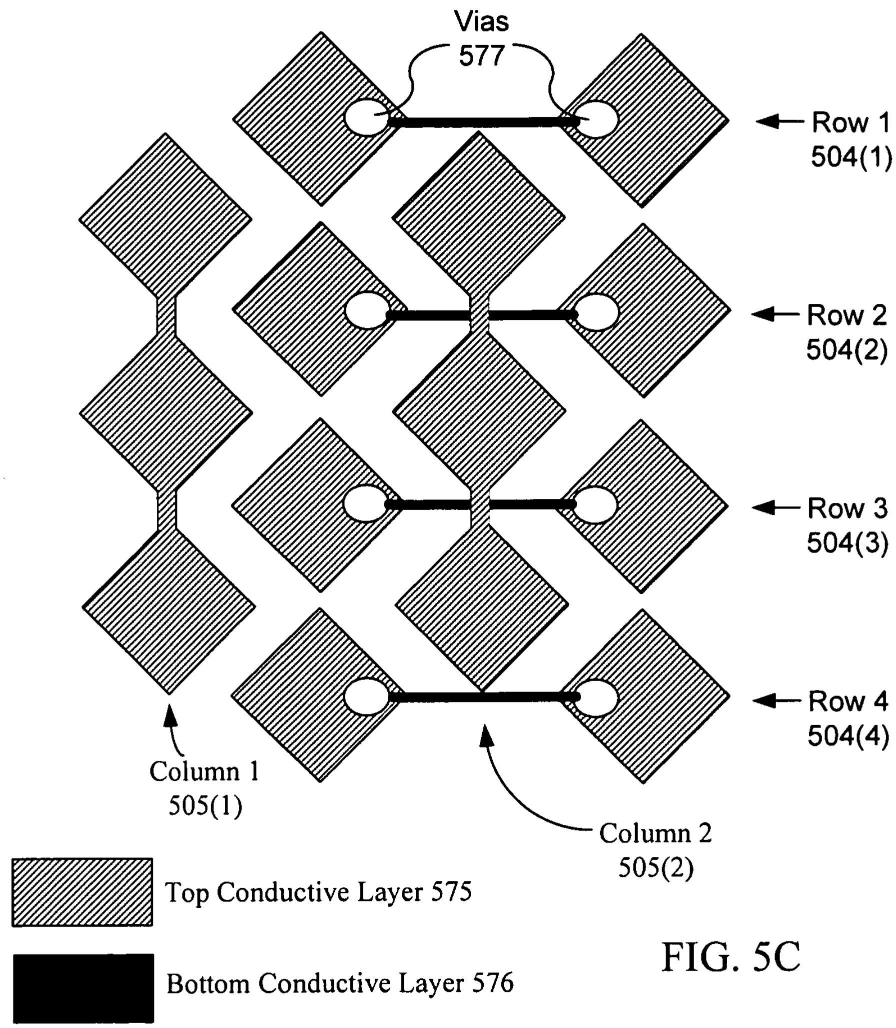


FIG. 5C

CROSS-SECTIONAL VIEW of 2-Layer Touch-Sensor Pad 220

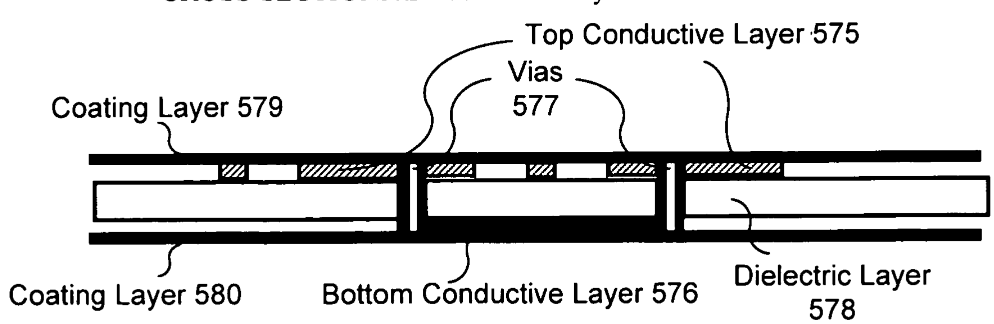


FIG. 5D

Replacement Sheet
Application No. 11/440,924

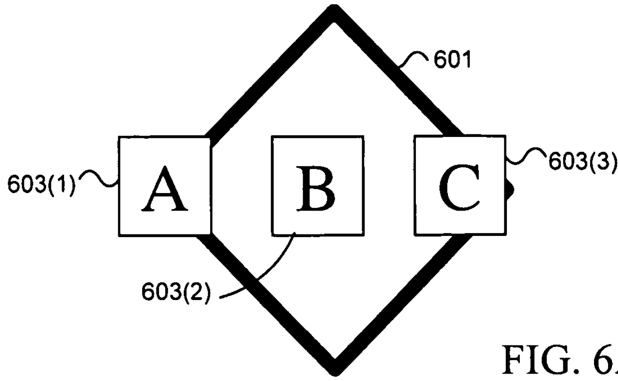


FIG. 6A

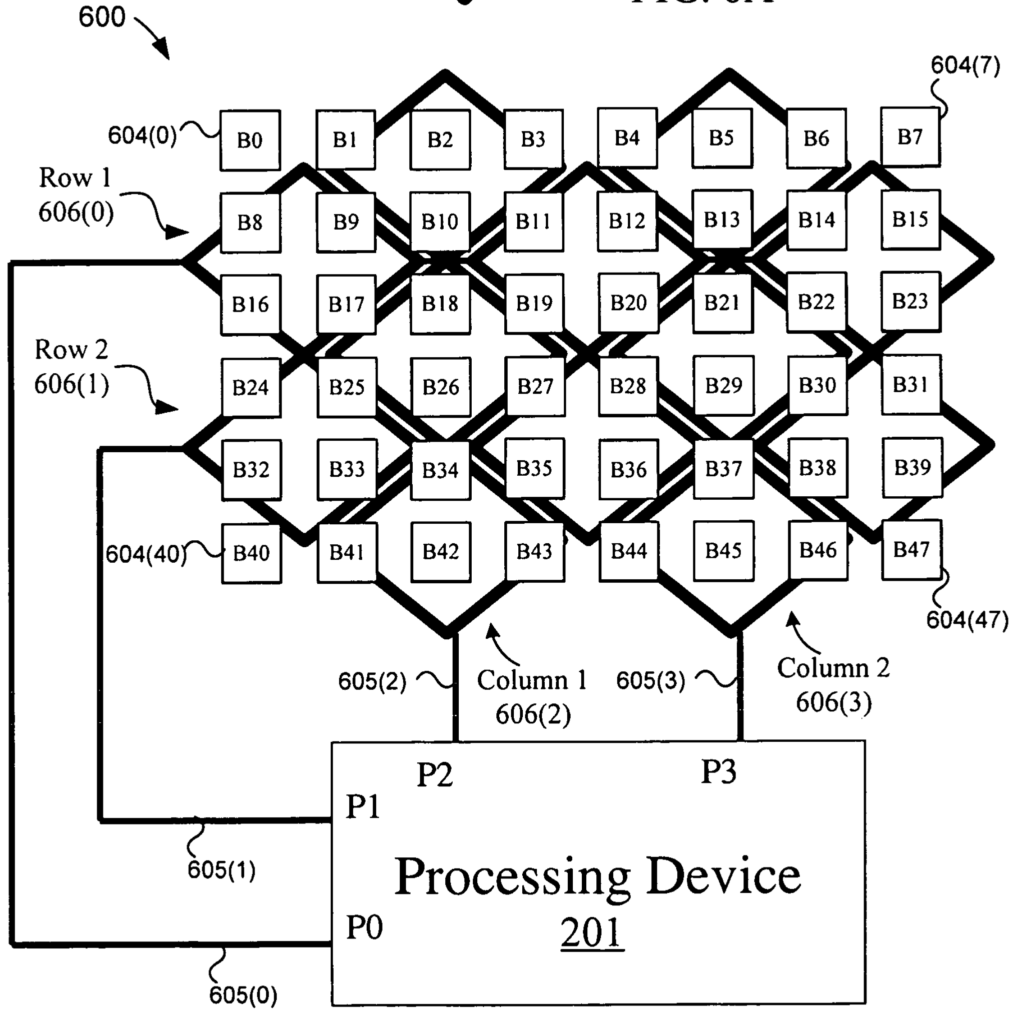


FIG. 6B

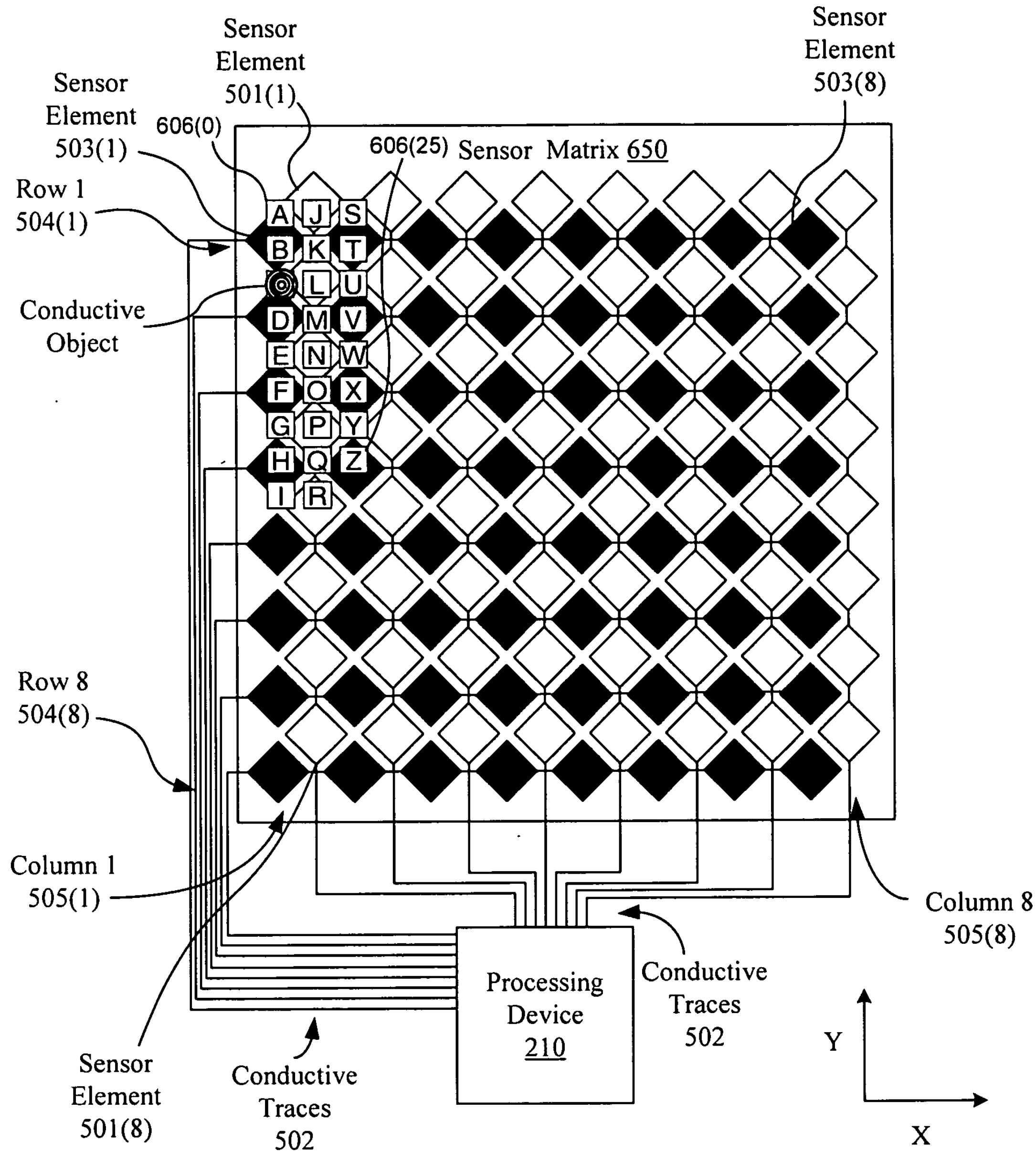

Sensor Element 503(1)
Sensor Element 501(1)
Sensor Element 503(8)
606(0)
606(25)
Sensor Matrix 650
Row 1 504(1)
A
J
S
B
K
T
L
U
D
M
V
E
N
W
F
O
X
G
P
Y
H
Q
Z
I
R
Conductive Object
Row 8 504(8)
Column 1 505(1)
Column 8 505(8)
Conductive Traces 502
Processing Device 210
Sensor Element 501(8)
Conductive Traces 502
Y
X

FIG. 6C

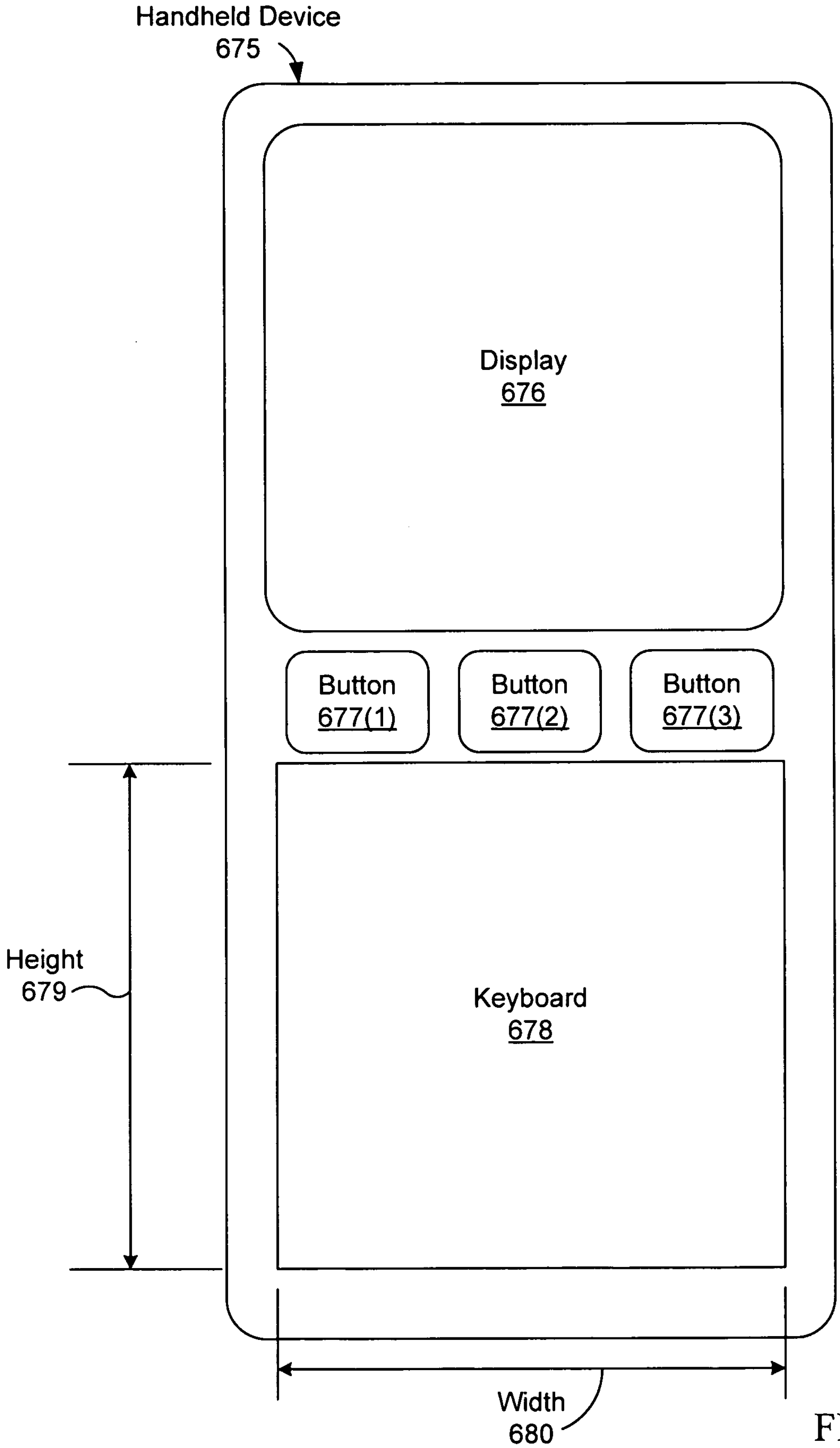

Handheld Device
675
Display
676
Button
677(1)
Button
677(2)
Button
677(3)
Keyboard
678
Height
679
Width
680

FIG. 6D

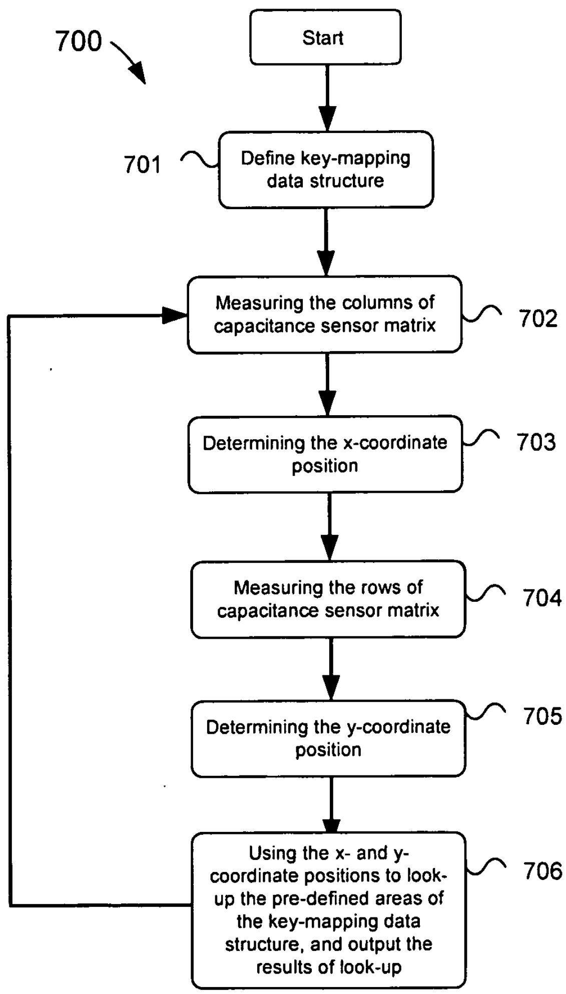

700
Start
701
Define key-mapping data structure
Measuring the columns of capacitance sensor matrix
702
Determining the x-coordinate position
703
Measuring the rows of capacitance sensor matrix
704
Determining the y-coordinate position
705
Using the x- and y-coordinate positions to look-up the pre-defined areas of the key-mapping data structure, and output the results of look-up
706

FIG. 7

Position 804

Key 801 | X-Coordinate 802 | Y-Coordinate 803

P (17 08)	F (13 08)	E (11 08)	E (0E 08)	D (0D 07)
D (0C 08)	D (09 08)	C (08 07)	C (08 07)	C (05 06)
B (04 06)	B (03 06)	B (02 06)	B (02 06)	B (02 06)
B (02 06)	B (02 06)	B (01 06)	B (01 06)	B (01 06)
B (00 06)	A (00 08)	A (00 08)	A (01 0A)	K (01 0A)
K (02 0A)	K (03 0D)	K (03 0C)	K (03 0D)	K (03 0D)
K (06 0E)	L (08 0E)	L (0A 0F)	L (0D 10)	M (0F 0F)
M (12 10)	N (13 12)	N (17 13)	O (18 13)	O (1A 14)
Y (1C 13)	P (1E 11)	P (1F 11)	Q (21 10)	Q (21 11)
Q (21 11)	Q (22 10)	Q (23 0F)	Q (23 0E)	Q (25 0E)
R (26 0D)	R (26 0D)	R (26 0D)	R (24 0E)	R (21 10)
Q (1F 11)	Q (1C 12)	P (17 13)	O (14 14)	W (12 15)
W (0D 14)	V (0C 14)	V (0B 15)	V (08 14)	U (04 13)
K (02 10)	K (02 0E)	K (01 0E)	K (02 0D)	K (02 0D)
K (04 0B)	K (08 0B)	L (0A 0B)	L (0D 0B)	M (10 0B)
N (12 0B)	N (13 0B)	N (14 0B)	N (15 0B)	O (16 0B)
O (17 09)	F (1C 08)	G (20 08)	H (25 08)	I (2B 05)
J (2D 03)	J (2C 03)	J (26 04)	I (1C 05)	G (16 05)
F (12 05)	E (0D 05)	D (08 05)	C (03 05)	B (01 05)
B (00 05)	A (02 06)	B (02 08)	B (03 09)	B (08 09)
C (0D 0A)	M (15 09)	F (1A 0C)	P (1C 0C)	P (21 0B)
Q (23 0A)	Q (26 08)	I (27 07)	I (2A 05)	J (2B 05)
J (2D 03)	J (2D 00)	J (26 03)	I (17 07)	F (0D 0B)
M (09 0D)	L (08 0C)	L (05 0B)		

FIG. 8

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APPLICATION NUMBER	FILING OR 371 (c) DATE	FIRST NAMED APPLICANT	ATTORNEY DOCKET NUMBER
11/440,924	05/25/2006	Liu Hua	16820P442

CONFIRMATION NO. 9376

FORMALITIES LETTER

08791
BLAKELY SOKOLOFF TAYLOR & ZAFMAN
12400 WILSHIRE BOULEVARD
SEVENTH FLOOR
LOS ANGELES, CA 90025-1030

Date Mailed: 06/19/2006

NOTICE TO FILE CORRECTED APPLICATION PAPERS

Filing Date Granted

An application number and filing date have been accorded to this application. The application is informal since it does not comply with the regulations for the reason(s) indicated below. Applicant is given TWO MONTHS from the date of this Notice within which to correct the informalities indicated below. Extensions of time may be obtained by filing a petition accompanied by the extension fee under the provisions of 37 CFR 1.136(a).

The required item(s) identified below must be timely submitted to avoid abandonment:

- Replacement drawings in compliance with 37 CFR 1.84 and 37 CFR 1.121(d) are required. The drawings submitted are not acceptable because:
  - More than one figure is present and each figure is not labeled "Fig." with a consecutive Arabic numeral (1, 2, etc.) or an Arabic numeral and capital letter in the English alphabet (A, B, etc.)(see 37 CFR 1.84(u)(1)). See Figure(s) 6D. A brief description of the several views of the drawings (see 37 CFR 1.74) should be added or amended to correspond to the corrected numbering of the figures. See also 37 CFR 1.77(b)(7).

Applicant is cautioned that correction of the above items may cause the specification and drawings page count to exceed 100 pages. If the specification and drawings exceed 100 pages, applicant will need to submit the required application size fee.

Replies should be mailed to: Mail Stop Missing Parts
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Office of Initial Patent Examination (571) 272-4000, or 1-800-PTO-9199, or 1-800-972-6382
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16562
052506
U.S. PTO

UTILITY PATENT APPLICATION TRANSMITTAL

(Only for new nonprovisional applications under 37 CFR 1.53(b))

Attorney Docket No.	16820P442
First Inventor	Liu Hua, et al.
Title	A LOW PIN COUNT SOLUTION USING CAPACITANCE SENSING MATRIX FOR KEYBOARD ARCHITECTURE
Express Mail Label No.	EV839870954US

113007 U.S. PTO
11/440924
052506

APPLICATION ELEMENTS

See MPEP chapter 600 concerning utility patent application contents

ADDRESS TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450

1. ☒ **Fee Transmittal Form** (e.g., PTO/SB/17) *(Submit an original and a duplicate for fee processing)*
2. ☐ **Applicant claims small entity status.** See 37 CFR 1.27.
3. ☒ **Specification** *[Total Pages 58]* Both the claims and abstract must start on a new page *(For information on the preferred arrangement, see MPEP 608.01(a))*
4. ☒ **Drawing(s)** *(35 U.S.C. 113)* *[Total Sheets 14]*
5. **Oath or Declaration** (signed) *[Total Pages 3]*
   a. ☒ Newly executed (original or copy)
   b. ☐ Copy from a prior application (37 CFR 1.63(d)) *(for continuation/divisional with Box 18 completed)*
      i. ☐ DELETION OF INVENTOR(S) Signed statement attached deleting inventor(s) named in the prior application, see 37 CFR 1.63(d)(2) and 1.33(b).
6. ☐ **Application Data Sheet.** See 37 CFR 1.76
7. ☐ **CD-ROM or CD-R** in duplicate, large table or Computer Program (*Appendix*)
8. **Nucleotide and/or Amino Acid Sequence Submission** *(if applicable, all necessary)*
   a. ☐ Computer Readable Form (CRF)
   b. Specification Sequence Listing on:
      i. ☐ CD-ROM or CD-R (2 copies); or
      ii. ☐ paper
   c. ☐ Statements verifying identity of above copies

ACCOMPANYING APPLICATION PARTS

9. ☒ **Assignment Papers** (cover sheet & document(s)) Name of Assignee Cypress Semiconductor Corporation
10. ☐ **37 CFR 3.73(b) Statement** *(when there is an assignee)* ☒ **Power of Attorney**
11. ☐ **English Translation Document** *(if applicable)*
12. ☒ **Information Disclosure Statement** (PTO/SB/08 or PTO-1449)
    ☒ Copies of citations attached
13. ☐ **Preliminary Amendment**
    ☐ Application Amended to Reflect Claim of Priority
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18. If a CONTINUING APPLICATION, *check appropriate box, and supply the requisite information below and in the first sentence of the specification following the title, or in an Application Data Sheet under 37 CFR 1.76:*

☐ Continuation ☐ Divisional ☐ Continuation-in-part (CIP) of prior application No: ______

Prior application Information: *Examiner* ______ *Group/Art Unit:* ______

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19. CORRESPONDENCE ADDRESS

☒ *Customer Number* **08791** *or* ☒ *Correspondence address below*

Name	Daniel E. Ovanezian				
	Blakely, Sokoloff, Taylor & Zafman LLP				
Address	12400 Wilshire Boulevard, 7th Floor				
City	Los Angeles	*State*	California	*Zip Code*	90025
Country	USA	*Telephone*	(408) 720-8300	*Fax*	(408) 720-8383

Name (Print/Type)	Daniel E. Ovanezian	*Registration No. (Attorney/Agent)*	41,236
Signature	[signature]	*Date*	5/24/06

Based on PTO/SB/05 (04-05) as modified by Blakely, Sokoloff, Taylor & Zafman (Mr) 11/30/2005.
SEND TO: Mail Stop Patent Application, Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450

Effective 12/08/2004
Fees pursuant to the Consolidated Appropriations Act, 2005 (H.R. 4818)

FEE TRANSMITTAL for FY 2005

☐ Applicant claims small entity status. See 37 CFR 1.27.

TOTAL AMOUNT OF PAYMENT	($)	1,340.00

Complete if Known	
Application Number	
Filing Date	
First Named Inventor	Liu Hua
Examiner Name	
Art Unit	
Attorney Docket No.	16820P442

METHOD OF PAYMENT *(check all that apply)*

☒ Check ☐ Credit card ☐ Money Order ☐ None ☐ Other (please identify): ________

☐ Deposit Account Deposit Account Number: 02-2666 Deposit Account Name: Blakely, Sokoloff, Taylor & Zafman LLP

For the above-identified deposit account, the Director is hereby authorized to: (check all that apply)

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FEE CALCULATION

1. BASIC FILING, SEARCH, AND EXAMINATION FEES

	FILING FEES		SEARCH FEES		EXAMINATION FEES		
		Small Entity		Small Entity		Small Entity	
Application Type	Fee ($)	Fee ($)	Fee ($)	Fee ($)	Fee ($)	Fee ($)	Fee(s) Paid ($)
Utility	300	150	500	250	200	100	1,000.00
Design	200	100	100	50	130	65	
Plant	200	100	300	150	160	80	
Reissue			500	250	600	300	
Provisional	200	100	0	0	0	0	

2. EXCESS CLAIM FEES

Fee Description	Fee ($)	Small Entity Fee ($)
Each claim over 20 (including Reissues)	50	25
Each independent claim over 3 (including Reissues)	200	100
Multiple independent claims	360	180

Total Claims **Extra Claims** **Fee ($)** **Fee Paid**

26 - 20 or HP = 6 X 50.00 = $300.00

HP = highest number of total claims paid for, if greater than 20

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Fee ($) **Fee Paid**
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3. APPLICATION SIZE FEE

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5. TOTAL AMOUNT OF PAYMENT ($) 1,340.00

SUBMITTED BY Complete (if applicable)

Name (Print/Type)	Daniel E. Ovanezian	Registration No. (Attorney/Agent)	41,236	Telephone	(408) 720-8300
Signature	[signature]			Date	5/24/06

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16562
052506
U.S. PTO

UTILITY PATENT APPLICATION TRANSMITTAL

(Only for new nonprovisional applications under 37 CFR 1.53(b))

Attorney Docket No.	16820P442
First Inventor	Liu Hua, et al.
Title	A LOW PIN COUNT SOLUTION USING CAPACITANCE SENSING MATRIX FOR KEYBOARD ARCHITECTURE
Express Mail Label No.	EV839870954US

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Prior application Information: Examiner ______ *Group/Art Unit:* ______

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Complete if Known	
Application Number	
Filing Date	
First Named Inventor	Liu Hua
Examiner Name	
Art Unit	
Attorney Docket No.	16820P442

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☒ Check ☐ Credit card ☐ Money Order ☐ None ☐ Other (please identify): ________

☐ Deposit Account Deposit Account Number: 02-2666 Deposit Account Name: Blakely, Sokoloff, Taylor & Zafman LLP

For the above-identified deposit account, the Director is hereby authorized to: (check all that apply)

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FEE CALCULATION

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		Small Entity		Small Entity		Small Entity	
Application Type	Fee ($)	Fee ($)	Fee ($)	Fee ($)	Fee ($)	Fee ($)	Fee(s) Paid ($)
Utility	300	150	500	250	200	100	1,000.00
Design	200	100	100	50	130	65	
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Reissue			500	250	600	300	
Provisional	200	100	0	0	0	0	

2. EXCESS CLAIM FEES

Fee Description	Fee ($)	Small Entity Fee ($)
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Each independent claim over 3 (including Reissues)	200	100
Multiple independent claims	360	180

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Signature	[signature]			Date	5/24/06

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SEND TO: Mail Stop Patent Application, Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450

UNITED STATES PATENT APPLICATION

For

A LOW PIN COUNT SOLUTION USING CAPACITANCE SENSING MATRIX FOR KEYBOARD ARCHITECTURE

Inventor(s):

Liu Hua
Jiang XiaoPing

BSTZ Docket No.: 16820P442
Cypress Reference No.: CD06015

Prepared By:
Blakely Sokoloff Taylor & Zafman LLP
12400 Wilshire Boulevard, Seventh Floor
Los Angeles, CA 90025-1030
(408) 720-8300

EV839870954US
("Express Mail" mailing label number)

May 24, 2006
(Date of Deposit)

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A LOW PIN COUNT SOLUTION USING CAPACITANCE SENSING MATRIX FOR KEYBOARD ARCHITECTURE

TECHNICAL FIELD

[0001] This invention relates to the field of user interface devices and, in particular, to touch-sensing devices.

BACKGROUND

[0002] Computing devices, such as notebook computers, personal data assistants (PDAs), and mobile handsets, have user interface devices, which are also known as human interface device (HID). One such user interface device is a keyboard. Keyboards include a set of input keys for the computing device. The input keys may be standard typewriter keys, such as the alphabetic letters and numbers. The input keys may also include several specialized keys, such as Enter, Control, Alt, Delete, Escape, Cursor keys, and the like.

[0003] Figure 1A illustrates a resistance matrix of a conventional keyboard. Conventional keyboard 100 includes a keyboard architecture using a resistance matrix. The resistance matrix includes multiple rows (X_0-X_2) 101(0)-101(2), and multiple columns (Y_0-Y_2) 102(0)-102(2). All the rows 101(0)-101(2) are each connected to a pull-up resistor (e.g., 103(0)-103(2)), and all the columns 102(0)-102(2) are each connected to a pull-down transistor (e.g., 104(0)-104(2)), such as an N-Channel MOSFET (NMOS). Above the resistance matrix there are multiple buttons 105(0)-105(8) (e.g., keyboard keys). Upon pressing a button, the corresponding row and column (X, Y) will be shorted together. For example, the row X will read "0," otherwise the row X is "1."

[0004] One example of the resistance matrix for a PC is a PS/2 keyboard. The PS/2 keyboard typically has between 101 and 104 keys that are uniquely positioned in a resistance scan matrix. The scan matrix consists of M rows and N columns, all of which are electrically isolated from each other. On average, the number of rows (M) is no greater than 8, and the number of columns (N) is no greater than 20. Each key sits over two isolated contacts of its corresponding row and column in the scan matrix. When a keyboard key 108 is pressed, the two contacts 106 and 107 are shorted together, and the row and column of the keyboard key 108 are electrically connected, as illustrated in Figure 1B.

[0005] The PS/2 keyboard may include an embedded controller that performs a variety of tasks, all of which help to cut down on the overall system overhead. The PS/2 controller may monitor the keys and report to the main computer whenever a keyboard key is pressed or released. Figure 1C illustrates scan results for no keyboard keys pressed on a conventional resistance scan matrix. The controller writes a scan pattern 109 out to the column lines consisting of all 1s and one 0 which is shifted through each column. In Figure 1C no keyboard keys are pressed, resulting in all 1s in the scan results 110 being read at the row lines. Figure 1D illustrates scan results for a keyboard key 111 pressed on a conventional resistance scan matrix. The controller writes a scan pattern 112 out to the column lines consisting of all 1s and one 0 which is shifted through each column. The scan results 113 are then read at the row lines. If a 0 is propagated to a row line, then the key 111 at the intersection of that column and row has been pressed.

[0006] The conventional resistance scan matrix designs described have large pin counts because every row and every column is connected to a pin. The pin count for these conventional resistance matrix keyboards is the sum of the number of rows and the number of columns. For example, the PC keyboard needs at least 21 pins to build a resistance scan matrix. Having a large pin count, may increase the die area of the circuit, or alternatively, or may decrease the robustness of the circuit by decreasing the possibility of additional functionality in the same circuit with limited pins. Also, the resistance scan matrix keyboards cannot be built in very small areas because it is limited by the pull-up resistor and mechanical button for each keyboard key. For example, the mechanical button of each keyboard key may have an area of about 0.5 centimeters (cm) x 0.5 cm, the total keyboard area will be at least 25.25 cm^2 for a keyboard having 101 keyboard keys (e.g., 101 x 0.5 cm x 0.5 cm = 25.25 cm^2).

[0007] Another conventional keyboard may include a virtual keyboard. Virtual keyboards are a representation of a keyboard displayed on a touch screen. Tapping the "virtual keys" with a stylus or finger is the same as pressing a real key on a keyboard. For example, a PDA may supply keyboard functionality by providing a keyboard displayed on the touch screen of the PDA, instead of including the mechanical keyboard keys on the assembly of the PDA. This design, however, may take up too much precious real estate on the display.

[0008] Another example of a conventional virtual keyboard is a representation of a keyboard projected onto a flat surface such as a desktop. Using fingers as with a normal keyboard, an optical or electronic beam is used to pick up the tapping of the keyboard keys of the projected image. Such a device enables PDAs and other small handhelds to create a full-size keyboard. One example of this type of virtual keyboards is a virtual laser keyboard (VKB). The VKB works by using both infrared and laser technology to produce an invisible circuit and project a full-size virtual QWERTY keyboard on to any surface. The virtual PC keyboard behaves exactly like a real one: direction technology based on optical recognition enables the user to tap the images of the keys, which feeds into the compatible PDA, Smartphone, laptop or PC. QWERTY refers to a standard English-language typewriter keyboard (sometimes called the Sholes keyboard after its inventor), as opposed to Dvorak, foreign-language layouts (e.g. "keyboard AZERTY" in French-speaking countries), a space-cadet, or APL keyboards.

BRIEF DESCRIPTION OF THE DRAWINGS

[0009] The present invention is illustrated by way of example, and not by way of limitation, in the figures of the accompanying drawings.

[0010] Figure 1A illustrates a resistance matrix of a conventional keyboard.

[0011] Figure 1B illustrates a keyboard key and two electrical contacts of the conventional resistance matrix of Figure 1A.

[0012] Figure 1C illustrates scan results for no keyboard keys pressed on a conventional resistance scan matrix.

[0013] Figure 1D illustrates scan results for a keyboard key pressed on a conventional resistance scan matrix.

[0014] Figure 2 illustrates a block diagram of one embodiment of an electronic system having a processing device for detecting a presence of a conductive object.

[0015] Figure 3A illustrates a varying switch capacitance.

[0016] Figure 3B illustrates one embodiment of a sensing device coupled to a processing device.

[0017] Figure 3C illustrates one embodiment of a relaxation oscillator.

[0018] Figure 4 illustrates a block diagram of one embodiment of a capacitance sensor including a relaxation oscillator and digital counter.

[0019] Figure 5A illustrates a top-side view of one embodiment of a sensor array having a plurality of sensor elements for detecting a presence of a conductive object on the sensor array of a touch-sensor pad.

[0020] Figure 5B illustrates a top-side view of one embodiment of a sensor array having a plurality of sensor elements for detecting a presence of a conductive object on the sensor array of a touch-sensor slider.

[0021] Figure 5C illustrates a top-side view of one embodiment of a two-layer touch-sensor pad.

[0022] Figure 5D illustrates a side view of one embodiment of the two-layer touch-sensor pad of Figure 5C.

[0023] Figure 6A illustrates one embodiment of a single sensor element of a sensing device that has three keyboard keys assigned to pre-defined areas of the sensing device.

[0024] Figure 6B illustrates one embodiment of a processing device coupled to a sensing device that has a capacitance sensor matrix and multiple keyboard keys assigned to pre-defined areas of the sensing device.

[0025] Figure 6C illustrates one embodiment of a processing device coupled to a sensing device that has a capacitance sensor matrix and keyboard keys A-Z assigned to pre-defined areas of the sensing device.

[0026] Figure 6D illustrates one embodiment of a handheld device having a keyboard.

[0027] Figure 7 illustrates a flowchart of one embodiment of a method for detecting a position of a pressed key on a sensing device.

[0028] Figure 8 illustrates a table of one exemplary embodiment of output positions of multiple keyboard keys.

DETAILED DESCRIPTION

[0029] Described herein is an apparatus and method for selecting a keyboard key based on a position of a presence of a conductive object on a sensing device and a pre-defined area of the keyboard key. The following description sets forth numerous specific details such as examples of specific systems, components, methods, and so forth, in order to provide a good understanding of several embodiments of the present invention. It will be apparent to one skilled in the art, however, that at least some embodiments of the present invention may be practiced without these specific details. In other instances, well-known components or methods are not described in detail or are presented in simple block diagram format in order to avoid unnecessarily obscuring the present invention. Thus, the specific details set forth are merely exemplary. Particular implementations may vary from these exemplary details and still be contemplated to be within the spirit and scope of the present invention.

[0030] Embodiments described herein use a capacitance sensor matrix in a keyboard architecture to lower a pin count between a sensing device, which includes the capacitance sensor matrix, and a processing device. This keyboard architecture may be implemented in a smaller area on a device, than the conventional architectures, such as the conventional scan matrix described above.

[0031] As described in more detail below, the sensing device has a capacitance sensor matrix, which includes multiple sensor elements that are configured in rows and columns. The keyboard keys of a keyboard can be assigned a pre-determined area on the sensor matrix. The sensor matrix is used to detect a presence of a conductive object, such as a finger or a stylus. Each keyboard key, being assigned a different pre-determined area on the sensor matrix, will provide a different capacitance variation from the sensor matrix to the processing device, as the conductive object is detected. The capacitance variation can be measured on the multiple capacitance sensing pins that are used to couple the sensing device to the processing device. The capacitance variation measured on the capacitance sensing pins can be used by the processing device to determine the x- and y-coordinate (e.g., X/Y location) of the detected presence of the conductive object on the sensing device. For example, 48 buttons are assigned into different pre-determined areas of a sensor matrix, having two rows and two columns, as illustrated in Figure 6B below. The two rows and two columns are coupled to the processing device using four capacitance sensing pins. The capacitance variation measured on the four pins can be used to determine the position of the conductive object.

[0032] As described in more detail below multiple keyboard keys can be assigned to pre-determined areas on a single sensor element. The capacitance variation measured on the capacitance sensing pins can be used to distinguish which keyboard key has been pressed. For example, a first keyboard key, keyboard key A, is assigned between 1 and 3 in the x-direction, and between 5 and 7 in the y-direction (e.g., {1<X<3 & 5<Y<7}). A second keyboard key, keyboard key B, is assigned between 5 and 7 in the x-direction and between 5 and 7 in the y-direction (e.g., {5<X<7 & 5<Y<7}). If the A or B keyboard key has been pressed, the X/Y location should be within the areas of A or B, respectively.

[0033] Using the capacitance sensor matrix, the measurements on the capacitance sensor matrix (e.g., capacitance variation) may include additional information than just "connect" or "disconnect," instead of only including "connect" or "disconnect" information in a conventional resistance matrix. The additional information is the location of the detected conductive object. The pressed key is outputted after comparing the located X/Y position of the conductive object and the pre-defined areas of the capacitance sensor matrix.

[0034] By assigning the different keys into different areas of the matrix and using the capacitance sensor matrix, the keyboard keys can be assigned to smaller areas than keys of a resistance matrix. This allows a keyboard (e.g., full personal computer (PC) keyboard, having 101 keys or more) to be implemented in smaller areas than the conventional keyboards that use resistance matrices. For example, a full keyboard having 101 keyboard keys, for example, can be implemented on a mobile handset. Instead of sacrificing real estate on a touch-screen display to implement the keyboard functions, the full keyboard can be mounted on the mobile handset as an additional user input device. This allows no sacrifice to the real estate of the touch-screen display, and avoids increased costs of providing the additional keyboard functionality to the device that operates the touch-screen display.

[0035] By decreasing the pin count of the keyboard, using the capacitance sensor matrix, the costs to manufacture the device also decrease. For example, the die cost is less than a device that requires more pins to implement the same number of keyboard keys. Similarly, by decreasing the pin count of the keyboard, the processing device may be used to further support other devices, such as additional user input devices (e.g., mouse, touch-sensor pad, touch-sensor sliders, touch-sensor buttons, touch-screen displays, and the like).

[0036] For example, in a PC interface, the keyboard and cursor positioning device (e.g., mouse or touch-sensor pad) are the most commonly used user input devices.

Because the conventional solution for keyboards require at least 21 general purpose input-output (GPIO) pins, and the cursor positioning requires about 12 GPIO pins, companies design two separate integrated circuits to control both user input devices (e.g., one higher pin count chip for the keyboard, and one lower pin count chip for the cursor positioning device. However, using the capacitance sensor matrix described herein, a keyboard and a cursor positioning device may be controlled or supported by a single chip (e.g., processing device) because the pin count for the keyboard has been reduced using the capacitance sensor matrix and capacitance sensing pins. Having a single chip reduces mask and die costs for the design.

[0037] Figure 2 illustrates a block diagram of one embodiment of an electronic system having a processing device for detecting a presence of a conductive object. Electronic system 200 includes processing device 210, touch-sensor pad 220, touch-sensor slider 230, touch-sensor buttons 240, host processor 250, embedded controller 260, and non-capacitance sensor elements 270. The processing device 210 may include analog and/or digital general purpose input/output ("GPIO") ports 207. GPIO ports 207 may be programmable. GPIO ports 207 may be coupled to a Programmable Interconnect and Logic ("PIL"), which acts as an interconnect between GPIO ports 207 and a digital block array of the processing device 210 (not illustrated). The digital block array may be configured to implement a variety of digital logic circuits (e.g., DAC, digital filters, digital control systems, etc.) using, in one embodiment, configurable user modules ("UMs"). The digital block array may be coupled to a system bus. Processing device 210 may also include memory, such as random access memory (RAM) 205 and program flash 204. RAM 205 may be static RAM (SRAM), and program flash 204 may be a nonvolatile storage, which may be used to store firmware (e.g., control algorithms executable by processing core 202 to implement operations described herein). Processing device 210 may also include a memory controller unit (MCU) 203 coupled to memory and the processing core 202.

[0038] The processing device 210 may also include an analog block array (not illustrated). The analog block array is also coupled to the system bus. Analog block array also may be configured to implement a variety of analog circuits (e.g., ADC, analog filters, etc.) using, in one embodiment, configurable UMs. The analog block array may also be coupled to the GPIO 207.

[0039] As illustrated, capacitance sensor 201 may be integrated into processing device 210. Capacitance sensor 201 may include analog I/O for coupling to an external component, such as touch-sensor pad 220, touch-sensor slider 230, touch-sensor buttons 240, and/or other devices. Capacitance sensor 201 and processing device 202 are described in more detail below.

[0040] It should be noted that the embodiments described herein are not limited to touch-sensor pads for notebook implementations, but can be used in other capacitive sensing implementations, for example, the sensing device may be a touch-sensor slider 230, or a touch-sensor button 240 (e.g., capacitance sensing button). Similarly, the operations described herein are not limited to notebook cursor operations, but can include other operations, such as lighting control (dimmer), volume control, graphic equalizer control, speed control, or other control operations requiring gradual adjustments. It should also be noted that these embodiments of capacitive sensing implementations may be used in conjunction with non-capacitive sensing elements, including but not limited to pick buttons, sliders (ex. display brightness and contrast), scroll-wheels, multi-media control (ex. volume, track advance, etc) handwriting recognition and numeric keypad operation.

[0041] In one embodiment, the electronic system 200 includes a touch-sensor pad 220 coupled to the processing device 210 via bus 221. Touch-sensor pad 220 may include a multi-dimension sensor array. The multi-dimension sensor array comprises a plurality of sensor elements, organized as rows and columns. In another embodiment, the electronic system 200 includes a touch-sensor slider 230 coupled to the processing device 210 via bus 231. Touch-sensor slider 230 may include a single-dimension sensor array. The single-dimension sensor array comprises a plurality of sensor elements, organized as rows, or alternatively, as columns. In another embodiment, the electronic system 200 includes a touch-sensor button 240 coupled to the processing device 210 via bus 241. Touch-sensor button 240 may include a single-dimension or multi-dimension sensor array. The single- or multi-dimension sensor array comprises a plurality of sensor elements. For a touch-sensor button, the plurality of sensor elements may be coupled together to detect a presence of a conductive object over the entire surface of the sensing device. Alternatively, the touch-sensor button 240 has a single sensor element to detect the presence of the conductive object. In one embodiment, the touch-sensor button 240 may be a capacitance sensor element. Capacitance sensor elements may be used as non-contact switches. These switches, when protected by an insulating layer, offer resistance to severe environments.

[0042] The electronic system 200 may include any combination of one or more of the touch-sensor pad 220, touch-sensor slider 230, and/or touch-sensor button 240. In another embodiment, the electronic system 200 may also include non-capacitance sensor elements 270 coupled to the processing device 210 via bus 271. The non-capacitance sensor elements 270 may include buttons, light emitting diodes (LEDs), and other user interface devices, such as a mouse, a keyboard, or other functional keys that do not require capacitance sensing. In one embodiment, buses 271, 241, 231, and 221 may be a single bus. Alternatively, these buses may be configured into any combination of one or more separate buses.

[0043] The processing device may also provide value-added functionality such as keyboard control integration, LEDs, battery charger, and general purpose I/O, as illustrated as non-capacitance sensor elements 270. Non-capacitance sensor elements 270 are coupled to the GPIO 207.

[0044] Processing device 210 may include internal oscillator/clocks 206 and communication block 208. The oscillator/clocks block 206 provides clock signals to one or more of the components of processing device 210. Communication block 208 may be used to communicate with an external component, such as a host processor 250, via host interface (I/F) line 251. Alternatively, processing block 210 may also be coupled to embedded controller 260 to communicate with the external components, such as host 250. Interfacing to the host 250 can be through various methods. In one exemplary embodiment, interfacing with the host 250 may be done using a standard PS/2 interface to connect to an embedded controller 260, which in turn sends data to the host 250 via low pin count (LPC) interface. In some instances, it may be beneficial for the processing device 210 to do both touch-sensor pad and keyboard control operations, thereby freeing up the embedded controller 260 for other housekeeping functions. In another exemplary embodiment, interfacing may be done using a universal serial bus (USB) interface directly coupled to the host 250 via host interface line 251. Alternatively, the processing device 210 may communicate to external components, such as the host 250 using industry standard interfaces, such as USB, PS/2, inter-integrated circuit (I2C) bus, or system packet interfaces (SPI). The host 250 and/or embedded controller 260 may be coupled to the processing device 210 with a ribbon or flex cable from an assembly, which houses the sensing device and processing device.

[0045] In one embodiment, the processing device 210 is configured to communicate with the embedded controller 260 or the host 250 to send and/or receive data. The data may be a command or alternatively a signal. In an exemplary embodiment, the electronic system 200 may operate in both standard-mouse compatible and enhanced modes. The standard-mouse compatible mode utilizes the HID class drivers already built into the Operating System (OS) software of host 250. These drivers enable the processing device 210 and sensing device to operate as a standard cursor control user interface device, such as a two-button PS/2 mouse. The enhanced mode may enable additional features such as scrolling (reporting absolute position) or disabling the sensing device, such as when a mouse is plugged into the notebook. Alternatively, the processing device 210 may be configured to communicate with the embedded controller 260 or the host 250, using non-OS drivers, such as dedicated touch-sensor pad drivers, or other drivers known by those of ordinary skill in the art.

[0046] In other words, the processing device 210 may operate to communicate data (e.g., commands or signals) using hardware, software, and/or firmware, and the data may be communicated directly to the processing device of the host 250, such as a host processor, or alternatively, may be communicated to the host 250 via drivers of the host 250, such as OS drivers, or other non-OS drivers. It should also be noted that the host 250 may directly communicate with the processing device 210 via host interface 251.

[0047] In one embodiment, the data sent to the host 250 from the processing device 210 includes click, double-click, movement of the cursor, scroll-up, scroll-down, scroll-left, scroll-right, step Back, and step Forward. Alternatively, other user interface device commands may be communicated to the host 250 from the processing device 210. These commands may be based on gestures occurring on the sensing device that are recognized by the processing device, such as tap, push, hop, and zigzag gestures. Alternatively, other commands may be recognized. Similarly, signals may be sent that indicate the recognition of these operations.

[0048] In particular, a tap gesture, for example, may be when the finger (e.g., conductive object) is on the sensing device for less than a threshold time. If the time the finger is placed on the touchpad is greater than the threshold time it may be considered to be a movement of the cursor, in the x- or y-axes. Scroll-up, scroll-down, scroll-left, and scroll-right, step back, and step-forward may be detected when the absolute position of the conductive object is within a pre-defined area, and movement of the conductive object is detected.

[0049] Processing device 210 may reside on a common carrier substrate such as, for example, an integrated circuit (IC) die substrate, a multi-chip module substrate, or the like. Alternatively, the components of processing device 210 may be one or more separate integrated circuits and/or discrete components. In one exemplary embodiment, processing device 210 may be a Programmable System on a Chip (PSoC™) processing device, manufactured by Cypress Semiconductor Corporation, San Jose, California. Alternatively, processing device 210 may be one or more other processing devices known by those of ordinary skill in the art, such as a microprocessor or central processing unit, a controller, special-purpose processor, digital signal processor (DSP), an application specific integrated circuit (ASIC), a field programmable gate array (FPGA), or the like. In an alternative embodiment, for example, the processing device may be a network processor having multiple processors including a core unit and multiple microengines. Additionally, the processing device may include any combination of general-purpose processing device(s) and special-purpose processing device(s).

[0050] Capacitance sensor 201 may be integrated into the IC of the processing device 210, or alternatively, in a separate IC. Alternatively, descriptions of capacitance sensor 201 may be generated and compiled for incorporation into other integrated circuits. For example, behavioral level code describing capacitance sensor 201, or portions thereof, may be generated using a hardware descriptive language, such as VHDL or Verilog, and stored to a machine-accessible medium (e.g., CD-ROM, hard disk, floppy disk, etc.). Furthermore, the behavioral level code can be compiled into register transfer level ("RTL") code, a netlist, or even a circuit layout and stored to a machine-accessible medium. The behavioral level code, the RTL code, the netlist, and the circuit layout all represent various levels of abstraction to describe capacitance sensor 201.

[0051] It should be noted that the components of electronic system 200 may include all the components described above. Alternatively, electronic system 200 may include only some of the components described above.

[0052] In one embodiment, electronic system 200 may be used in a notebook computer. Alternatively, the electronic device may be used in other applications, such as a mobile handset, a personal data assistant (PDA), a keyboard, a television, a remote control, a monitor, a handheld multi-media device, a handheld video player, a handheld gaming device, or a control panel.

[0053] In one embodiment, capacitance sensor 201 may be a capacitive switch relaxation oscillator (CSR). The CSR may have an array of capacitive touch switches using a current-programmable relaxation oscillator, an analog multiplexer, digital counting functions, and high-level software routines to compensate for environmental and physical switch variations. The switch array may include combinations of independent switches, sliding switches (e.g., touch-sensor slider), and touch-sensor pads implemented as a pair of orthogonal sliding switches. The CSR may include physical, electrical, and software components. The physical component may include the physical switch itself, typically a pattern constructed on a printed circuit board (PCB) with an insulating cover, a flexible membrane, or a transparent overlay. The electrical component may include an oscillator or other means to convert a changed capacitance into a measured signal. The electrical component may also include a counter or timer to measure the oscillator output. The software component may include detection and compensation software algorithms to convert the count value into a switch detection decision. For example, in the case of slide switches or X-Y touch-sensor pads, a calculation for finding position of the conductive object to greater resolution than the physical pitch of the switches may be used.

[0054] It should be noted that there are various known methods for measuring capacitance. Although the embodiments described herein are described using a relaxation oscillator, the present embodiments are not limited to using relaxation oscillators, but may include other methods, such as current versus voltage phase shift measurement, resistor-capacitor charge timing, capacitive bridge divider, charge transfer, or the like.

[0055] The current versus voltage phase shift measurement may include driving the capacitance through a fixed-value resistor to yield voltage and current waveforms that are out of phase by a predictable amount. The drive frequency can be adjusted to keep the phase measurement in a readily measured range. The resistor-capacitor charge timing may include charging the capacitor through a fixed resistor and measuring timing on the voltage ramp. Small capacitor values may require very large resistors for reasonable timing. The capacitive bridge divider may include driving the capacitor under test through a fixed reference capacitor. The reference capacitor and the capacitor under test form a voltage divider. The voltage signal is recovered with a synchronous demodulator, which may be done in the processing device 210. The charge transfer may be conceptually similar to an R-C charging circuit. In this method, C_P is the capacitance being sensed. C_{SUM} is the summing capacitor, into which charge is transferred on successive cycles. At the start of the measurement cycle, the voltage on C_{SUM} is reset. The voltage on C_{SUM} increases exponentially (and only slightly) with each clock cycle. The time for this voltage to reach a specific threshold is measured with a counter. Additional details regarding these alternative embodiments have not been included so as to not obscure the present embodiments, and because these alternative embodiments for measuring capacitance are known by those of ordinary skill in the art.

[0056] Figure 3A illustrates a varying switch capacitance. In its basic form, a capacitive switch 300 is a pair of adjacent plates 301 and 302. There is a small edge-to-edge capacitance Cp, but the intent of switch layout is to minimize the base capacitance Cp between these plates. When a conductive object 303 (e.g., finger) is placed in proximity to the two plate 301 and 302, there is a capacitance 2*Cf between one electrode 301 and the conductive object 303 and a similar capacitance 2*Cf between the conductive object 303 and the other electrode 302. The capacitance between one electrode 301 and the conductive object 303 and back to the other electrode 302 adds in parallel to the base capacitance Cp between the plates 301 and 302, resulting in a change of capacitance Cf. Capacitive switch 300 may be used in a capacitance switch array. The capacitance switch array is a set of capacitors where one side of each is grounded. Thus, the active capacitor (as represented in Figure 3C as capacitor 351) has only one accessible side. The presence of the conductive object 303 increases the capacitance (Cp + Cf) of the switch 300 to ground. Determining switch activation is then a matter of measuring change in the capacitance (Cf) or capacitance variation. Switch 300 is also known as a grounded variable capacitor. In one exemplary embodiment, Cf may range from approximately 10-30 picofarads (pF). Alternatively, other ranges may be used.

[0057] The conductive object in this case is a finger, alternatively, this technique may be applied to any conductive object, for example, a conductive door switch, position sensor, or conductive pen in a stylus tracking system (e.g., stylus).

[0058] Figure 3B illustrates one embodiment of a capacitive switch 307 coupled to a processing device 210. Capacitive switch 307 illustrates the capacitance as seen by the processing device 210 on the capacitance sensing pin 306. As previously described, when a conductive object 303 (e.g., finger) is placed in proximity to one of the metal plates 305, there is a capacitance, Cf, between the metal plate and the conductive object

303 with respect to ground. Also, there is a capacitance, Cp, between the two metal plates. Accordingly, the processing device 210 can measure the change in capacitance, capacitance variation Cf, as the conductive object is in proximity to the metal plate 305. Above and below the metal plate that is closest to the conductive object 303 is dielectric material 304. The dielectric material 304 above the metal plate 305 can be the overlay, as described in more detail below. The overlay may be non-conductive material used to protect the circuitry to environmental elements and to insulate the user's finger (e.g., conductive object) from the circuitry. Capacitance switch 307 may be a sensor element of a touch-sensor pad, a touch-sensor slider, or a touch-sensor button.

[0059] Figure 3C illustrates one embodiment of a relaxation oscillator. The relaxation oscillator 350 is formed by the capacitance to be measured on capacitor 351, a charging current source 352, a comparator 353, and a reset switch 354. It should be noted that capacitor 351 is representative of the capacitance measured on a sensor element of a sensor array. The relaxation oscillator is coupled to drive a charging current (Ic) 357 in a single direction onto a device under test ("DUT") capacitor, capacitor 351. As the charging current piles charge onto the capacitor 351, the voltage across the capacitor increases with time as a function of Ic 357 and its capacitance C. Equation (1) describes the relation between current, capacitance, voltage and time for a charging capacitor.

$$CdV = I_C dt \tag{1}$$

[0060] The relaxation oscillator begins by charging the capacitor 351 from a ground potential or zero voltage and continues to pile charge on the capacitor 351 at a fixed charging current Ic 357 until the voltage across the capacitor 351 at node 355 reaches a reference voltage or threshold voltage, V_{TH} 355. At V_{TH} 355, the relaxation oscillator allows the accumulated charge at node 355 to discharge (e.g., the capacitor 351 to "relax" back to the ground potential) and then the process repeats itself. In particular, the output of comparator 353 asserts a clock signal F_{OUT} 356 (e.g., F_{OUT} 356 goes high), which enables the reset switch 354. This resets the voltage on the capacitor at node 355 to ground and the charge cycle starts again. The relaxation oscillator outputs a relaxation oscillator clock signal (F_{OUT} 356) having a frequency (f_{RO}) dependent upon capacitance C of the capacitor 351 and charging current Ic 357.

[0061] The comparator trip time of the comparator 353 and reset switch 354 add a fixed delay. The output of the comparator 353 is synchronized with a reference system clock to guarantee that the comparator reset time is long enough to completely reset the charging voltage on capacitor 355. This sets a practical upper limit to the operating frequency. For example, if capacitance C of the capacitor 351 changes, then f_{RO} will change proportionally according to Equation (1). By comparing f_{RO} of F_{OUT} 356 against the frequency (f_{REF}) of a known reference system clock signal (REF CLK), the change in capacitance ΔC can be measured. Accordingly, equations (2) and (3) below describe that a change in frequency between F_{OUT} 356 and REF CLK is proportional to a change in capacitance of the capacitor 351.

$$\Delta C \propto \Delta f \text{, where} \tag{2}$$

$$\Delta f = f_{RO} - f_{REF}. \tag{3}$$

[0062] In one embodiment, a frequency comparator may be coupled to receive relaxation oscillator clock signal (F_{OUT} 356) and REF CLK, compare their frequencies f_{RO} and f_{REF}, respectively, and output a signal indicative of the difference Δf between these frequencies. By monitoring Δf one can determine whether the capacitance of the capacitor 351 has changed.

[0063] In one exemplary embodiment, the relaxation oscillator 350 may be built using a programmable timer (e.g., 555 timer) to implement the comparator 353 and reset switch 354. Alternatively, the relaxation oscillator 350 may be built using other circuiting. Relaxation oscillators are known in by those of ordinary skill in the art, and accordingly, additional details regarding their operation have not been included so as to not obscure the present embodiments.

[0064] Figure 4 illustrates a block diagram of one embodiment of a capacitance sensor including a relaxation oscillator and digital counter. Capacitance sensor 201 of Figure 4 includes a sensor array 410 (also known as a switch array), relaxation oscillator 350, and a digital counter 420. Sensor array 410 includes a plurality of sensor elements 355(1)-355(N), where N is a positive integer value that represents the number of rows (or alternatively columns) of the sensor array 410. Each sensor element is represented as a capacitor, as previously described with respect to Figure 3B. The sensor array 410 is coupled to relaxation oscillator 350 via an analog bus 401 having a plurality of pins 401(1)-401(N). In one embodiment, the sensor array 410 may be a single-dimension sensor array including the sensor elements 355(1)-355(N), where N is a positive integer value that represents the number of sensor elements of the single-dimension sensor array. The single-dimension sensor array 410 provides output data to the analog bus 401 of the processing device 210 (e.g., via lines 231). Alternatively, the sensor array 410 may be a multi-dimension sensor array including the sensor elements 355(1)-355(N), where N is a positive integer value that represents the number of sensor elements of the multi-dimension sensor array. The multi-dimension sensor array 410 provides output data to the analog bus 401 of the processing device 210 (e.g., via bus 221).

[0065] Relaxation oscillator 350 of Figure 4 includes all the components described with respect to Figure 3C, and a selection circuit 430. The selection circuit 430 is coupled to the plurality of sensor elements 355(1)-355(N), the reset switch 354, the current source 352, and the comparator 353. Selection circuit 430 may be used to allow the relaxation oscillator 350 to measure capacitance on multiple sensor elements (e.g., rows or columns). The selection circuit 430 may be configured to sequentially select a sensor element of the plurality of sensor elements to provide the charge current and to measure the capacitance of each sensor element. In one exemplary embodiment, the selection circuit 430 is a multiplexer array of the relaxation oscillator 350. Alternatively, selection circuit may be other circuitry outside the relaxation oscillator 350, or even outside the capacitance sensor 201 to select the sensor element to be measured. Capacitance sensor 201 may include one relaxation oscillator and digital counter for the plurality of sensor elements of the sensor array. Alternatively, capacitance sensor 201 may include multiple relaxation oscillators and digital counters to measure capacitance on the plurality of sensor elements of the sensor array. The multiplexer array may also be used to ground the sensor elements that are not being measured. This may be done in conjunction with a dedicated pin in the GP10 port 207.

[0066] In another embodiment, the capacitance sensor 201 may be configured to simultaneously scan the sensor elements, as opposed to being configured to sequentially scan the sensor elements as described above. For example, the sensing device may include a sensor array having a plurality of rows and columns. The rows may be scanned simultaneously, and the columns may be scanned simultaneously.

[0067] In one exemplary embodiment, the voltages on all of the rows of the sensor array are simultaneously moved, while the voltages of the columns are held at a constant voltage, with the complete set of sampled points simultaneously giving a profile of the conductive object in a first dimension. Next, the voltages on all of the rows are held at a constant voltage, while the voltages on all the rows are simultaneously moved, to obtain a complete set of sampled points simultaneously giving a profile of the conductive object in the other dimension.

[0068] In another exemplary embodiment, the voltages on all of the rows of the sensor array are simultaneously moved in a positive direction, while the voltages of the columns are moved in a negative direction. Next, the voltages on all of the rows of the sensor array are simultaneously moved in a negative direction, while the voltages of the columns are moved in a positive direction. This technique doubles the effect of any transcapacitance between the two dimensions, or conversely, halves the effect of any parasitic capacitance to the ground. In both methods, the capacitive information from the sensing process provides a profile of the presence of the conductive object to the sensing device in each dimension. Alternatively, other methods for scanning known by those of ordinary skill in the art may be used to scan the sensing device.

[0069] Digital counter 420 is coupled to the output of the relaxation oscillator 350. Digital counter 420 receives the relaxation oscillator output signal 356 (F_{OUT}). Digital counter 420 is configured to count at least one of a frequency or a period of the relaxation oscillator output received from the relaxation oscillator.

[0070] As previously described with respect to the relaxation oscillator 350, when a finger or conductive object is placed on the switch, the capacitance increases from Cp to Cp + Cf so the relaxation oscillator output signal 356 (F_{OUT}) decreases. The relaxation oscillator output signal 356 (F_{OUT}) is fed to the digital counter 420 for measurement. There are two methods for counting the relaxation oscillator output signal 356, frequency measurement and period measurement. In one embodiment, the digital counter 420 may include two multiplexers 423 and 424. Multiplexers 423 and 424 are configured to select the inputs for the PWM 421 and the timer 422 for the two measurement methods, frequency and period measurement methods. Alternatively, other selection circuits may be used to select the inputs for the PWM 421 and the time 422. In another embodiment, multiplexers 423 and 424 are not included in the digital counter, for example, the digital counter 420 may be configured in one, or the other, measurement configuration.

[0071] In the frequency measurement method, the relaxation oscillator output signal 356 is counted for a fixed period of time. The counter 422 is read to obtain the number of counts during the gate time. This method works well at low frequencies where the oscillator reset time is small compared to the oscillator period. A pulse width modulator (PWM) 441 is clocked for a fixed period by a derivative of the system clock, VC3 426 (which is a divider from system clock 425, e.g., 24 MHz). Pulse width modulation is a modulation technique that generates variable-length pulses to represent the amplitude of an analog input signal; in this case VC3 426. The output of PWM 421 enables timer 422 (e.g., 16-bit). The relaxation oscillator output signal 356 clocks the timer 422. The timer 422 is reset at the start of the sequence, and the count value is read out at the end of the gate period.

[0072] In the period measurement method, the relaxation oscillator output signal 356 gates a counter 422, which is clocked by the system clock 425 (e.g., 24 MHz). In order to improve sensitivity and resolution, multiple periods of the oscillator are counted with the PWM 421. The output of PWM 421 is used to gate the timer 422. In this method, the relaxation oscillator output signal 356 drives the clock input of PWM 421. As previously described, pulse width modulation is a modulation technique that generates variable-length pulses to represent the amplitude of an analog input signal; in this case the relaxation oscillator output signal 356. The output of the PWM 421 enables timer 422 (e.g., 16-bit), which is clocked at the system clock frequency 425 (e.g., 24 MHz). When the output of PWM 421 is asserted (e.g., goes high), the count starts by releasing the capture control. When the terminal count of the PWM 421 is reached, the capture signal is asserted (e.g., goes high), stopping the count and setting the PWM's interrupt. The timer value is read in this interrupt. The relaxation oscillator 350 is indexed to the next switch (e.g., capacitor 351(2)) to be measured and the count sequence is started again.

[0073] The two counting methods may have equivalent performance in sensitivity and signal-to-noise ratio (SNR). The period measurement method may have a slightly faster data acquisition rate, but this rate is dependent on software loads and the values of the switch capacitances. The frequency measurement method has a fixed-switch data acquisition rate.

[0074] The length of the counter 422 and the detection time required for the switch are determined by sensitivity requirements. Small changes in the capacitance on capacitor 351 result in small changes in frequency. In order to find these small changes, it may be necessary to count for a considerable time.

[0075] At startup (or boot) the switches (e.g., capacitors 351(1)-(N)) are scanned and the count values for each switch with no actuation are stored as a baseline array (Cp). The presence of a finger on the switch is determined by the difference in counts between a stored value for no switch actuation and the acquired value with switch actuation, referred to here as Δn. The sensitivity of a single switch is approximately:

$$\frac{\Delta \mathrm{n}}{n} = \frac{Cf}{Cp} \tag{4}$$

[0076] The value of Δn should be large enough for reasonable resolution and clear indication of switch actuation. This drives switch construction decisions.

[0077] Cf should be as large a fraction of Cp as possible. In one exemplary embodiment, the fraction of Cf/Cp ranges between approximately 0.01 to approximately 2.0. Alternatively, other fractions may be used for Cf/Cp. Since Cf is determined by finger area and distance from the finger to the switch's conductive traces (through the over-lying insulator), the baseline capacitance Cp should be minimized. The baseline capacitance Cp includes the capacitance of the switch pad plus any parasitics, including routing and chip pin capacitance.

[0078] In switch array applications, variations in sensitivity should be minimized. If there are large differences in Δn, one switch may actuate at 1.0 cm, while another may not actuate until direct contact. This presents a non-ideal user interface device. There are numerous methods for balancing the sensitivity. These may include precisely matching on-board capacitance with PC trace length modification, adding balance capacitors on each switch's PC board trace, and/or adapting a calibration factor to each switch to be applied each time the switch is tested.

[0079] In one embodiment, the PCB design may be adapted to minimize capacitance, including thicker PCBs where possible. In one exemplary embodiment, a 0.062 inch thick PCB is used. Alternatively, other thicknesses may be used, for example, a 0.015 inch thick PCB.

[0080] It should be noted that the count window should be long enough for Δn to be a "significant number." In one embodiment, the "significant number" can be as little as 10, or alternatively, as much as several hundred. In one exemplary embodiment, where Cf is 1.0% of Cp (a typical "weak" switch), and where the switch threshold is set at a count value of 20, n is found to be:

$$n = \Delta n \cdot \frac{Cf}{Cp} = 2000 \tag{5}$$

[0081] Adding some margin to yield 2500 counts, and running the frequency measurement method at 1.0 MHz, the detection time for the switch is 2.5 microseconds. In the frequency measurement method, the frequency difference between a switch with and without actuation (i.e., CP + CF vs. CP) is approximately:

$$\Delta n = \frac{t_{count} \cdot i_c}{V_{TH}} \frac{Cf}{Cp^2} \tag{6}$$

[0082] This shows that the sensitivity variation between one channel and another is a function of the square of the difference in the two channels' static capacitances. This sensitivity difference can be compensated using routines in the high-level Application Programming Interfaces (APIs).

[0083] In the period measurement method, the count difference between a switch with and without actuation (i.e., CP+CF vs. CP) is approximately:

$$\Delta n = N_{Periods} \cdot \frac{Cf \cdot V_{TH}}{i_C} \cdot f_{SysClk} \qquad (7)$$

[0084] The charge currents are typically lower and the period is longer to increase sensitivity, or the number of periods for which f_{SysClk} is counted can be increased. In either method, by matching the static (parasitic) capacitances Cp of the individual switches, the repeatability of detection increases, making all switches work approximately at the same difference. Compensation for this variation can be done in software at runtime. The compensation algorithms for both the frequency method and period method may be included in the high-level APIs.

[0085] Some implementations of this circuit use a current source programmed by a fixed-resistor value. If the range of capacitance to be measured changes, external components, (i.e., the resistor) should be adjusted.

[0086] Using the multiplexer array 430, multiple sensor elements may be sequentially scanned to provide current to and measure the capacitance from the capacitors (e.g., sensor elements), as previously described. In other words, while one sensor element is being measured, the remaining sensor elements are grounded using the GPIO port 207. This drive and multiplex arrangement bypasses the existing GPIO to connect the selected pin to an internal analog multiplexer (mux) bus. The capacitor charging current (e.g., current source 352) and reset switch 353 are connected to the analog mux bus. This may limit the pin-count requirement to simply the number of switches (e.g., capacitors 351(1)-351(N)) to be addressed. In one exemplary embodiment, no external resistors or capacitors are required inside or outside the processing device 210 to enable operation.

[0087] The capacitor charging current for the relaxation oscillator 350 is generated in a register programmable current output DAC (also known as IDAC). Accordingly, the current source 352 is a current DAC or IDAC. The IDAC output current may be set by an 8-bit value provided by the processing device 210, such as from the processing core 202. The 8-bit value may be stored in a register or in memory.

[0088] Estimating and measuring PCB capacitances may be difficult; the oscillator-reset time may add to the oscillator period (especially at higher frequencies); and there may be some variation to the magnitude of the IDAC output current with operating frequency. Accordingly, the optimum oscillation frequency and operating current for a particular switch array may be determined to some degree by experimentation.

[0089] In many capacitive switch designs the two "plates" (e.g., 301 and 302) of the sensing capacitor are actually adjacent sensor elements that are electrically isolated (e.g., PCB pads or traces), as indicated in Figure 3A. Typically, one of these plates is grounded. Layouts for touch-sensor slider (e.g., linear slide switches) and touch-sensor pad applications have switches that are immediately adjacent. In this case, all of the switches that are not active are grounded through the GPIO 207 of the processing device 210 dedicated to that pin. The actual capacitance between adjacent plates is small (Cp), but the capacitance of the active plate (and its PCB trace back to the processing device 210) to ground, when detecting the presence of the conductive object 303, may be considerably higher (Cp + Cf). The capacitance of two parallel plates is given by the following equation:

$$C = \varepsilon_0 \cdot \varepsilon_R \cdot \frac{A}{d} = \varepsilon_R \cdot 8.85 \cdot \frac{A}{d} pF/m \qquad (8)$$

[0090] The dimensions of equation (8) are in meters. This is a very simple model of the capacitance. The reality is that there are fringing effects that substantially increase the switch-to-ground (and PCB trace-to-ground) capacitance.

[0091] Switch sensitivity (i.e., actuation distance) may be increased by one or more of the following: 1) increasing board thickness to increase the distance between the active switch and any parasitics; 2) minimizing PC trace routing underneath switches; 3) utilizing a grided ground with 50% or less fill if use of a ground plane is absolutely necessary; 4) increasing the spacing between switch pads and any adjacent ground plane; 5) increasing pad area; 6) decreasing thickness of any insulating overlay; or 7) verifying that there is no air-gap between the PC pad surface and the touching finger.

[0092] There is some variation of switch sensitivity as a result of environmental factors. A baseline update routine, which compensates for this variation, may be provided in the high-level APIs.

[0093] Sliding switches are used for control requiring gradual adjustments. Examples include a lighting control (dimmer), volume control, graphic equalizer, and speed control. These switches are mechanically adjacent to one another. Actuation of one switch results in partial actuation of physically adjacent switches. The actual position in the sliding switch is found by computing the centroid location of the set of switches activated.

[0094] In applications for touch-sensor sliders (e.g., sliding switches) and touch-sensor pads it is often necessary to determine finger (or other capacitive object) position to more resolution than the native pitch of the individual switches. The contact area of a finger on a sliding switch or a touch-pad is often larger than any single switch. In one embodiment, in order to calculate the interpolated position using a centroid, the array is first scanned to verify that a given switch location is valid. The requirement is for some number of adjacent switch signals to be above a noise threshold. When the strongest signal is found, this signal and those immediately adjacent are used to compute a centroid:

$$Centroid = \frac{n_{i-1} \cdot (i-1) + n_i i + n_{i+1} \cdot (i+1)}{n_{i-1} + n_i i + n_{i+1}} \quad (9)$$

[0095] The calculated value will almost certainly be fractional. In order to report the centroid to a specific resolution, for example a range of 0 to 100 for 12 switches, the centroid value may be multiplied by a calculated scalar. It may be more efficient to combine the interpolation and scaling operations into a single calculation and report this result directly in the desired scale. This may be handled in the high-level APIs. Alternatively, other methods may be used to interpolate the position of the conductive object.

[0096] A physical touchpad assembly is a multi-layered module to detect a conductive object. In one embodiment, the multi-layer stack-up of a touchpad assembly includes a PCB, an adhesive layer, and an overlay. The PCB includes the processing device 210 and other components, such as the connector to the host 250, necessary for operations for sensing the capacitance. These components are on the non-sensing side of the PCB. The PCB also includes the sensor array on the opposite side, the sensing side of the PCB. Alternatively, other multi-layer stack-ups may be used in the touchpad assembly.

[0097] The PCB may be made of standard materials, such as FR4 or Kapton™ (e.g., flexible PCB). In either case, the processing device 210 may be attached (e.g., soldered) directly to the sensing PCB (e.g., attached to the non-sensing side of the PCB). The PCB thickness varies depending on multiple variables, including height restrictions and sensitivity requirements. In one embodiment, the PCB thickness is at least approximately 0.3 millimeters (mm). Alternatively, the PCB may have other thicknesses. It should be noted that thicker PCBs may yield better results. The PCB length and width is dependent on individual design requirements for the device on which the sensing device is mounted, such as a notebook or mobile handset.

[0098] The adhesive layer is directly on top of the PCB sensing array and is used to affix the overlay to the overall touchpad assembly. Typical material used for connecting the overlay to the PCB is non-conductive adhesive such as 3M 467 or 468. In one exemplary embodiment, the adhesive thickness is approximately 0.05 mm. Alternatively, other thicknesses may be used.

[0099] The overlay may be non-conductive material used to protect the PCB circuitry to environmental elements and to insulate the user's finger (e.g., conductive object) from the circuitry. Overlay can be ABS plastic, polycarbonate, glass, or Mylar™. Alternatively, other materials known by those of ordinary skill in the art may be used. In one exemplary embodiment, the overlay has a thickness of approximately 1.0 mm. In another exemplary embodiment, the overlay thickness has a thickness of approximately 2.0 mm. Alternatively, other thicknesses may be used.

[00100] The sensor array may be a grid-like pattern of sensor elements (e.g., capacitive elements) used in conjunction with the processing device 210 to detect a presence of a conductive object, such as finger, to a resolution greater than that which is native. The touch-sensor pad layout pattern maximizes the area covered by conductive material, such as copper, in relation to spaces necessary to define the rows and columns of the sensor array.

[00101] Figure 5A illustrates a top-side view of one embodiment of a sensor array having a plurality of sensor elements for detecting a presence of a conductive object 303 on the sensor array 500 of a touch-sensor pad. Touch-sensor pad 220 includes a sensor array 500. Sensor array 500 includes a plurality of rows 504(1)-504(N) and a plurality of columns 505(1)-505(M), where N is a positive integer value representative of the number of rows and M is a positive integer value representative of the number of columns. Each row includes a plurality of sensor elements 503(1)-503(K), where K is a positive integer value representative of the number of sensor elements in the row. Each column includes a plurality of sensor elements 501(1)-501(L), where L is a positive integer value representative of the number of sensor elements in the column. Accordingly, sensor array is an N x M sensor matrix. The N x M sensor matrix, in conjunction with the processing device 210, is configured to detect a position of a presence of the conductive object 303 in the x-, and y-directions.

[00102] Figure 5B illustrates a top-side view of one embodiment of a sensor array having a plurality of sensor elements for detecting a presence of a conductive object 303 on the sensor array 550 of a touch-sensor slider. Touch-sensor slider 230 includes a sensor array 550. Sensor array 550 includes a plurality of columns 504(1)-504(M), where M is a positive integer value representative of the number of columns. Each column includes a plurality of sensor elements 501(1)-501(L), where L is a positive integer value representative of the number of sensor elements in the column. Accordingly, sensor array is a 1 x M sensor matrix. The 1 x M sensor matrix, in conjunction with the processing device 210, is configured to detect a position of a presence of the conductive object 303 in the x-direction. It should be noted that sensor array 500 may be configured to function as a touch-sensor slider 230.

[00103] Alternating columns in Figure 5A correspond to x- and y-axis elements. The y-axis sensor elements 503(1)-503(K) are illustrated as black diamonds in Figure 5A, and the x-axis sensor elements 501(1)-501(L) are illustrated as white diamonds in Figure 5A and Figure 5B. It should be noted that other shapes may be used for the sensor elements. In another embodiment, the columns and row may include vertical and horizontal bars (e.g., rectangular shaped bars); however, this design may include additional layers in the PCB to allow the vertical and horizontal bars to be positioned on the PCB so that they are not in contact with one another.

[00104] Figure 5C and 5D illustrate top-side and side views of one embodiment of a two-layer touch-sensor pad. Touch-sensor pad, as illustrated in Figure 5C and 5D, include the first two columns 505(1) and 505(2), and the first four rows 504(1)-504(4) of sensor array 500. The sensor elements of the first column 501(1) are connected together in the top conductive layer 575, illustrated as hashed diamond sensor elements and connections. The diamond sensor elements of each column, in effect, form a chain of elements. The sensor elements of the second column 501(2) are similarly connected in the top conductive layer 575. The sensor elements of the first row 504(1) are connected together in the bottom conductive layer 575 using vias 577, illustrated as black diamond sensor elements and connections. The diamond sensor elements of each row, in effect, form a chain of elements. The sensor elements of the second, third, and fourth rows 504(2)-504(4) are similarly connected in the bottom conductive layer 576.

[00105] As illustrated in Figure 5D, the top conductive layer 575 includes the sensor elements for both the columns and the rows of the sensor array, as well as the connections between the senor elements of the columns of the sensor array. The bottom conductive layer 576 includes the conductive paths that connect the sensor elements of the rows that reside in the top conductive layer 575. The conductive paths between the sensor elements of the rows use vias 577 to connect to one another in the bottom conductive layer 576. Vias 577 go from the top conductive layer 575, through the dielectric layer 578, to the bottom conductive layer 576. Coating layers 579 and 589 are applied to the surfaces opposite to the surfaces that are coupled to the dielectric layer 578 on both the top and bottom conductive layers 575 and 576.

[00106] It should be noted that the space between coating layers 579 and 589 and dielectric layer 578, which does not include any conductive material, may be filled with the same material as the coating layers or dielectric layer. Alternatively, it may be filled with other materials.

[00107] It should be noted that the present embodiments are not be limited to connecting the sensor elements of the rows using vias to the bottom conductive layer 576, but may include connecting the sensor elements of the columns using vias to the bottom conductive layer 576. Furthermore, the present embodiments are not limited two-layer configurations, but may include disposing the sensor elements on multiple layers, such as three- or four-layer configurations.

[00108] When pins are not being sensed (only one pin is sensed at a time), they are routed to ground. By surrounding the sensing device (e.g., touch-sensor pad) with a ground plane, the exterior elements have the same fringe capacitance to ground as the interior elements.

[00109] In one embodiment, an IC including the processing device 210 may be directly placed on the non-sensor side of the PCB. This placement does not necessary have to be in the center. The processing device IC is not required to have a specific set of dimensions for a touch-sensor pad, nor a certain number of pins. Alternatively, the IC may be placed somewhere external to the PCB.

[00110] Figure 6A illustrates one embodiment of a single sensor element of a sensing device that has three keyboard keys assigned to pre-defined areas of the sensing device. Sensor element 601 is a diamond-shaped sensor element of a sensing device. Keyboard keys, A-C 603(1)-603(3), are assigned pre-defined areas of the sensing device. In this embodiment, the keyboard keys 603(1)-603(3) correspond to pre-defined areas that are disposed in a horizontal line along a center line of the diamond-shaped sensor element, sensor element 601. Alternatively, the pre-defined areas of keyboard keys 603(1)-603(3) may be disposed in other configurations on the sensing device. It should be noted that the gaps between the pre-defined areas (represented as square buttons) are merely for illustration and description purposes, and accordingly, the keyboard keys may be assigned adjacent to one another without any space between the keyboard keys.

[00111] In one embodiment, the keyboard keys may be assigned to pre-defined areas of the sensing area using a data structure. For example, the data structure may be a key-mapping data structure. The data structure may include positional data of the pre-

defined areas of the keyboard keys. The positional data may be the x- and y-coordinate ranges of the pre-defined areas of the keyboard keys. Accordingly, after the location of the conductive object that is present on the sensing device is determined, the position of the conductive object may be compared with the positional data of the pre-defined areas of the data structure to determine which keyboard key has been pressed. After determining which keyboard key has been pressed, the keyboard data that corresponds to the pressed key can be sent to a host or other component that is external to the processing device. In one embodiment, the data structure may be pre-determined and stored in memory of the processing device. The data structure may be a look-up table. Alternatively the data structure may be defined during operation of the processing device. This may be used to calibrate the pre-defined areas of the sensing device.

[00112] Sensor element 601 may be coupled to additional sensor elements in the sensing device, such as to other sensor elements in the same row or column. Furthermore, it should be noted that the embodiments described herein are not limited to being diamond shaped, but may include other shapes, such hexagons, octagons, squares, rectangles, triangles, circles, ovals, or the like.

[00113] Figure 6B illustrates one embodiment of a processing device 210 coupled to a sensing device that has a capacitance sensor matrix 600 and multiple keyboard keys 604(0)-604(47) assigned to pre-defined areas of the sensing device. Capacitance sensor matrix 600 includes two rows 606(0) and 606(1) and two columns 606(2) and 606(3). Both the rows and columns have 3 sensor elements each. Row 606(0) and 606(1) are coupled to processing device 210 using capacitance sensing pins 605(0) and 605(1), respectively. Column 606(2) and 606(3) are coupled to processing device 210 using capacitance sensing pins 605(2) and 605(3), respectively. Keyboard keys 604(0)-604(47) are assigned to pre-defined areas of the sensing device. In particular, keyboard key B0 is assigned to be in the upper-left most keyboard key of the sensor matrix 600, and the keyboard key B47 is assigned to be in the lower-right most keyboard key of the sensor matrix 600. These keyboard keys may be assigned to represent different keyboard keys, such as alphanumeric characters, function keys, and the like.

[00114] As previously described, after the keyboard keys have been assigned a pre-defined area of the sensing device, a presence of a conductive object can be detected on the sensing device. The processing device determines the position of the presence of the conductive object, and selects which keyboard key has been pressed based on the pre-defined areas and the position of the presence of the conductive object. Selecting the keyboard may include comparing the position with the pre-defined areas. Once the keyboard key has been selected, the processing device may output keyboard data that corresponds to the selected key to a component external to the processing device. The component may be a processor, a driver of a processor, or an embedded controller.

[00115] In one embodiment, the position of the presence of the conductive object may be determined by measuring a capacitance (e.g., or capacitance variation) of each row (e.g., 606(0) and 606(1)) of sensor elements of the capacitance sensor matrix 600, and determining a first dimension position (e.g., y-coordinate location) based on the measured capacitance of the rows of sensor elements. Similarly, a capacitance of each column (e.g., 606(2) and 606(3)) of sensor elements of the capacitance sensor matrix 600 can be measured to determine a second dimension position (e.g., x-coordinate location) based on the measured capacitance of the columns of sensor elements. The position of the detected presence of the conductive object is determined using the first and second dimension positions.

[00116] As described above, the keyboard keys 604(0)-604(47) can be assigned to pre-defined areas using a data structure. After determining the position of the conductive object, the processing device can compare the position with the pre-defined areas of the data structure to select which keyboard key has been pressed.

[00117] This embodiment includes 3 x 3 capacitance sensor matrix. However, it should be noted that other dimensions may be used to detect the presence of the conductive object. Similarly, it should be noted that the embodiments are not limited to 48 buttons, or the configuration of the 48 buttons in a 6 x 8 matrix, but may include any number of keyboard keys, such as 2 to 107 keyboard keys, and other configurations (such as illustrated in Figure 6C). It is also contemplated that a keyboard having more than 107 keyboard keys may be implemented using a capacitance sensor matrix, as described herein.

[00118] Figure 6C illustrates one embodiment of processing device 210 coupled to a sensing device that has a capacitance sensor matrix 650 and keyboard keys A-Z 606(0)-606(25) assigned to pre-defined areas of the sensing device. Capacitance sensor matrix 600 includes eight rows 504(1)-504(8) and eight columns 505(1)-505(8). The rows and columns have 8 sensor elements each, sensor elements 501(1)-501(8) and 503(1)-503(8). Rows 504(1)-504(8) are coupled to processing device 210 using capacitance sensing pins, conductive traces 502. Columns 505(1)-505(8) are coupled to processing device 210 using capacitance sensing pins, conductive traces 502. Since sensor matrix 650 is an 8 x 8 matrix, there are 16 total capacitance sensing pins that couple the sensor matrix 650 to the processing device 210. Keyboard keys 606(0)-606(25), which represent the letters A to Z of the alphabet, are assigned to pre-defined areas of the sensing device. In particular, the keyboard keys are assigned to the upper-left most area of the sensing device. In one embodiment, the remaining surface area of the sensing device that is not assigned pre-defined areas of keyboard keys may be used for other functionality, such as cursor positioning, or the like. Alternatively, the remaining surface area may be assigned additional keyboard keys. It should also be noted that the 26 keys represented in Figure 6C may be different keyboard keys than those 26 keys, such as alphanumeric characters of other languages, function keys, and the like.

[00119] As previously described, after the keyboard keys have been assigned a pre-defined area of the sensing device, a presence of a conductive object can be detected on the sensing device. In this embodiment, the conductive object 303 is detected in the pre-defined area of the keyboard key C 606(2). In particular, the processing device 210 determines the position of the presence of the conductive object 303, and selects the keyboard key C 606(2), which has been pressed, based on the pre-defined areas and the position of the presence of the conductive object 303. Selecting the keyboard may include comparing the position with the pre-defined areas, determining that the keyboard key C 606(2) has been pressed. Once the keyboard key C has been selected, the processing device may output keyboard data that corresponds to the keyboard key C to a component external to the processing device. The component may be a processor, a driver of a processor, or an embedded controller.

[00120] In this embodiment, similar method as to those described above may be used to determine the position of the presence of the conductive object 303. Similarly, as described above, the keyboard keys 606(0)-606(25) can be assigned to pre-defined areas using a data structure. After determining the position of the conductive object 303, the processing device 210 can compare the position with the pre-defined areas of the data structure to select which keyboard key has been pressed; in this case, keyboard key C 606(2).

[00121] Figure 6D illustrates one embodiment of a handheld device 675 having a keyboard 678. Handheld device 675 includes display 676, buttons 677(1)-677(3), and keyboard 678. Display 676 may be a liquid crystal display (LCD) or other displays known by those of ordinary skill in the art. Display 676 may be used to display video, graphics, text, or the like. Alternatively, display 676 may be used as a graphical user interface (GUI). The GUI may be implemented with a touch-screen display. This touch-screen display may be resistive or capacitive type sensing.

[00122] Buttons 677(1)-677(3) are additional buttons for the handheld device. These buttons may be mechanical buttons, or alternatively, may be capacitance sensing buttons. These buttons may be used to provide additional button functionality to the handheld device. In another embodiment, the buttons may be incorporated with the keyboard 678, or not included at all in the handheld device 675.

[00123] As previously described, by implementing the keyboard in a touch-screen display, the real estate of the screen of display 676 is reduced. In order to not reduce the screen of display 676, handheld device 675 includes a keyboard 678 in addition to the display 676. Keyboard 678 includes a capacitance sensor matrix, as described in the embodiments herein. They keyboard 678 may have multiple keys, for example, 48, 83, 84, 101, 102, 104, 105, 107, or more keyboard keys (as described in more detail below).

They keyboard 678 may have a layout, such as QWERTY, Dvorak, foreign-language layouts (e.g. "keyboard AZERTY" in French-speaking countries), a space-cadet, or APL keyboard layouts. Alternatively, other customized layouts may be used.

[00124] In one embodiment, the keyboard 678 may be a PC keyboard. The PC keyboard has evolved over time to include more keys. For example, the PC/XT keyboard layout has 83 keyboard keys. It includes original left hand side function key (F key) columns with 10 keys F1 through F10. These types of keyboards may not be compatible with later keyboard types. The PC/AT keyboard layout includes 84 keys, and the 84th key is the system request key (e.g., SysRq). The numerical block is clearly separated from the main keyboard, and they PC/AT layout includes indicator LEDs for Caps/Scroll/NumLock. One enhanced keyboard layout includes 101 keyboard keys. This enhanced layout includes additional navigation and control keys, 12 function keys in row along the top of the main keyboard, often grouped as F1-F4, F5-F8, and F9-12. Another enhanced layout includes 102 keyboard keys. This layout is similar to the layout of 101 keys, but includes an additional key to the right of the left Shift key for European layouts. Another enhanced layout is the Windows® keyboard layout, which includes additional keys for the Windows® key (which provides a shortcut to open the "Start" menu in Windows® standard Explorer shell) and menu keys. Correspondingly, the European layouts included 105 keys for the additional key to the right of the left Shift key. An additional enhanced layout includes 107 keyboard keys, which includes the additional keys, such as Wake, Sleep, and Power keys for power management functionality. Alternatively, there are additional enhanced layouts that are called multimedia keyboard layouts, which may offer additional buttons to the 104 or 107 "standard" keys, often providing volume control, media player buttons, and miscellaneous user-configurable shortcuts, e.g., to email clients, web browsers, document folders, applications, etc. It should be noted that the embodiments described herein are not limited to PC keyboards, and PC keyboard keys, but may include other keyboard keys for other platforms and other systems.

[00125] In one embodiment, handheld device 675 is a mobile handset. Alternatively, handheld device 675 may be PDA, Smartphone, or laptop. Alternatively, the embodiments described herein may be used in a keyboard, a television, a remote control, a display, a handheld multi-media device (e.g., MP3 player), a handheld video player, a handheld gaming device, a control panel, or the like.

[00126] In one embodiment, the keyboard 678 may include a capacitance sensor matrix, as describe above, and both keyboard keys and cursor positioning may be implemented on the same sensor matrix. Alternatively, the processing device may be coupled to both the sensor matrix of a keyboard, and an additional user input device, such as a cursor positioning device, a touch-sensor pad, touch-sensor slider, touch-sensor button, mouse, touch-screen display, or the like.

[00127] In one embodiment, the keyboard 678 can be implemented within a surface area on a device, such as a handheld device. For example, the keyboard 678 may be a standard PC keyboard (e.g., including 101 to 107 keyboard keys) and may be implemented within a 3 cm x 3cm surface area. For example, keyboard 678 may have a height 679 of 3 cm, and a width 680 of 3 cm. Alternatively, the keyboard 678 may have other dimensions within the same surface area. In another embodiment, the keyboard key

678 may be implemented within a surface are less than 10 cm x 10 cm. Alternatively, other surface areas may be used to implement the keyboard keys of keyboard 678.

[00128] In one embodiment, the keyboard 678 may be a standard PC keyboard (e.g., including 101 to 107 keyboard keys). The sensing device, which includes keyboard 678, is coupled to processing device 210 using less than 21 capacitance sensing pins. Alternatively, keyboard 678 may include 48 keyboard keys, and the processing device 210 is coupled to the sensing device, which includes the 48 keyboard keys assigned to pre-defined areas of the sensing device, using 4 capacitance sensing pins. In another embodiment, the keyboard 678 includes 101 keyboard keys and the processing device 210 is coupled to the sensing device using less than 12 capacitance sensing pins. Alternatively, the keyboard 678 includes 107 keyboard keys and the processing device 210 is coupled to the sensing device using less than 21 capacitance sensing pins. In another embodiment, the keyboard 678 includes 107 keyboard keys and the processing device 210 is coupled to the sensing device using less than 12 capacitance sensing pins.

[00129] Figure 7 illustrates a flowchart 700 of one embodiment of a method for detecting a position of a pressed key on a sensing device. Method 700 includes, first, defining the pre-defined areas of the keyboard keys on the sensing device. This may be done by defining a key-mapping data structure, operation 701. The data structure may include positional data of the pre-defined areas of the keyboard keys. The positional data may be the x- and y-coordinate ranges of the pre-defined areas of the keyboard keys. For example, the keyboard key A can be defined as having x- and y-coordinate ranges, such as $\{1<x<3, 7<y<9\}$, the keyboard key B can be defined as having different x- and y-coordinate range, such as $\{4<x<6, 7<y<9\}$, and so on for the additional keyboard keys.

Next, the processing device scans and measures the columns of the capacitance sensing matrix, operation 702, to determine the x-coordinate of the detected presence of the conductive object on the sensing device, operation 703. This may be done using the embodiments of described herein with respect to Figures 3A-3C, and 4. For example, determining the x-coordinate may result in x = 4.8. Next, the processing device scans and measures the rows of the capacitance sensing matrix, operation 704, to determine the y-coordinate of the detected presence of the conductive object on the sensing device, operation 704. This may also be done using the embodiments of described herein with respect to Figures 3A-3C, and 4. For example, determining the x-coordinate may result in y = 8.1. Next, using the x- and y-coordinate positions of the conductive object, the position of the conductive object may be compared with the positional data of the pre-defined areas of the data structure to determine which keyboard key has been pressed, operation 706. This may be done using a look-up table to determine the pre-defined area of the keyboard key that was pressed within the key-mapping data structure. Accordingly, the look-up results of the data structure are output from the processing device. In the example where x = 4.8, and y = 8.1, the position of the detected presence falls within the range of pre-defined area of keyboard key B. Accordingly, the key B is output in response to these measurements of the sensing device.

[00130] Alternatively, the method may be performed in different orders, such as measuring the rows before the columns, or measuring both rows and columns before making the determination of the x- and y-coordinates.

[00131] Figure 8 illustrates a table of one exemplary embodiment of output positions of multiple keyboard keys. Table 800 includes the output positions 804 of multiple keyboard keys. Table 800 includes three entries for each column, the key 801, x-coordinate position 802, and y-coordinate position 803. The x- and y-coordinate positions 801 and 802 are the values of the positions determined by measuring the capacitance (e.g., capacitance variation) on the rows and columns of the capacitance sensor matrix. The x- and y-coordinate positions 801 and 802 are used to determine the keyboard key 801 that was pressed. This may be done by comparing the x- and y-coordinate positions 801 and 802 to the pre-defined areas of a key-mapping data structure. For example, the first row of the first column includes the results from determining that the conductive object is present on the sensing device at x-coordinate position of 17 (hex) and y-coordinate position of 08 (hex). Using these coordinate positions, it is determined that the key 801 that is pressed is the keyboard key P.

[00132] Embodiments of the present invention, described herein, include various operations. These operations may be performed by hardware components, software, firmware, or a combination thereof. As used herein, the term "coupled to" may mean coupled directly or indirectly through one or more intervening components. Any of the signals provided over various buses described herein may be time multiplexed with other signals and provided over one or more common buses. Additionally, the interconnection between circuit components or blocks may be shown as buses or as single signal lines. Each of the buses may alternatively be one or more single signal lines and each of the single signal lines may alternatively be buses.

[00133] Certain embodiments may be implemented as a computer program product that may include instructions stored on a machine-readable medium. These instructions may be used to program a general-purpose or special-purpose processor to perform the described operations. A machine-readable medium includes any mechanism for storing or transmitting information in a form (e.g., software, processing application) readable by a machine (e.g., a computer). The machine-readable medium may include, but is not limited to, magnetic storage medium (e.g., floppy diskette); optical storage medium (e.g., CD-ROM); magneto-optical storage medium; read-only memory (ROM); random-access memory (RAM); erasable programmable memory (e.g., EPROM and EEPROM); flash memory; electrical, optical, acoustical, or other form of propagated signal (e.g., carrier waves, infrared signals, digital signals, etc.); or another type of medium suitable for storing electronic instructions.

[00134] Additionally, some embodiments may be practiced in distributed computing environments where the machine-readable medium is stored on and/or executed by more than one computer system. In addition, the information transferred between computer systems may either be pulled or pushed across the communication medium connecting the computer systems.

[00135] Although the operations of the method(s) herein are shown and described in a particular order, the order of the operations of each method may be altered so that certain operations may be performed in an inverse order or so that certain operation may be performed, at least in part, concurrently with other operations. In another embodiment, instructions or sub-operations of distinct operations may be in an intermittent and/or alternating manner.

[00136] In the foregoing specification, the invention has been described with reference to specific exemplary embodiments thereof. It will, however, be evident that various modifications and changes may be made thereto without departing from the broader spirit and scope of the invention as set forth in the appended claims. The specification and drawings are, accordingly, to be regarded in an illustrative sense rather than a restrictive sense.

CLAIMS

What is claimed is:

1. A method, comprising:

assigning a plurality of keyboard keys into pre-defined areas of a sensing device having a plurality of sensor elements and a plurality of capacitance sensing pins to couple the sensing device to a processing device;

detecting a presence of a conductive object on the sensing device;

determining a position of the presence of the conductive object on the sensing device; and

selecting a keyboard key of the plurality of keyboard keys based on the position of the presence of the conductive object and the pre-defined areas of the sensing device.

2. The method of claim 1, wherein selecting the keyboard key comprises comparing the position of the conductive object with the pre-defined areas.

3. The method of claim 1, further comprising outputting keyboard data corresponding to the selected key from the processing device to a component external to the processing device.

4. The method of claim 1, wherein determining the position of the conductive object comprises:

measuring a capacitance of each row of sensor elements of a capacitance sensor matrix of the sensing device;

determining a first dimension position based on the measured capacitance of the rows of sensor elements;

measuring a capacitance of each column of sensor elements of the capacitance sensor matrix; and

determining a second dimension position based on the measured capacitance of the columns of sensor elements, wherein determining the position of the detected presence is determined using the first and second dimension positions.

5. The method of claim 3, wherein assigning the plurality of keyboard keys into pre-defined areas comprises defining a data structure comprising positional data of the pre-defined areas of the plurality of keyboard keys, wherein selecting the keyboard key comprises comparing the position of the conductive object with the positional data of the pre-defined areas of the data structure to determine a pressed key of the plurality of keyboard keys, and wherein outputting the keyboard data comprises outputting keyboard data that corresponds to the pressed key.

6. An apparatus, comprising:

a sensing device comprising a plurality of sensor elements to detect a presence of a conductive object on the sensing device, wherein a plurality of keyboard keys are assigned to pre-defined areas of the sensing device; and

a processing device coupled to the sensing device using capacitance sensing pins, wherein the processing device is operable to determine a position of the presence of the conductive object on the sensing device, and to select a keyboard key of the plurality of keyboard keys based on the position of the presence of the conductive object and the pre-defined areas of the sensing device.

7. The apparatus of claim 6, wherein the plurality of keyboard keys are a personal computer (PC) keyboard, and wherein the processing device is coupled to the sensing device using less than 21 capacitance sensing pins.

8. The apparatus of claim 6, wherein the plurality of keyboard keys comprises approximately 48 keyboard keys, and wherein the processing device is coupled to the sensing device using 4 capacitance sensing pins.

9. The apparatus of claim 6, wherein the plurality of keyboard keys comprises approximately 101 keyboard keys, and wherein the processing device is coupled to the sensing device using less than 12 capacitance sensing pins.

10. The apparatus of claim 6, wherein the plurality of keyboard keys comprises approximately 107 keyboard keys, and wherein the processing device is coupled to the sensing device using less than 21 capacitance sensing pins.

11. The apparatus of claim 6, wherein the plurality of keyboard keys comprises approximately 107 keyboard keys, and wherein the processing device is coupled to the sensing device using less than 12 capacitance sensing pins.

12. The apparatus of claim 6, wherein a total surface area of the assigned keyboard keys is less than approximately 10 centimeters (cm) by 10 cm.

13. The apparatus of claim 6, wherein a total surface area of the assigned keyboard keys is approximately 3 centimeters (cm) by 3 cm.

14. The apparatus of claim 6, wherein the sensing device comprises a capacitance sensor matrix comprising the plurality of sensor elements configured in rows and columns to detect the presence of the conductive object on the sensing device, and wherein the plurality of keyboard keys are assigned to the pre-defined areas of the capacitance sensor matrix.

15. The apparatus of claim 14, wherein the processing device comprises one or more capacitance sensors coupled to the capacitance sensor matrix, wherein the one or more capacitance sensors are operable to measure a capacitance of each row of sensor elements of the capacitance sensor matrix, and to measure a capacitance of each column of sensor elements of the capacitance sensor matrix, and wherein the processing device is operable to determine the position of the presence of the keyboard key using the measured capacitance of the rows and columns of sensor elements of the capacitance sensor matrix.

16. The apparatus of claim 15, wherein the one or more capacitance sensors are relaxation oscillators, wherein each relaxation oscillator comprises:

a current source to provide a charge current to the plurality of sensor elements;

a selection circuit coupled to the plurality of sensor elements and the current source, wherein the selection circuit is operable to sequentially select a sensor element of the plurality of sensor elements to provide the charge current and to measure the capacitance of each sensor element of the sensing device;

a comparator coupled to the current source and the selection circuit, wherein the comparator is operable to compare a voltage on the selected sensor element and a threshold voltage; and

a reset switch coupled to the comparator, current source, and selection circuit, wherein the reset switch is operable to reset the charge current on the selected sensor element, wherein the one or more capacitance sensors further comprise a digital counter coupled to the relaxation oscillator, wherein the digital counter is operable to count at least one of a frequency of an oscillator output or a period of the oscillator received from the relaxation oscillator.

17. The apparatus of claim 6, further comprising a component external to the processing device, wherein the processing device is operable to send keyboard data to the component that corresponds to the selected keyboard key.

18. The apparatus of claim 17, wherein the component external to the processing device is at least one of a processor, a driver of a processor, or an embedded controller.

19. The apparatus of claim 17, wherein the keyboard data comprises is at least one of a keyboard data signal, or a keyboard data command.

20. The apparatus of claim 6, wherein the sensing device is mounted on a mobile handset.

21. The apparatus of claim 6, wherein the processing device is coupled to an additional user input device, and wherein the additional input device is at least one of a cursor positioning device, a touch-sensor pad, a touch-sensor slider, a touch-sensor button, mouse, or a touch-screen display.

22. An apparatus, comprising:

a sensing device comprising a plurality of sensor elements to detect a presence of a conductive object on the sensing device, wherein a plurality of keyboard keys are assigned to pre-defined areas of the sensing device;

means for determining a position of the presence of the conductive object on the sensing device; and

means for selecting a keyboard key of the plurality of keyboard keys based on the position of the presence of the conductive object and the pre-defined areas of the sensing device.

23. The apparatus of claim 22, further comprising means for assigning the plurality of keyboard keys into the pre-defined areas of the sensing device.

24. The apparatus of claim 22, further comprising means for reducing a number of capacitance sensing pins used to connect the sensing device to the means for determining the position of the conductive object.

25. The apparatus of claim 22, further comprising means for reducing a total surface area of the sensing device while maintaining a number of keyboard keys on a device.

26. The apparatus of claim 22, further comprising means for outputting keyboard data based on the position of the presence of the keyboard key.

ABSTRACT

An apparatus and method for selecting a keyboard key based on a position of a presence of a conductive object on a sensing device and a pre-defined area of the keyboard key. The apparatus may include a sensing device and a processing device. The sensing device may include a plurality of sensor elements to detect a presence of a conductive object on the sensing device. Multiple keyboard keys are assigned to pre-defined areas of the sensing device. The processing device is coupled to the sensing device using capacitance sensing pins, and may be operable to determine a position of the presence of the conductive object, and to select a keyboard key based on the position of the conductive object and the pre-defined areas of the sensing device.

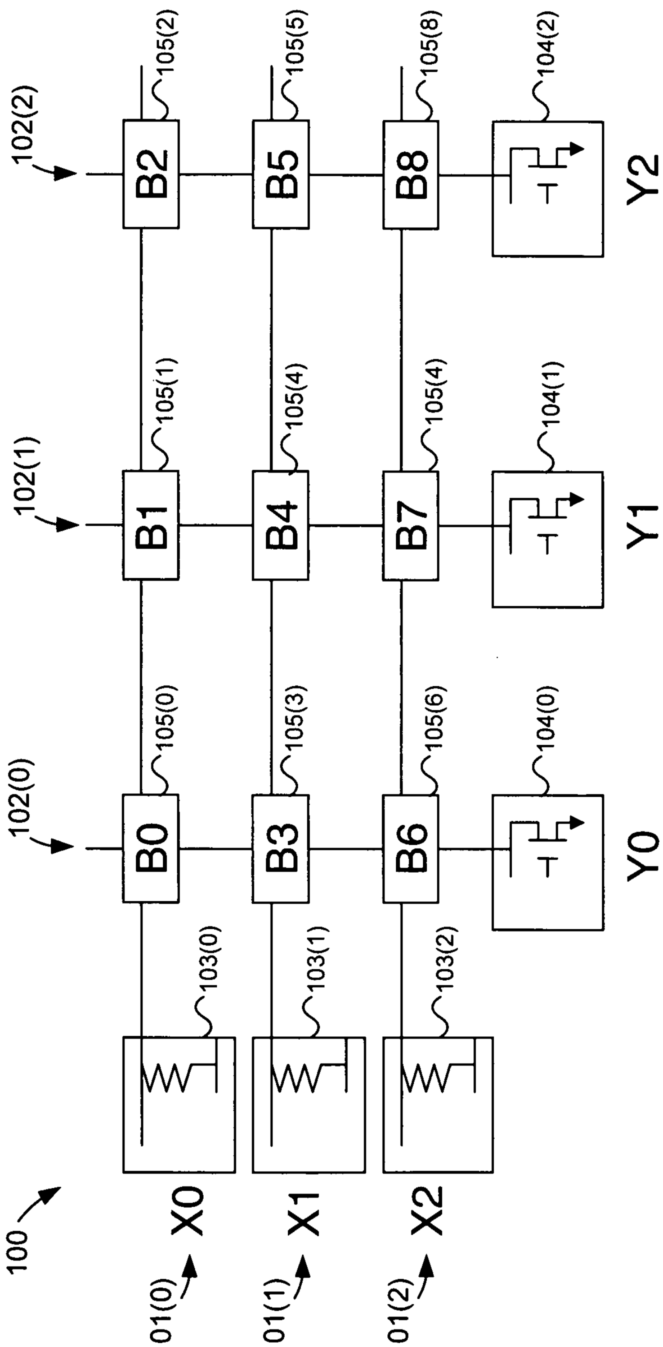

100
101(0)
101(1)
101(2)
X0
X1
X2
103(0)
103(1)
103(2)
102(0)
102(1)
102(2)
B0
B1
B2
B3
B4
B5
B6
B7
B8
105(0)
105(1)
105(2)
105(3)
105(4)
105(5)
105(6)
105(4)
105(8)
104(0)
104(1)
104(2)
Y0
Y1
Y2

FIG. 1A

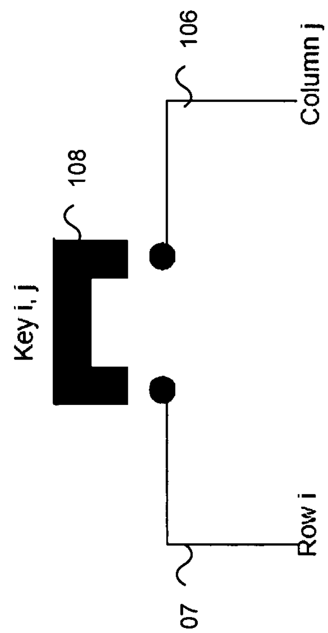
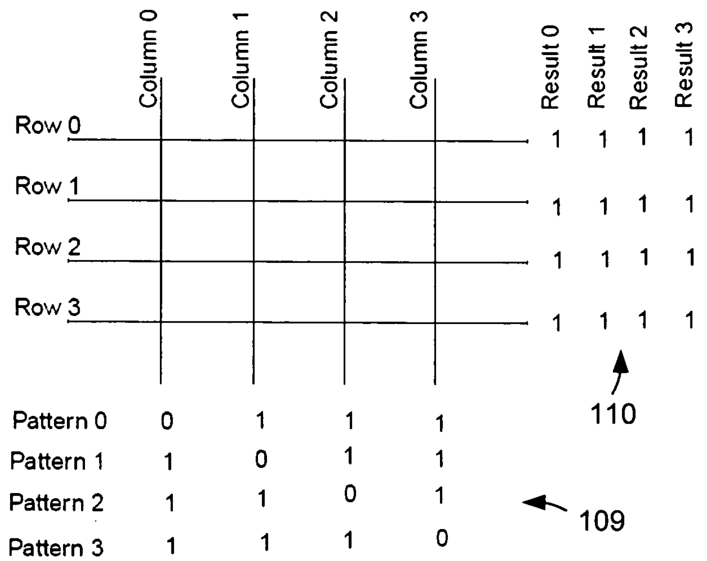
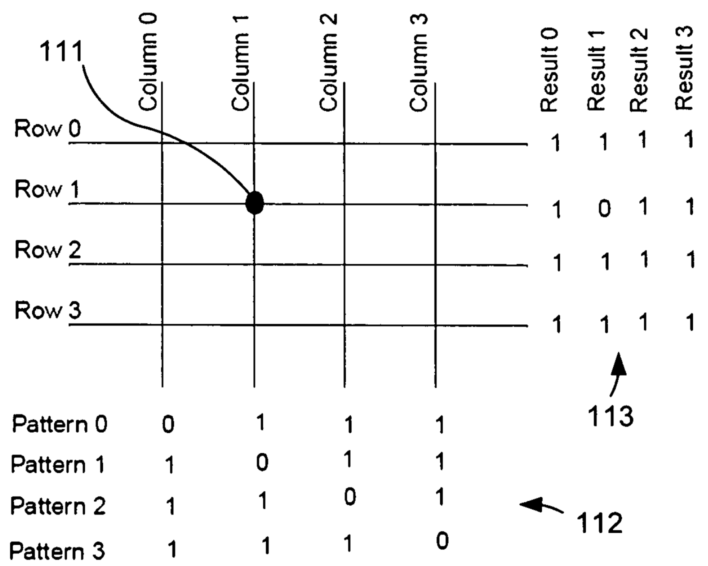

Key i, j
108
106
Column j
107
Row i

FIG. 1B



. Scan Results For No Key Press

FIG. 1C



Scan Results for Key $_{1,1}$ Pressed

FIG. 1D

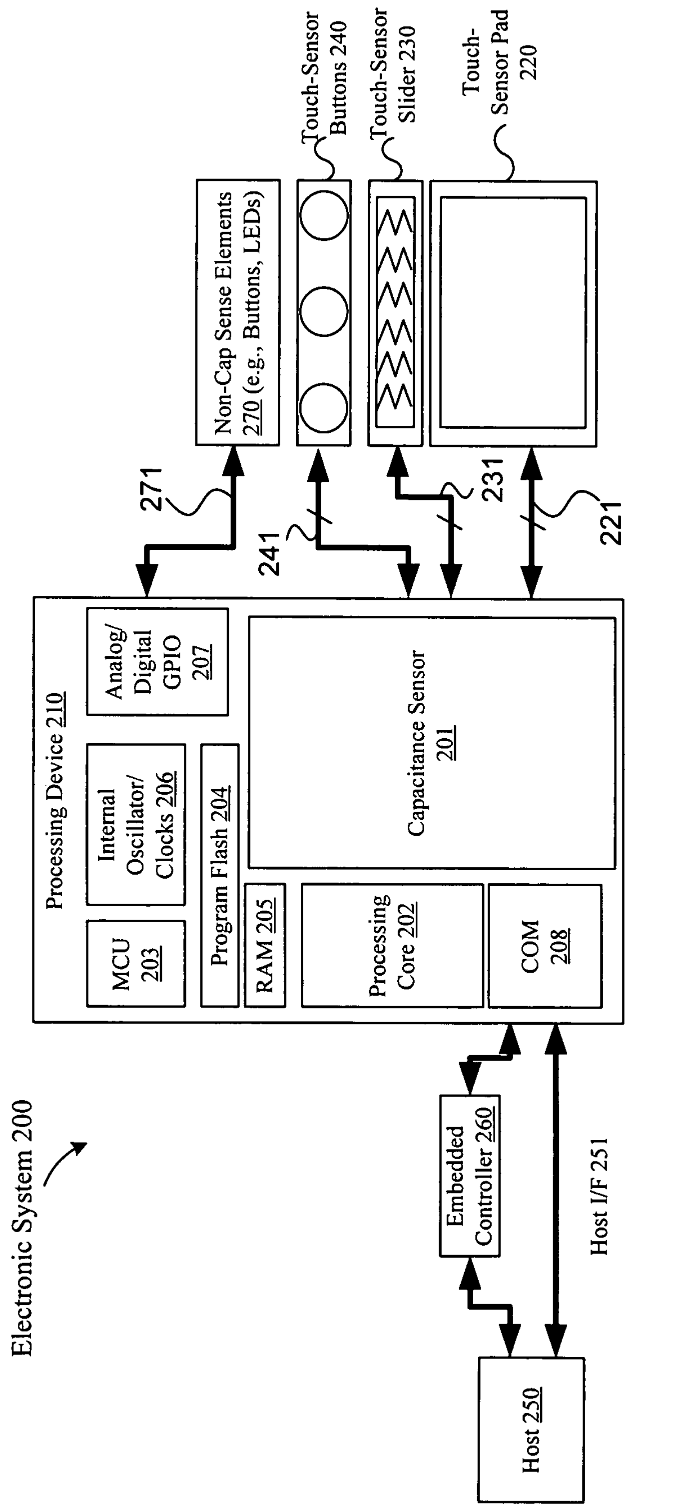

Electronic System 200
Host 250
Embedded Controller 260
Host I/F 251
Processing Device 210
MCU 203
Internal Oscillator/ Clocks 206
Analog/ Digital GPIO 207
Program Flash 204
RAM 205
Processing Core 202
COM 208
Capacitance Sensor 201
Non-Cap Sense Elements 270 (e.g., Buttons, LEDs)
Touch-Sensor Buttons 240
Touch-Sensor Slider 230
Touch-Sensor Pad 220
271
241
231
221

FIG. 2

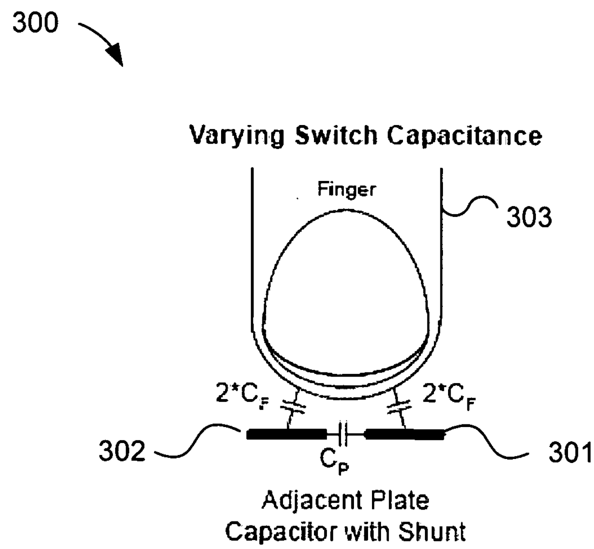

300
Varying Switch Capacitance
Finger
303
2*C_F
2*C_F
302
C_P
301
Adjacent Plate
Capacitor with Shunt

FIG. 3A

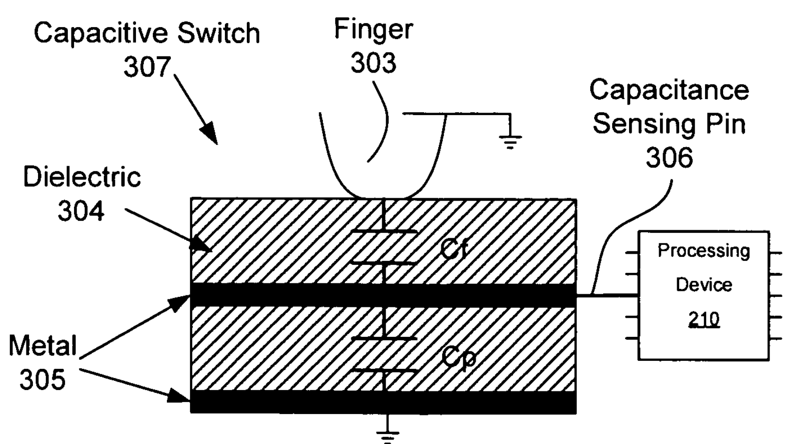

Capacitive Switch
307
Finger
303
Capacitance
Sensing Pin
306
Dielectric
304
Cf
Processing
Device
210
Metal
305
Cp

FIG. 3B

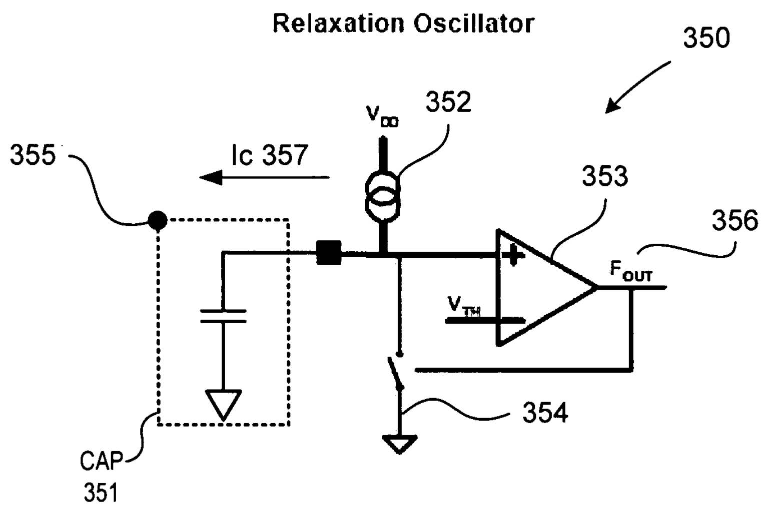

Relaxation Oscillator
350
352
V_{DD}
355
Ic 357
353
356
F_{OUT}
V_{TH}
354
CAP 351

FIG. 3C

Blakely, Sokoloff, Taylor & Zafman LLP (408) 720-8300
Title: A LOW PIN COUNT SOLUTION USING CAPACITANCE SENSING MATRIX FOR KEYBOARD ARCHITECTURE
1st Named Inventor: Liu Hua
Express Mail No.: EV839870954US Docket No.: 16820P442
Sheet: 6/14

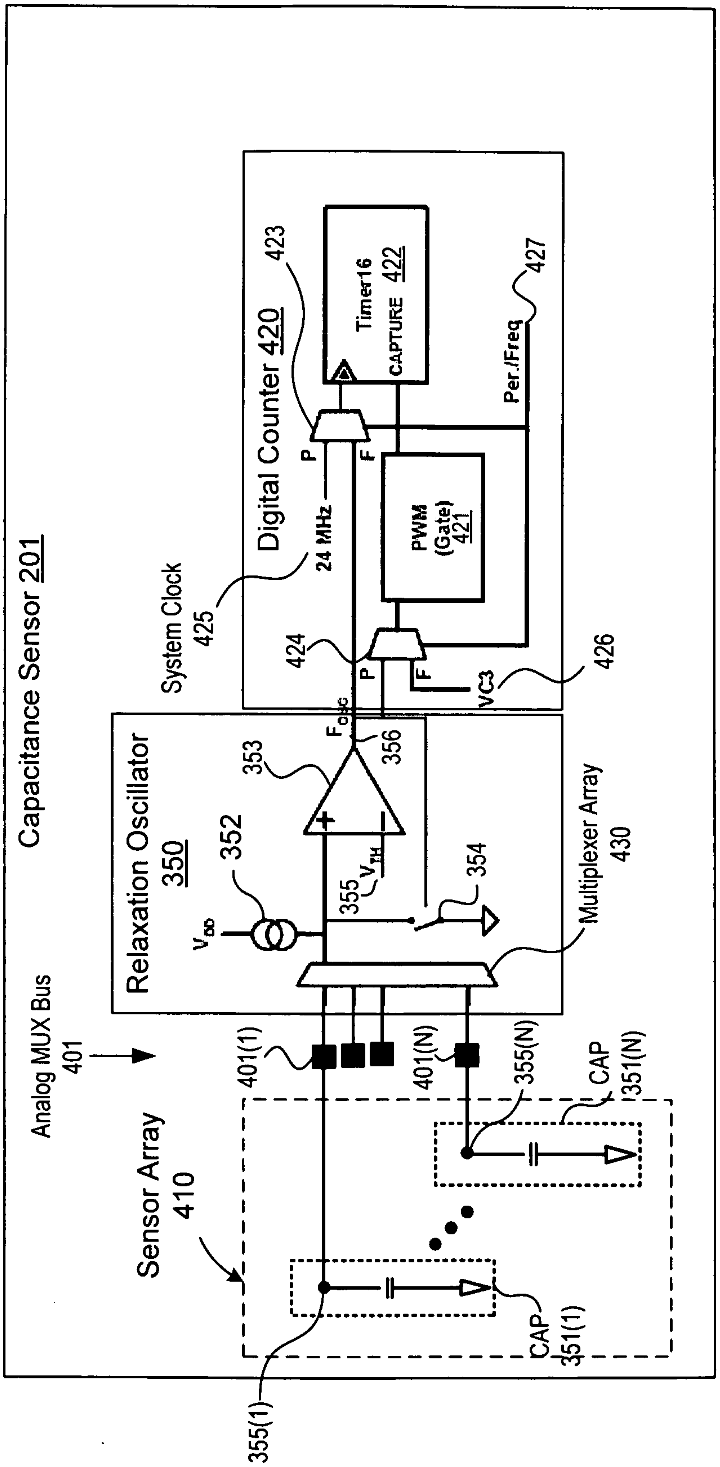


FIG. 4

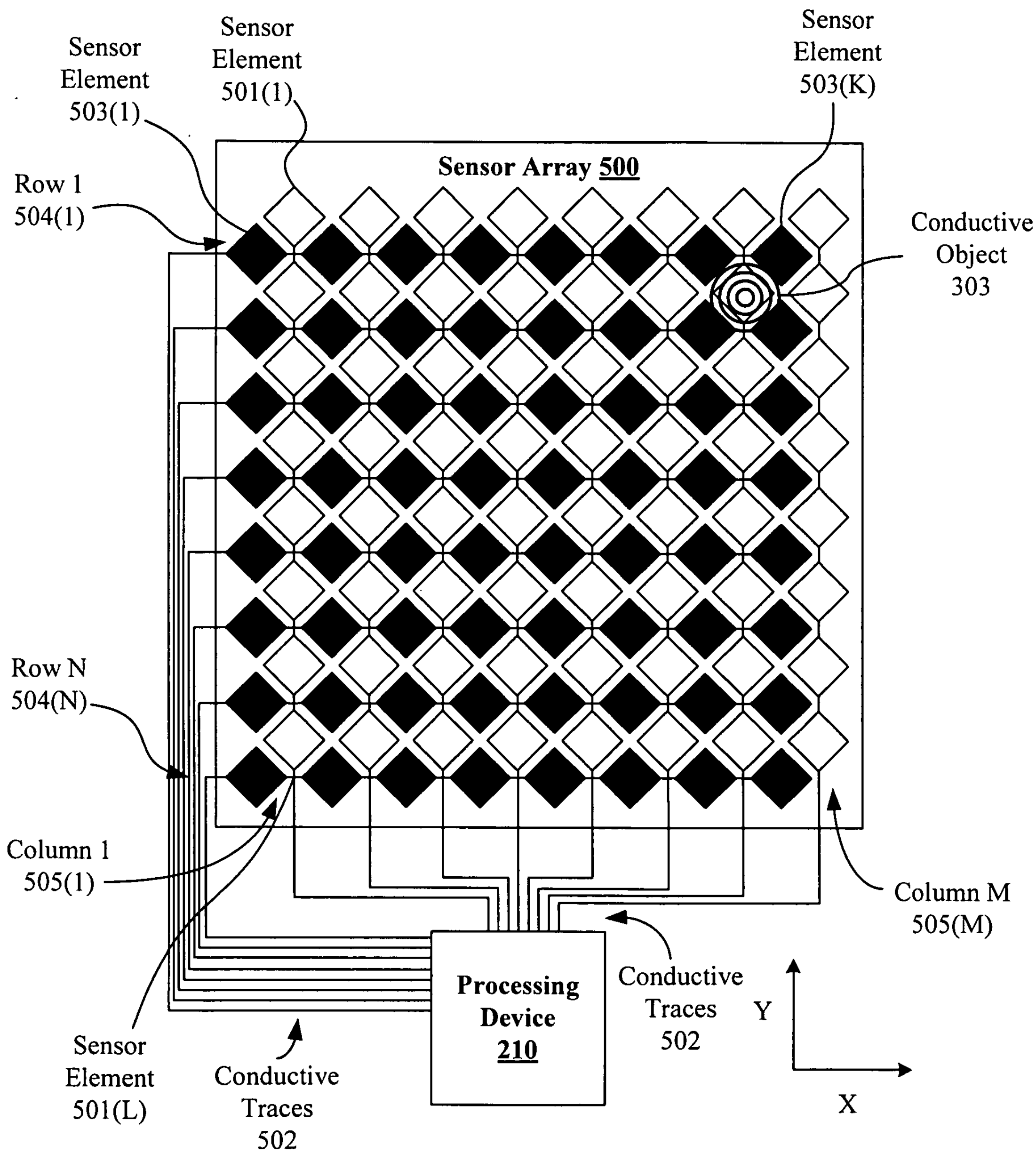

Sensor Element 503(1)
Sensor Element 501(1)
Sensor Element 503(K)
Sensor Array 500
Row 1 504(1)
Conductive Object 303
Row N 504(N)
Column 1 505(1)
Column M 505(M)
Processing Device 210
Conductive Traces 502
Y
X
Sensor Element 501(L)
Conductive Traces 502

FIG. 5A

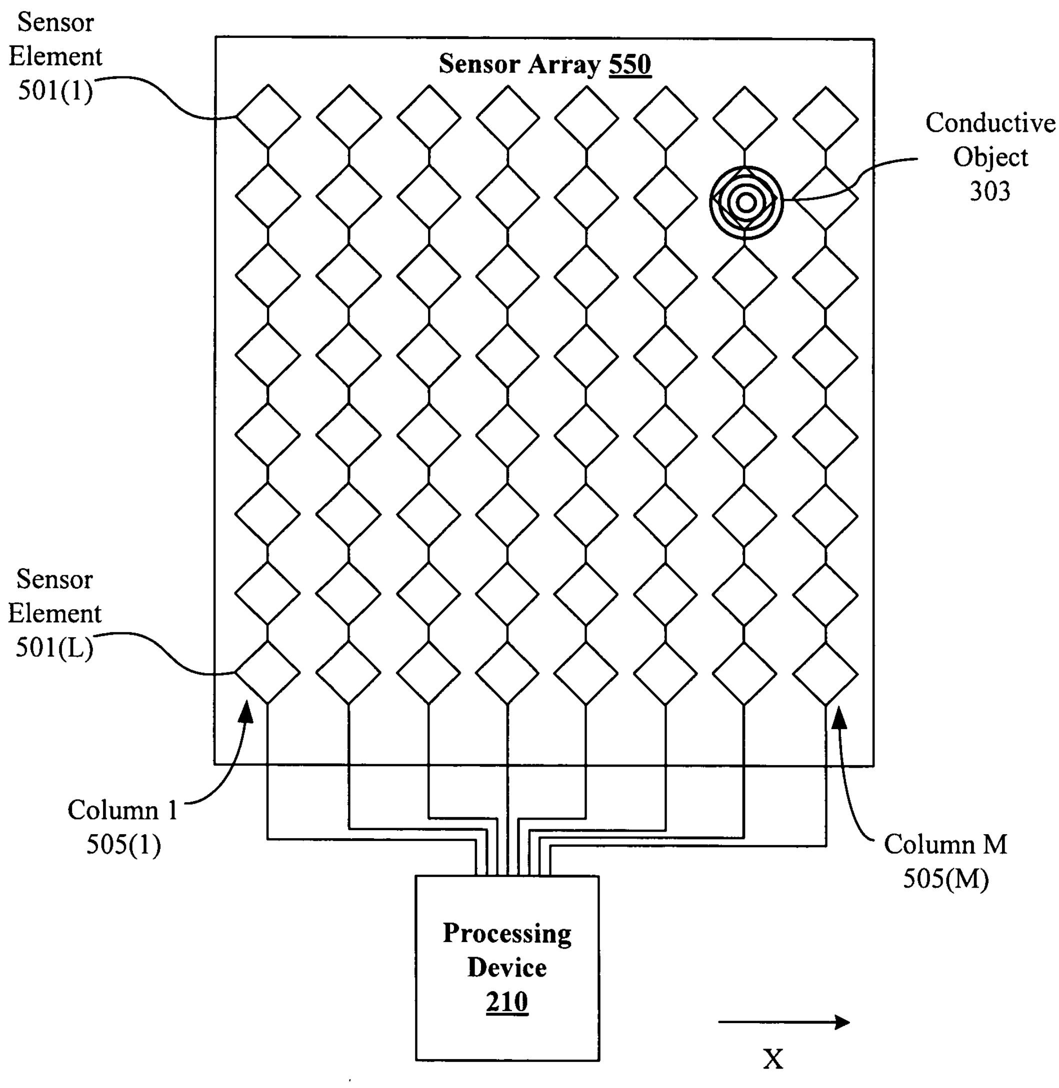

Sensor Element 501(1)
Sensor Array 550
Conductive Object 303
Sensor Element 501(L)
Column 1 505(1)
Column M 505(M)
Processing Device 210
X

FIG. 5B

TOP-VIEW of 2-Layer Touch-Sensor Pad 220

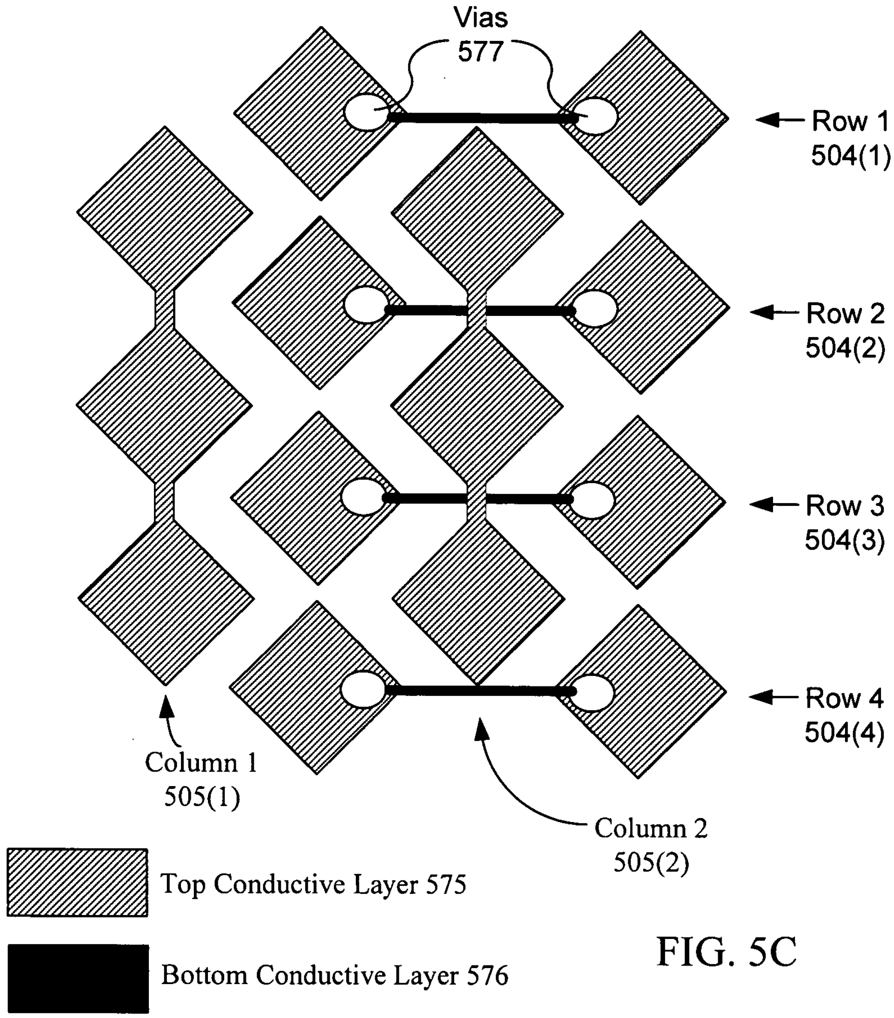


FIG. 5C

CROSS-SECTIONAL VIEW of 2-Layer Touch-Sensor Pad 220

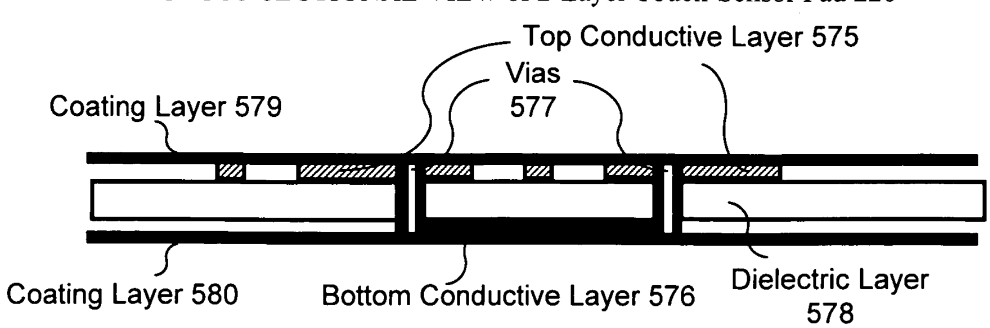


FIG. 5D

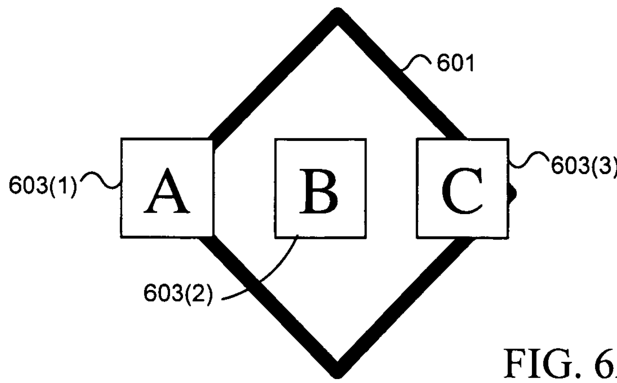

601
603(1)
A
B
C
603(3)
603(2)

FIG. 6A

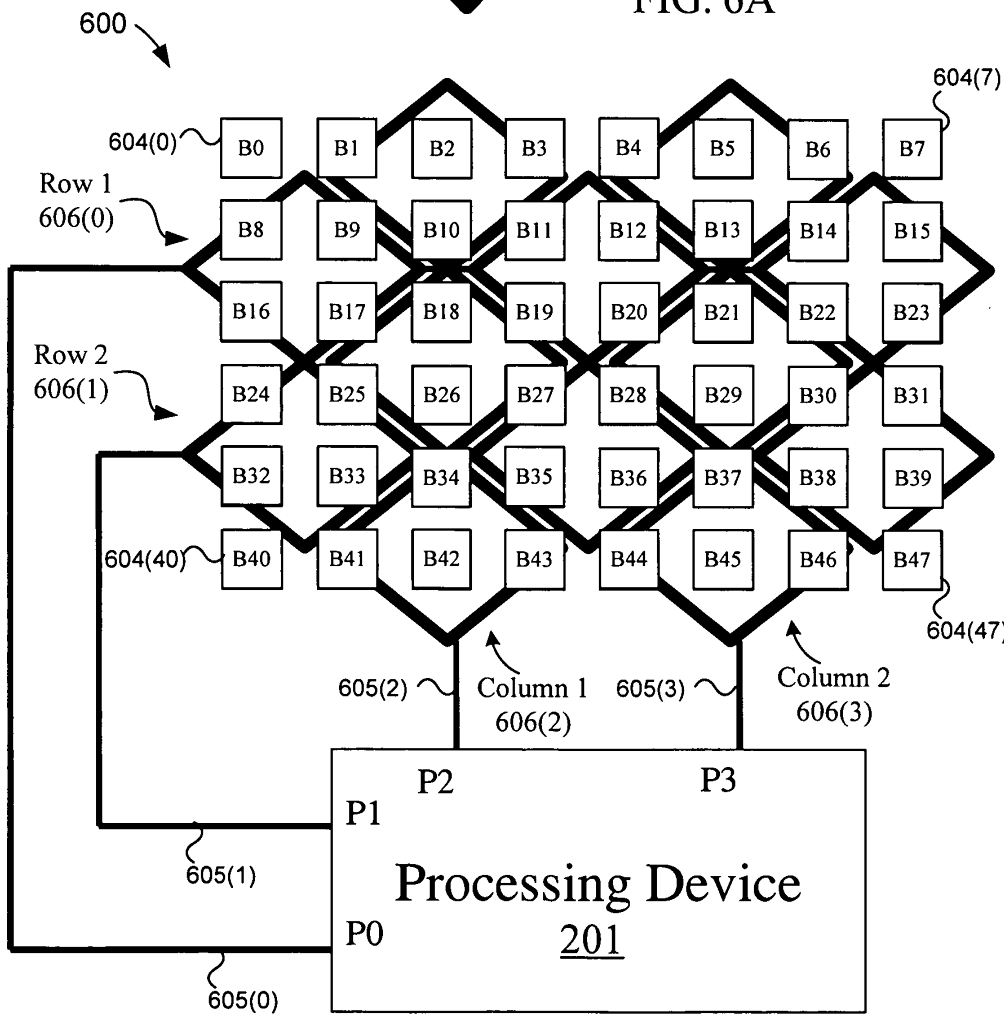

600
604(7)
604(0)
B0
B1
B2
B3
B4
B5
B6
B7
Row 1
606(0)
B8
B9
B10
B11
B12
B13
B14
B15
B16
B17
B18
B19
B20
B21
B22
B23
Row 2
606(1)
B24
B25
B26
B27
B28
B29
B30
B31
B32
B33
B34
B35
B36
B37
B38
B39
604(40)
B40
B41
B42
B43
B44
B45
B46
B47
604(47)
605(2)
Column 1
606(2)
605(3)
Column 2
606(3)
P2
P3
P1
605(1)
Processing Device
201
P0
605(0)

FIG. 6B

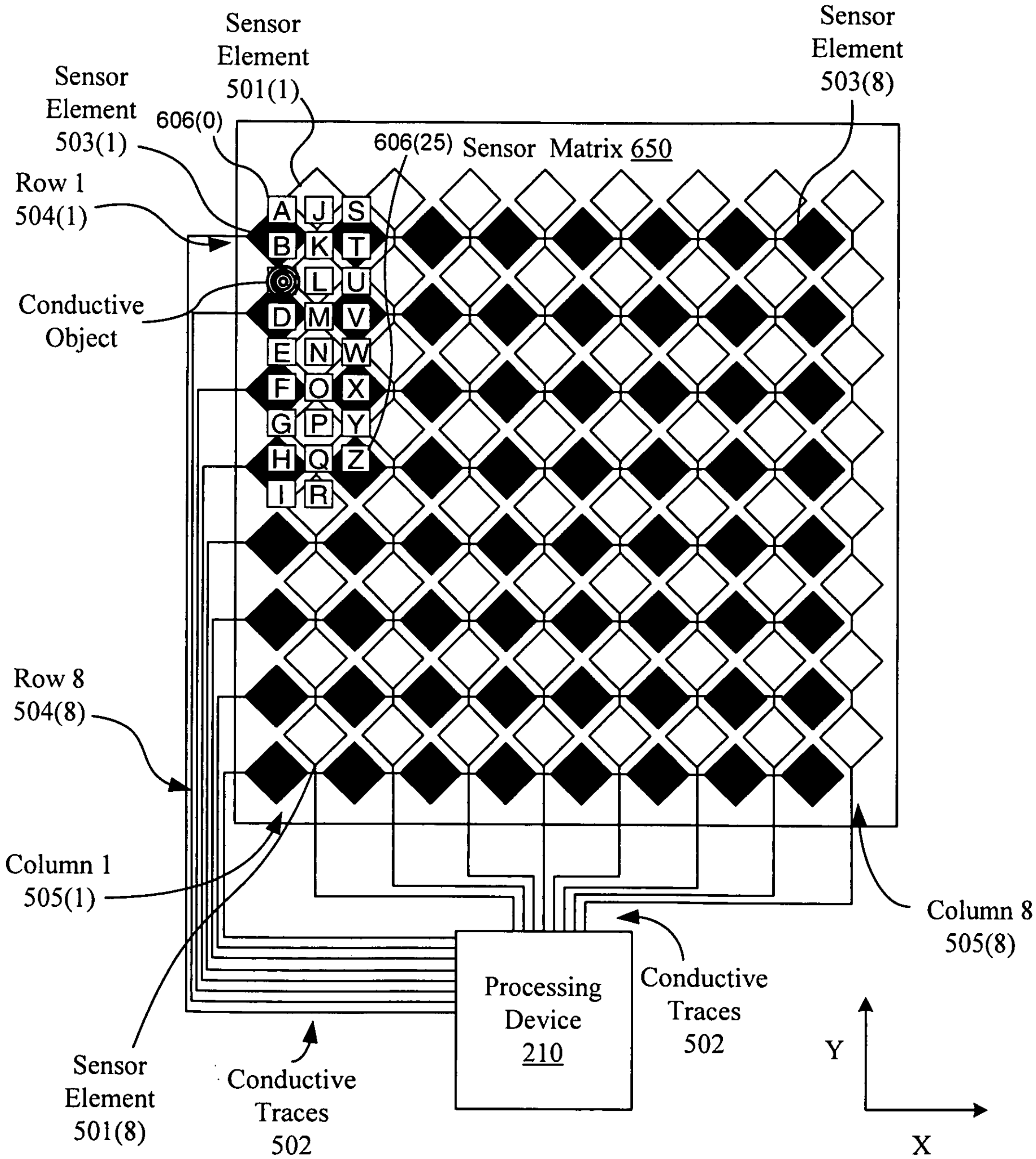
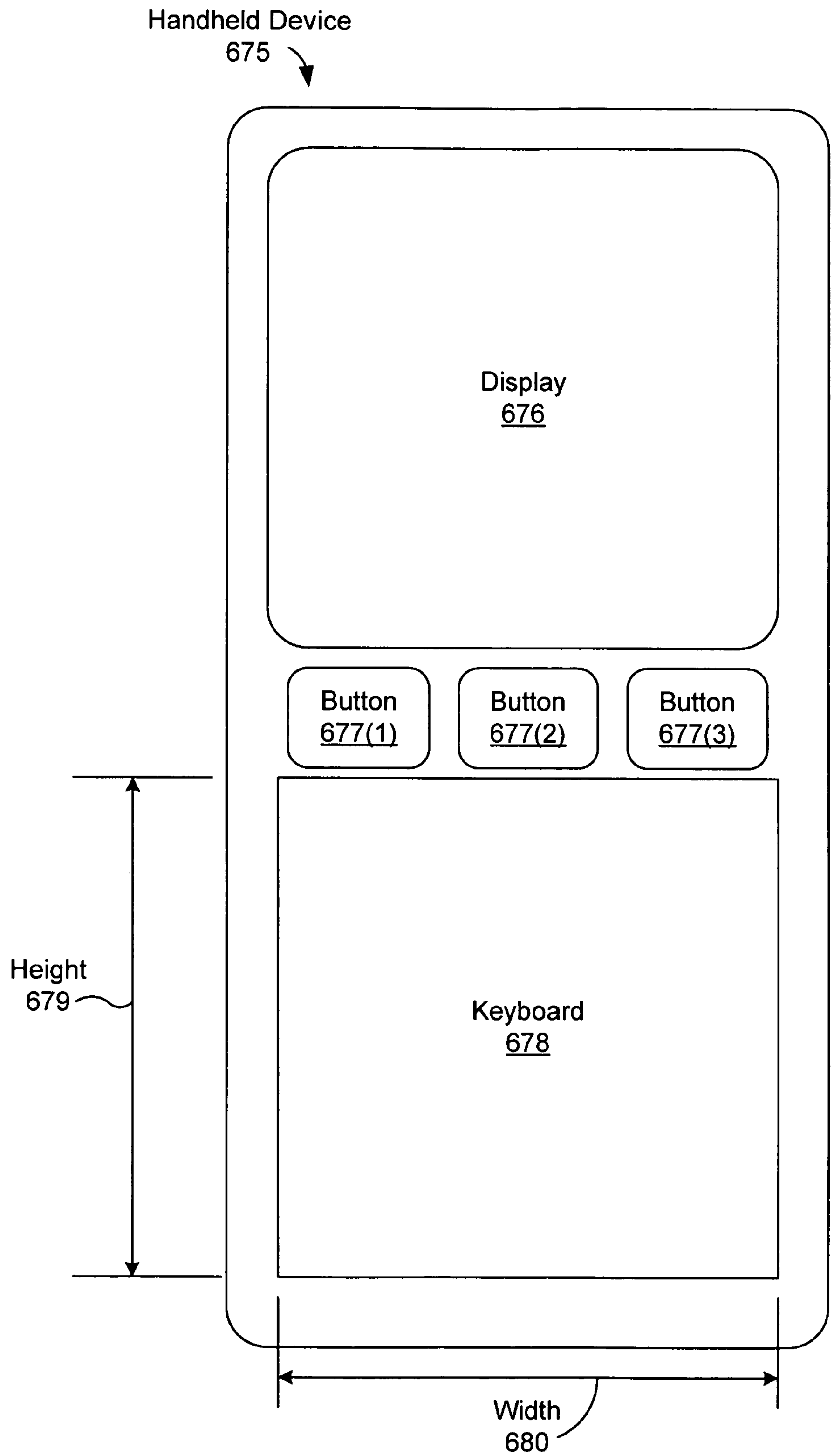

Sensor Element 501(1)
Sensor Element 503(8)
Sensor Element 503(1)
606(0)
606(25)
Sensor Matrix 650
Row 1 504(1)
Conductive Object
A J S
B K T
L U
D M V
E N W
F O X
G P Y
H Q Z
I R
Row 8 504(8)
Column 1 505(1)
Column 8 505(8)
Processing Device 210
Conductive Traces 502
Sensor Element 501(8)
Conductive Traces 502
Y
X

FIG. 6C


Handheld Device
675
Display
676
Button
677(1)
Button
677(2)
Button
677(3)
Keyboard
678
Height
679
Width
680

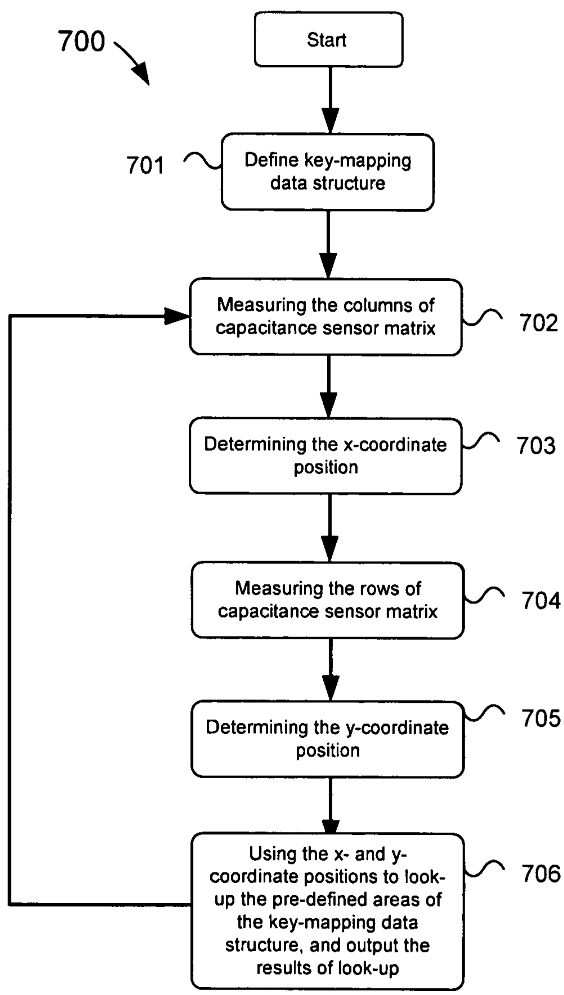

700
Start
701
Define key-mapping data structure
Measuring the columns of capacitance sensor matrix
702
Determining the x-coordinate position
703
Measuring the rows of capacitance sensor matrix
704
Determining the y-coordinate position
705
Using the x- and y-coordinate positions to look-up the pre-defined areas of the key-mapping data structure, and output the results of look-up
706

FIG. 7

Position 804
X- Coordinate 802 Y- Coordinate 803
Key 801

P (17 08)	F (13 08)	E (11 08)	E (0E 08)	D (0D 07)
D (0C 08)	D (09 08)	C (08 07)	C (08 07)	C (05 06)
B (04 06)	B (03 06)	B (02 06)	B (02 06)	B (02 06)
B (02 06)	B (02 06)	B (01 06)	B (01 06)	B (01 06)
B (00 06)	A (00 08)	A (00 08)	A (01 0A)	K (01 0A)
K (02 0A)	K (03 0D)	K (03 0C)	K (03 0D)	K (03 0D)
K (06 0E)	L (08 0E)	L (0A 0F)	L (0D 10)	M (0F 0F)
M (12 10)	N (13 12)	N (17 13)	O (18 13)	O (1A 14)
Y (1C 13)	P (1E 11)	P (1F 11)	Q (21 10)	Q (21 11)
Q (21 11)	Q (22 10)	Q (23 0F)	Q (23 0E)	Q (25 0E)
R (26 0D)	R (26 0D)	R (26 0D)	R (24 0E)	R (21 10)
Q (1F 11)	Q (1C 12)	P (17 13)	O (14 14)	W (12 15)
W (0D 14)	V (0C 14)	V (0B 15)	V (08 14)	U (04 13)
K (02 10)	K (02 0E)	K (01 0E)	K (02 0D)	K (02 0D)
K (04 0B)	K (08 0B)	L (0A 0B)	L (0D 0B)	M (10 0B)
N (12 0B)	N (13 0B)	N (14 0B)	N (15 0B)	O (16 0B)
O (17 09)	F (1C 08)	G (20 08)	H (25 08)	I (2B 05)
J (2D 03)	J (2C 03)	J (26 04)	I (1C 05)	G (16 05)
F (12 05)	E (0D 05)	D (08 05)	C (03 05)	B (01 05)
B (00 05)	A (02 06)	B (02 08)	B (03 09)	B (08 09)
C (0D 0A)	M (15 09)	F (1A 0C)	P (1C 0C)	P (21 0B)
Q (23 0A)	Q (26 08)	I (27 07)	I (2A 05)	J (2B 05)
J (2D 03)	J (2D 00)	J (26 03)	I (17 07)	F (0D 0B)
M (09 0D)	L (08 0C)	L (05 0B)		

FIG. 8

Attorney Docket No.: 16820P442 Patent

First Named Inventor: Liu Hua

Check One:

X Declaration Submitted with Initial Filing OR

___ Declaration Submitted After Initial Filing (Surcharge under 37 C.F.R. § 1.16(e) Required).

Complete If Known:

Application No.: ______

Filing Date: ______

Art Unit: ______

Examiner Name: ______

DECLARATION AND POWER OF ATTORNEY FOR UTILITY OR DESIGN PATENT APPLICATION

I hereby declare that:

Each inventor's residence, mailing address, and citizenship are as stated below next to their name.

I believe the inventor(s) named below to be the original and first inventor(s) of the subject matter which is claimed and for which a patent is sought on the invention entitled:

A LOW PIN COUNT SOLUTION USING CAPACITANCE SENSING MATRIX FOR KEYBOARD ARCHITECHTURE

(Title of the Invention)

the specification of which

X is attached hereto **OR**

___ was filed on ______
as United States Application Number ______
or PCT International Application Number ______
and was amended on (MM/DD/YYYY) ______.
(if applicable)

I hereby state that I have reviewed and understand the contents of the above-identified specification, including the claim(s), as amended by any amendment specifically referred to above.

I do not know and do not believe that the claimed invention was ever known or used in the United States of America before my invention thereof, or patented or described in any printed publication in any country before my invention thereof or more than one year prior to this application. I do not know and do not believe that the claimed invention was in public use or on sale in the United States of America more than one year prior to this application, nor do I know or believe that the invention has been patented or made the subject of an inventor's certificate issued before the date of this application in any country foreign to the United States of America on an application filed by me or my legal representatives or assigns more than twelve months (for a utility patent application) or six months (for a design patent application) prior to this application.

I acknowledge the duty to disclose information which is material to patentability as defined in 37 C.F.R. 1.56, including for continuation-in-part applications, material information which became available between the filing date of the prior application and the national or PCT international filing date of the continuation-in-part application.

I hereby claim foreign priority benefits under 35 U.S.C. 119(a)-(d) or (f), or 365(b) of any foreign application(s) for patent, inventor's or plant breeder's rights certificate(s), or 365(a) of any PCT international application which designated at least one country other than the United States of America, listed below and have also identified below, by checking the box, any foreign application for patent, inventor's or plant breeder's rights certificate(s), or any PCT international application having a filing date before that of the application on which priority is claimed:

Prior Foreign Application(s)			Priority Claimed?		Certified Copy Attached?	
(Number)	(Country)	(Foreign Filing Date - MM/DD/YYYY)	Yes	No	Yes	No
(Number)	(Country)	(Foreign Filing Date - MM/DD/YYYY)	Yes	No	Yes	No
(Number)	(Country)	(Foreign Filing Date - MM/DD/YYYY)	Yes	No	Yes	No

Appointment of Patent Practitioners:

I hereby appoint the patent practitioners associated with the **Customer Number** 08791 as my respective patent attorneys and patent agents, with full power of substitution and revocation, to prosecute this application and to transact all business in the U.S. Patent and Trademark Office connected herewith.

If this patent application is assigned, then the undersigned hereby authorizes the patent attorneys and patent agents named herein to accept and follow instructions from the assignee(s) as to any action to be taken in the United States Patent and Trademark Office regarding this application without direct communication between the patent attorneys and patent agents and the undersigned. In the event of a change in the persons from whom instructions may be taken, at least one patent attorney or patent agent named herein will be so notified by the undersigned.

Direct all correspondence to (check one):

_X_ **Customer Number** 08791 **OR**

____ **Correspondence Address Below:**

(Name of Attorney or Agent)
BLAKELY, SOKOLOFF, TAYLOR & ZAFMAN LLP
12400 Wilshire Boulevard
Seventh Floor
Los Angeles, California 90025 U.S.A.
Telephone: (408) 720-8300
Fax: (408) 720-8383

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under 18 U.S.C. 1001 and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

NAME OF SOLE OR FIRST INVENTOR: ☐ A petition has been filed for this unsigned inventor

Full Name: Liu Hua
(Given Name (First and Middle [if any]), Family Name (or Surname), and Suffix [if any])

Inventor's Signature Liu Hua Date 5/24/2006

Residence Shanghai, P.R. China Citizenship China
(City, State, Country) *(Country)*

Mailing Address Room 06-07, 26 F, 1 Gateway Plaza, No. 1 Hong Qiao Road
Shanghai, P.R. China, 200030

NAME OF SECOND INVENTOR: ☐ A petition has been filed for this unsigned inventor

Full Name: Jiang XiaoPing
(Given Name (First and Middle [if any]), Family Name (or Surname), and Suffix [if any])

Inventor's Signature Jiang XiaoPing Date May. 24, 2006

Residence Shanghai, P.R. China Citizenship China
(City, State, Country) *(Country)*

Mailing Address Room 06-07, 26 F, 1 Gateway Plaza, No. 1 Hong Qiao Road
Shanghai, P.R. China, 200030

PTO/SB/06 (12-04)
Approved for use through 7/31/2006. OMB 0651-0032
U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE
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PATENT APPLICATION FEE DETERMINATION RECORD

Substitute for Form PTO-875 Effective December 8, 2004

Application or Docket Number: 11/440,924

APPLICATION AS FILED – PART I

FOR	NUMBER FILED (Column 1)	NUMBER EXTRA (Column 2)	SMALL ENTITY RATE ($)	SMALL ENTITY FEE ($)	OR	OTHER THAN SMALL ENTITY RATE ($)	OTHER THAN SMALL ENTITY FEE ($)
BASIC FEE (37 CFR 1.16(a), (b), or (c))	N/A	N/A	N/A	150.00		N/A	300.00
SEARCH FEE (37 CFR 1.16(k), (i), or (m))	N/A	N/A.	N/A	$250		N/A	$500
EXAMINATION FEE (37 CFR 1.16(o), (p), or (q))	N/A	N/A	N/A	$100		N/A	$200
TOTAL CLAIMS (37 CFR 1.16(i))	26 minus 20 =	* 6	X$ 25 =		OR	X$50 =	300
INDEPENDENT CLAIMS (37 CFR 1.16(h))	3 minus 3 =	* –	X100 =			X200 =	
APPLICATION SIZE FEE (37 CFR 1.16(s))	If the specification and drawings exceed 100 sheets of paper, the application size fee due is $250 ($125 for small entity) for each additional 50 sheets or fraction thereof. See 35 U.S.C. 41(a)(1)(G) and 37 CFR 1.16(s).						
MULTIPLE DEPENDENT CLAIM PRESENT (37 CFR 1.16(j))			+180=			+360=	
			TOTAL			TOTAL	1300

* If the difference in column 1 is less than zero, enter "0" in column 2.

1
6
22

APPLICATION AS AMENDED – PART II

AMENDMENT A

	CLAIMS REMAINING AFTER AMENDMENT (Column 1)		HIGHEST NUMBER PREVIOUSLY PAID FOR (Column 2)	PRESENT EXTRA (Column 3)	SMALL ENTITY RATE ($)	SMALL ENTITY ADDITIONAL FEE ($)	OR	OTHER THAN SMALL ENTITY RATE ($)	OTHER THAN SMALL ENTITY ADDITIONAL FEE ($)
Total (37 CFR 1.16(i))	*	Minus	**	=	X$ 25 =		OR	X$50 =	
Independent (37 CFR 1.16(h))	*	Minus	***	=	X100 =		OR	X200 =	
Application Size Fee (37 CFR 1.16(s))									
FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM (37 CFR 1.16(j))					+180=		OR	+360=	
					TOTAL ADD'L FEE		OR	TOTAL ADD'L FEE	

AMENDMENT B

	CLAIMS REMAINING AFTER AMENDMENT (Column 1)		HIGHEST NUMBER PREVIOUSLY PAID FOR (Column 2)	PRESENT EXTRA (Column 3)	SMALL ENTITY RATE ($)	SMALL ENTITY ADDITIONAL FEE ($)	OR	OTHER THAN SMALL ENTITY RATE ($)	OTHER THAN SMALL ENTITY ADDITIONAL FEE ($)
Total (37 CFR 1.16(i))	*	Minus	**	=	X$ 25 =		OR	X$50 =	
Independent (37 CFR 1.16(h))	*	Minus	***	=	X100 =		OR	X200 =	
Application Size Fee (37 CFR 1.16(s))									
FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM (37 CFR 1.16(j))					+180=		OR	+360=	
					TOTAL ADD'L FEE		OR	TOTAL ADD'L FEE	

* If the entry in column 1 is less than the entry in column 2, write "0" in column 3.
** If the "Highest Number Previously Paid For" IN THIS SPACE is less than 20, enter "20".
*** If the "Highest Number Previously Paid For" IN THIS SPACE is less than 3, enter "3".
The "Highest Number Previously Paid For" (Total or Independent) is the highest number found in the appropriate box in column 1.

PATENT APPLICATION SERIAL NO. ____________________

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05/30/2006 SFELEKE1 00000062 11440924

01	FC:1011	300.00 OP
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*U.S. Government Printing Office: 2002 — 489-267/69033

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In Re the Application of:	
LIU HUA, ET AL.	Art Group:
Application No.:	Examiner:
Filed:	
For: **A LOW PIN COUNT SOLUTION USING CAPACITANCE SENSING MATRIX FOR KEYBOARD ARCHITECTURE**	

INFORMATION DISCLOSURE STATEMENT UNDER 37 C.F.R. §1.97

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In accordance with the duty of disclosure, enclosed is a copy of IDS Citation Form PTO/SB/08 or PTO-1449, together with copies of the documents cited on that form, except for copies not required to be submitted (e.g., copies of U.S. patents and U.S. published patent applications need not be enclosed). This IDS and IDS Citation Form are being submitted concurrently with the Utility Application. It is respectfully requested that the cited references be considered and that the enclosed copy of PTO/SB/08 be initialed by the Examiner to indicate such consideration and a copy thereof returned to applicant(s).

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Please charge any fees due to Deposit Account 02-2666. A duplicate copy of the Fee Transmittal (PTO/SB/17) is enclosed for this purpose.

Respectfully submitted,

BLAKELY, SOKOLOFF, TAYLOR & ZAFMAN LLP

Date: 5/24/06

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INFORMATION DISCLOSURE STATEMENT BY APPLICANT				Application Number	
(use as many sheets as necessary)				Filing Date	
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Sheet	1	**of**	2	Attorney Docket Number	16820P442

U.S. PATENT DOCUMENTS

Examiner Initials*	Cite No.[1]	Document Number Number - Kind Code[2] *(if known)*	Publication Date Issue Date MM-DD-YYYY	Name of Patentee or Applicant of Cited Document	Pages, Columns, Lines, Where Relevant Passages or Relevant Figures Appear
		US-6,380,931	04-30-2002	Gillespie et al.	
		US-5,305,017	04-19-1994	Gerpheide	
		US-6,188,391	02-13-2001	Seely et al.	
		US-6,498,720 B2	12-24-2002	Glad	
		US-6,574,095 B2	06-03-2003	Suzuki	
		US-6,037,929	03-14-2000	Ogura et al.	
		US-4,103,252	07-25-1978	Bobick	
		US-4,736,191	04-05-1988	Matzke et al.	
		US-5,543,590	08-06-1996	Gillespie et al.	
		US-6,704,005 B2	03-09-2004	Kato et al.	
		US-6,262,717 B1	07-17-2001	Donohue et al.	
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FOREIGN PATENT DOCUMENTS

Examiner Initials*	Cite No.[1]	Foreign Patent Document Country Code[3] - Number[4] - Kind Code[5] *(if known)*	Publication Date MM-DD-YYYY	Name of Patentee or Applicant of Cited Document	Pages, Columns, Lines, Where Relevant Passages or Relevant Figures Appear	T[6]
		WO 00/02188 A1	01-13-2000	Cirque Corporation		
		EP 0 574 213	06-07-1993	Synaptics, Incorporated		

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				Art Unit	
				Examiner Name	
Sheet	2	**of**	2	Attorney Docket Number	16820P442

NON PATENT LITERATURE DOCUMENTS

Examiner Initials*	Cite No.[1]	Include name of the author (in CAPITAL LETTERS), title of the article (when appropriate), title of the item (book, magazine, journal, serial, symposium, catalog, etc.), date, page(s), volume-issue number(s), publisher, city and/or country where published.	T[2]
		Chapweske, Adam, "The PS/2 Mouse Interface", PS/2 Mouse Interfacing, 2001, 10 pages.	
		"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, 4 pages, dowloaded April 13, 2006.	
		"CY8C21x34 Data Sheet", Cypress Semiconductore Corporation, CSR User Module, CSR v1.0, October 6, 2005, pgs. 1-36.	
		"IBM PC keyboard", Wikipedia, the free encyclopedia, 3 pages, http://en.wikipedia.org/wiki/PC_keyboard	

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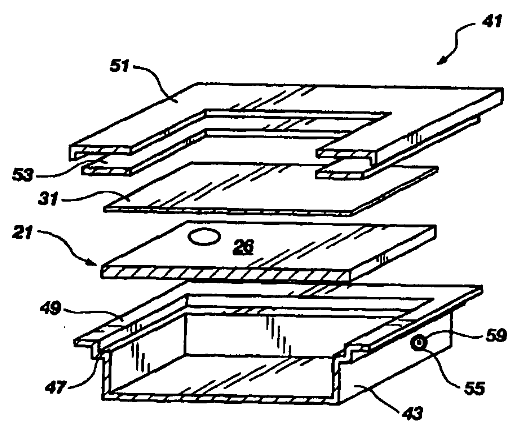

(57) Abstract

A simplified touch pad (21) which detects a "touch" in a specific absolute positioning programmable zone or "enter/select" zone (29) rather than requiring a "tap". The touch pad (21) also has an audible feedback device built into the touch pad (21) for immediate feedback and a touch sensitive surface (26) comprising a relative cursor positioning zone (27). By simplifying a touch pad (21)to include only basic functions, the touch pad (21) is easier to operate, simpler to manufacture, and more amenable to use with graphical interface display systems typically using touch screens. The invention is preferably incorporated into a kiosk (23) where simplified use is of great benefit. An embodiment of the invention includes an enclosure which completely seals the touch pad (21) from external contamination making the touch pad (21) waterproof and dust proof. A cover plate (51) also provides durability and added protection for the touch-sensitive surface (26) of the touch pad (21).

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KIOSK TOUCH PAD

TECHNICAL FIELD

This invention relates to an improved interface control for graphical user interface systems such as those currently using a touch screen. More specifically, the invention relates to a touch pad having a defined programmable input zone which responds to any "touch" or "push" rather than requiring a "tap" to input an "enter/select" command.

BACKGROUND

Computer systems today strive for "user friendliness." Through simpler, more clearly explained displays and easier-to-use interfaces, designers attempt to make a system understandable for both an expert and a first time user. Designers developed touch screen displays from this desire for user friendly systems. Touch screen displays comprise a display surface on which an operator can selectively display information or perform a function by touching an icon displayed on the screen in an interactive manner. The touch screen is operatively connected to a microprocessor which stores, computes, and supplies information required or functions to perform. Several touch screen displays and their applications are described in the following patents: U.S. Patent 5,737,729 to Denman (April 7, 1998), U.S. Patent 5,717,433 to Doba (February 10, 1998), U.S. Patent 5,572,573 to Sylvan (November 5, 1996), U.S. Patent 5,481,250 to Hano (January 2, 1996), and U.S. Patent 5,457,636 to Sansone (October 10, 1995).

A kiosk, or small stand, is used for merchandising or vending services or goods, or for accessing information. Kiosks are well known in the art as indicated by the following U.S. Patents: U.S. Patent 4,179,723 to Spencer (Dec. 18, 1979), U.S. Patent 4,265,059 to Johnson (May 5, 1981), U.S. Patent 4,817,043 to Brown (Mar. 28, 1989), and U.S. Patent 5,271,669 to Pearlson (Dec. 21, 1993). One advantage of a kiosk is that it can be provided in public areas and be used by many operators because of the simple, secure system provided in conjunction with the kiosk. Kiosks often include a microprocessor and visual display or monitor for interaction with the operator. This interaction is generally simple and allows an operator to step through several pre-set options by typing basic commands on a keyboard or selecting the options on a touch screen interface which perform internal functions such as calculations or displaying information, distributing merchandise or money, or if associated with a printing device and paper source, printing an output.

Touch screens are currently used in many commercial and noncommercial fields including industrial control systems such as plant and process controls, commercial control systems such as typical kiosk systems used with postal, photo, copy center, video phone, hospitals, and ATM systems, information kiosks such as those used in many tourist areas, libraries and restaurants, and many other systems where simple operator-interactive means are needed. Many systems also combine touch screens with other interface systems such as numeric or alphanumeric key pads (*e.g.*, ATMs), and other more simple function keys. Although touch screen systems, as they exist, function adequately, there are a number of inadequacies. First, touch screen displays are relatively expensive. A typical touch screen costs more than a non-touch screen display.

Second, because the screen of a touch screen needs to be touched to activate it and because touch screens give off heat, touch screens are not easy to completely seal from the environment. This draw back may become significant when the display needs to be used in an area where it will be subjected to dust, chemical or bacterial contamination, or where the risk of contact with moisture is high. Because the system is not completely sealed and insulated from its surroundings, careful, thorough cleaning methods are applied, and the risk exists that contamination will damage the internal components of the device or come in contact with a subsequent user.

Third, once the screen is touched, the operator must wait for the computer to indicate the operator pressed hard enough and long enough for the touch screen to register the selection. Depending on how busy the system's processes are, this passage of time can be almost instantaneous, or can take some time. Often this delay frustrates users who make a selection which the processor does not register and indicate fast enough and inadvertently make a second undesired selection by pressing again.

It would be advantageous to have a device as user friendly as a touch screen which is inexpensive, sealed to contamination, easily washable, and provides immediate feedback when an operator makes a selection.

User friendly input devices for computers are well known in the art. One of the several types of input devices is the familiar "mouse." When combined with a graphical user interface, a mouse can be much easier to use than typed keyboard commands. By moving the mouse across a surface, an operator causes a cursor to move correspondingly on a display screen. The mouse has been accepted as a "user friendly" input device for both experienced and novice computer users providing a simple means to interact with a computer. However, mice are disadvantageous in many applications because they generally require a free-rolling surface, *e.g.*, a table top, on which to operate. Thus, a mouse is not well suited for use in confined spaces, or where little or no surface space exists such as with a kiosk or other touch screen application. A mouse also includes mechanical parts which can become jammed, dirty or worn, and generally cannot be sealed from outside contamination.

In answer to the long existing need for a more convenient input device suitable for all space requirements, limited or not, various alternative input devices have been proposed. These alternative input devices include devices commonly referred to as track balls, track pens and track point devices, as well as various devices which sense the position of a pointing object on a position sensing surface. Devices which sense the position of a pointing object on a sensing surface generally have the advantages of being simple to use, reliable, rugged, compact and easy to integrate with current computers and other computing devices.

Numerous types of input devices utilize a position sensing surface. Examples are provided in various patent references. For example, U.S. Patent 3,886,311 to Rodgers et al. (May 27, 1975) discloses a writing pen for detecting time varying electrostatic field produced by a writing tablet. U.S. Patent 4,672,154, also to Rodgers et al. (June 9, 1987) discloses a cordless stylus which emits a directional electric field from the tip of a conductive pen cartridge sensed by a digitizer tablet having an X-Y coordinate system. U.S. Patent 4,680,430 to Yoshikawa et al. (July 14, 1987) discloses a tablet-like coordinate detecting apparatus including a resistive film for determining the coordinate position data of a point on a plane indicated by the touch of a finger tip or other load. U.S. Patent 4,103,252 to Bobick (July 25, 1978) discloses a position sensing tablet with electrodes located on the boundaries of a sensing region which detects a human touch by the change in capacitive charge caused by the touch which varies the time constant of an RC network which is part of an oscillator. U.S. Patent 4,736,191 to Matzke (April 5, 1988) discloses a touch activated control device comprising individual conductive plates wherein a user's touch on the dieleectric layer overlaying the plates is detected by individually charging and discharging each of the sectors in the plates in a sequential manner to determine the increased capacitance of the sector. U.S. Patent 4,550,221 to Mabusth (October 29, 1985) discloses a touch sensitive control device which translates touch location to output signals and which includes a substrate that supports first and second interleaved, closely spaced, non-overlapping conducting plates. U.S. Patent 4,639,720 to Rympalski et al. (January 27, 1987) discloses an electronic sketch pad which contains a graphics input pad having an array of transparent capacitive pixels, the capacitance characteristics of which are changed in response to the passing of a conductive tipped stylus over the surface of the pad. European Patent Publication 574,213 to Miller (filed July 6, 1993,) discloses a proximity sensor includes a sensor matrix array which senses changes in capacitance between horizontal and vertical conductors connected to the position sensing pad to determine x, y & z position information)).

Among recent additions to the position sensing pad art is U.S. Patent 5,305,017 to Gerpheide (April 19, 1994). The devices and methods of the Gerpheide patent include a touch sensitive input pad upon which a user conveniently inputs position information with a finger. In operation, the user's finger tip is brought in close proximity to the top surface of the position sensing surface of the touch sensitive pad. The device of the Gerpheide patent detects the position of the finger tip in the horizontal ("x") and vertical ("y") directions of the touch pad as well as the finger's proximity in the z direction in relation to the sensing surface. A device with a relative position sensing surface which is primarily operated by the touch of an operator's finger is commonly called a touch pad. In addition to a finger, Gerpheide's and many other touch pads can also be operated by other conductive objects.

Touch pads detect a finger placed on or near the sensing surface and translate movement of the finger into corresponding movement of a cursor on a display screen. One advantage of using a touch pad as an input device is that space is conserved. More specifically, the touch pad can be fixed in place and an operator can still manipulate a cursor on a display screen. This characteristic is very important when space constraints are at a premium.

Specifically, with regard to touch pad technology, touch pads have been modified for additional user friendliness through the addition of feedback systems. Touch pads with tactile feedback systems were developed to assist an operator in determining through touch where the operator's finger is resting in relation to different touch pad regions. An example of tactile feedback is disclosed in co-owned, co-pending International Publication Number WO 9718546 to Gerpheide (filed Nov. 12, 1996,) herein incorporated by reference. The tactile feedback disclosed by Gerpheide includes a combination of textures and raised ridges on the pad surface to indicate programmable "button" portions which, when tapped, execute a function programmably assigned to that button.

Touch pads with auditory feedback were developed to assist an operator in determining when a portion of the touch pad has been selected. One example of an auditory feedback includes a microprocessor using the PC speaker to emit a tone to indicate a selection has been made. However, as with the touch screen display system, this audible feedback is subject to the processor's response time, and may be slow.

Touch pads have also been adapted to perform additional functions by defining numeric or alphanumeric key pads on a portion of the surface of a touch pad. More recently, touch pads have also been adapted by adding a stylus and pattern recognition software for recognizing signatures and handwriting such as commercially sold by Advance Recognition Technologies, Inc. of Chattsworth, California, and CyberSIGN, Inc. of Santa Clara, California.

In addition to the many advantages provided by touch pads existing in the art, disadvantages also exist, both generally as previously mentioned, and when existing touch pads are applied to particular applications. First, existing touch pads, even those with enter zones on the touch pad surface, require a combination of operator taps on the surface to send a "mouse button click" or "enter/select" command to the host computer. For example, a slow and hard, down-and-up tap motion of the finger is required by some touchpads to generate a "mouse button click" command. The appropriate timing and force for the taps of a given pad, although convenient and efficient for expert users, do take time to learn and can be confusing and even painful for novice users and even expert users on a new system. Furthermore, there are people who, because of physical limitation, are unable to perform the tap combinations required on existing touch pads, or the double-click combination required by existing mouse devices. Second, existing touch pads include many functions which are not needed in many simple applications such as in an information kiosk or other graphical interface. These additional functions may complicate touch pad operation and confuse an operator. Third, existing touch pads are not durable enough for many applications. Due to the thin plastic layer typically used to protect the sensing surface, touch pads may wear or deteriorate after extended or frequent use. Furthermore, the thin plastic layer typically used on the sensing surface of a touch pad may be insufficient to protect the surface from abrasive environments where kiosk systems are typically found such as industrial plants, restaurants, copy centers, hospitals, ATMs , and other environments where a touch pad will be used frequently by one person or frequently by numerous people such as in a library or other information center. Fourth, touch pads which are not completely sealed from external contamination may be inadequate for environments where dust, chemicals, moisture, or other contamination is prevalent, or risk of exposure to liquids is high.

It would be advantageous to have a touch pad which is simple to learn and use, includes only the functions necessary for a simple application such as a graphical user interface, is more durable and rugged than existing touch pads, can be completely sealed from external contamination, and is not subject to processor speed for providing audible feedback to inform an operator a selection has been made.

DISCLOSURE OF THE INVENTION

The invention includes a touch pad for use in a kiosk or other graphical user interface system such as desktop computers. For simplified use, the touch pad may have a relative cursor positioning touch-sensitive zone, an absolute positioning touch-sensitive zone, and an auditory feedback device. The touch pad may also have a second absolute positioning touch-sensitive zone programmed to scroll-up or scroll-down depending on the direction an operator's finger is moving within the region. Optionally, the touch pad may be enclosed by a housing to seal the touch pad completely from external contamination. In one embodiment, a rigid and durable protective plate is placed over the touch pad sensing surface to increase the life of the touch pad. In another embodiment, tactile feedback is used to assist an operator in distinguishing between touch pad zones by touch.

Some of the advantages of the invention are seen in its simplicity of use, user friendliness, durability, and applicability. By establishing "touch" sensitive absolute positioning zones, operators are not required to learn or use "taps" to operate a system, but can instead operate the zone on the touch pad surface similar to a mechanical button without the disadvantages associated with mechanical buttons. By simplifying a touch pad to include only basic functions required for graphical user interface applications such as point and click, and scroll-up and -down, the touch pad is simple to use for both beginners and experts. By completely sealing the touch pad from external contamination, the touch pad is waterproof and dust proof, making the touch pad more easily cleaned and reliable in contaminating environments. By covering the touch-sensitive surface with a protective plate, the touch pad is more durable and thus lasts longer in environments where heavy use is a factor or additional protection is needed. Finally, by adding sensory feedback to indicate the differences between zones, and when a zone has been selected, the touch pad is more user friendly and useful to an operator.

Other features and advantages of the present invention will become apparent from a consideration of the drawings and related description.

BRIEF DESCRIPTION OF DRAWINGS

In the drawings, which depict presently preferred embodiments of the invention and in which like reference numerals refer to like parts in different views:

FIG. 1 is a front view of a kiosk employing a graphical monitor and a touch pad.

FIG. 2 is a sectional perspective view of a preferred embodiment of a touch pad touch-sensitive surface and protective enclosure separated to emphasize individual parts.

FIG. 3 is a top view of a preferred embodiment of a simplified touch-sensitive surface depicting an "enter zone", a "scroll zone", and a "relative cursor positioning zone".

FIG. 4 is a side view of a preferred embodiment of a touch pad depicting a protective cover, a touch-sensitive surface, a speaker, and electronic components.

FIG. 5 is a front view of an interactive panel employing a monitor and a touch pad adapted for alphanumeric or symbolic entry as well as relative cursor positioning.

FIG. 6 is an front view of an embodiment of an alphanumeric touch pad.

FIG. 7 is a front view of an interactive information panel employing a graphical interface monitor and a touch pad having a scroll zone, enter zone, and relative cursor positioning zone.

FIG. 8 is a front view of a kiosk panel such as that of an ATM, depicting a monitor and a touch pad with a relative cursor positioning zone, an enter zone, a numeric entry zone, and a signature verification zone with stylus for signature entry.

BEST MODE FOR CARRYING OUT THE INVENTION

FIG. 1 depicts a preferred touch pad **21** for use in a kiosk generally **23** in addition to a touch screen monitor **25**, or with an ordinary monitor **25** in place of the touch function typically served by a touch. The touch pad **21** comprises a programmable touch-sensitive surface **26** having at least two contiguous zones: a relative cursor positioning zone **27**, and an "enter" or "select" zone **29**. The "enter" or "select" zone **29** is an absolute positioning programmable zone **29** preferably programmed to register an "enter", "select" or "mouse button click" command to the host computer (not shown) when the touch-sensitive surface in that zone detects a "touch" from an operator's finger. A "touch" includes any form of touching done within the programmable zone **29**, such as pressing, tapping, or even simply bringing a finger substantially near the programmable zone **29**. The farther from the touch-sensitive surface a conductive object, such as a finger, is placed, the less the surface is able to detect its presence. The distance from which a conductive object can be placed from a given touch-sensitive surface and still be detected varies with each surface and can be readily determined by one of ordinary skill in the art.

The "tap" required by existing touch pads to input an "enter" or "select" command or select a programmable zone on the surface of the touch pad requires a specific duration as well as a sufficient surface area (or "z-value") registering the contact to function correctly. Unlike the "tap" required by existing touch pads to select a programmable zone, the "touch" permitted by the current invention registers contact within the programmable zone **29** and inputs the command regardless of the duration of the contact. In other words, the current invention registers the "touch" contact and inputs the command upon contact, or substantially upon contact, thereby simulating a mechanical button, whereas existing touch pads input the command not upon contact, but upon release and only if the "touch" is held throughout a timing requirement duration within a window of time established within the system; not too long, not too short. Thus, the programmable zones **29** of the current invention respond to any "touch" with sufficient z-value as defined by the programming without a timing requirement. It is also preferable that the relative positioning zone **27** be programmed so as to not be capable of relaying an "enter/select" command. This means that it is preferred that the "taps", which are used to actuate the "enter/select" command with many touch pad surfaces, not function to actuate the "enter/select" function on a touch pad with an "enter/select" zone **29**. By creating a touch pad **21** which relays an "enter/select" command only when the "enter/select" zone **29** is touched, operators is less likely to mistakenly make a selection.

"Touch" capability is particularly useful in a touch pad because both novice and expert touch pad users may quickly and easily learn and perform operations using the simplified device without the being required to first master the "tap" timing of a given touch pad. It is also contemplated that the "touch" capacity of the programmable zones **29** may alternatively be programmed to respond only to "touches" which are of a sufficiently long duration, for example a duration longer than the "tap" duration required by existing touch pads. By requiring an extended "touch", unintentional "touches" can be more easily avoided.

A "touch" is preferably detected by the touch-sensitive surface **26** when a user's finger either actually touches the surface **26**, or comes close enough to the surface **26** to indicate such an intention, although the surface can be programmed to respond otherwise by one of skill in the art. The enter/select zone **29** of the current embodiment is preferably substantially congruous with the contiguous relative positioning zone **27** and programmed so that a finger "gliding" from the relative positioning zone **27** through an absolute positioning programmable zone **29** will not register as a "touch" within the zone, but rather will be treated as if it simply glided across another part of the relative positioning zone **27**. However, if a finger not presently in contact with the touch pad surface touches within, or comes near enough to the surface **26** for the surface to detect a "touch", an "enter/select" command will be communicated to the host computer (not shown). It is contemplated that the enter/select zone **29** may be programmed to relay other commands, and that multiple enter/select zones programmed with other functions may also be placed on the touch sensitive surface to simulate mechanical buttons. Although it is preferable to avoid mechanical buttons due to problems inherent in mechanical buttons for many applications, it is contemplated that this device may also embody mechanical buttons in addition to simulated mechanical buttons.

In addition to the "touch" rather than "tap" nature of the invention simulating mechanical buttons, for durability and applicability, the touch pad **21** is preferably protected by a transparent cover plate **31** which overlays and preferably extends beyond the boundary **33** of the touch pad **21**; thus the width and length of the cover plate **31** should correspond to, or exceed that of the touch-sensitive surface **26**. The cover plate **31**, although it is most preferably formed of glass for durability and cosmetics, may be also preferably be formed of a polymer such as polycarbonate, or polyester and bonded or adhered to the touch-sensitive surface **26** where less durability is required. The thickness of the cover plate **31** will vary with the type of touch pad **21** used because different touch pads use different technologies, each having different tolerances. However, one of skill in the art can calculate the allowed maximum dimensions for a cover plate **31** used with a given touch pad **21**. For the touch pad technology disclosed by Gerpheide in U.S. Patent 5,305,017, however, for a durable, reliable system the cover plate **31** is preferably within the thickness range of 0.0254 to 0.1016 centimeters (0.01 inches to 0.07 inches). The cover plate **31** thickness, however, may be increased or decreased depending on the level of protection versus reliability of response desired for a given application. The cover plate **31**, although preferably affixed to the kiosk face plate **35** by adhesive, may alternatively be affixed by screws or equivalent means. Since many touch pads exist which require actual finger contact with the surface of the touch pad for operation, and with which a cover plate would render the touch pad inoperable, it is contemplated that a cover plate is only preferable for protection in certain embodiments, and not required by the invention.

By bringing a finger, or other conductive object, near the surface of the touch pad **21** and moving it within the touch pad boundary **33**, an operator can navigate a cursor **37** shown on the monitor **25** (also called a "display"). To select a function shown on the monitor **25**, an operator navigates the cursor **37**, using the relative cursor positioning zone **27**, to a place on the monitor **25** corresponding to a desired function, often indicated by a graphical symbol **39** (or "icon"). An operator then selects the function by bringing a finger, or other conductive object near or in contact with the touch pad's touch-sensitive surface **26** within the enter/select zone **29**. One particular advantage of using a touch pad to select objects rather than a touch screen with such a system is that it enables smaller screen icons **39** to be selected than with a touch screen. Because the cursor **37** can be programmed to appear as small as needed, and select objects as small as needed, even large fingers can select small or densely spread icons **39** using a touch pad.

FIG. 2 depicts a preferred touch pad enclosure **41** which completely seals the touch pad **21** from external contamination. The enclosure **41** comprises a base **43** sized and shaped to contain the touch pad **21** and any related components **45** (see FIG. 4). The touch pad **21** is disposed within the base **43** which also preferably comprises an inset ridge **47** for seating the touch pad **21** and a lip **49** upon which a cover **51** and cover gasket **53** are disposed to seal the enclosure **41**. An optional cover plate **31** is preferably placed between the cover gasket **53** and the touch pad's touch-sensitive surface **26** for added protection. The cover plate **31** may also be placed above the cover **51** for some applications, or the cover **51** may be formed into a cover plate **31**, although this is less preferable because it may increase the distance between the cover **51** and the touch pad's touch-sensitive surface **26** and thereby decrease reliability. The cover plate **31** is preferably transparent allowing visual indications of the touch-sensitive zones (*e.g.*, made with ink) on the surface of the touch pad **21** to be visible through the cover plate **31**. However, transparancy is not required as the cover plate **31** can be marked to indicate such zones, tactile feedback means previously discussed may be used, or no indication of touch-sensitive zones may be also preferable in some applications. It is also preferable, where a completely waterproof and dust proof enclosure is desired, to seal the touch pad cables (not shown) and provide a system with no mechanical buttons.

In the embodiment of FIG. 2, the base **43** further comprises a touch pad cable aperture **55** sufficient to house a touch pad cable **57** (*see*, FIG. 4). The touch pad cable aperture **55** is sealed (*e.g.*, made waterproof and dust proof) by a cable gasket **59** placed within the touch pad cable aperture **55** around the touch pad cable **57** (FIG. 4). The waterproof and dust proof nature of the touch pad enclosure **41** can be further reinforced by the use of adhesive or other sealant in relation to the touch pad cable aperture **55**, touch pad cable **57** (not shown) and cable gasket **59**. Although it is not required for the invention, the cover **51** and cover gasket **53** are preferably affixed to the base and touch pad by adhesive for a better seal. The touch pad cable **57**, may optionally be sealed with a protective layer to further prevent contamination.

The cover **51** can be manufactured to engage the base **43** in a way that secures the cover **51** to the base **43** and creates a seal through the cover gasket **53** (*e.g.*, a snap-fit, adhered, or screwed-on cover). The base **43** and cover **51** may be formed of a polymer, or of a metal such as aluminum. If a metal is used, an additional layer of insulative material preferably should be placed so as to insulate the touch pad touch-sensitive surface **26** from the metal. Similarly, gaskets **53** and **59** and methods of their manufacture are well known in the art.

For a sealed system, the cover **51** or the cover gasket **53** preferably overlaps the touch pad boundary **33** sufficient to create a watertight and dust tight seal, and is associated with the base **43**, which in addition to other seals described herein, serves to completely seal the touch pad circuitry from external contamination. If the touch pad **21** is to be used in an area where bacterial or chemical contamination is a concern and seams are undesirable due to the nature of the potential contamination, the cover plate **31** may alternatively include an entire panel having no seams or apertures. In this case, the touch pad **21** is preferably adhered to the back of the panel by an adhesive or supported by a structure, the monitor also being placed behind the panel and supported by a structure.

FIG. 3 depicts a top view of the touch pad **21** showing a touch pad boundary **33**, a relative cursor positioning zone **27**, and an enter/select zone **29**. An optional scroll zone **61** is also included. The enter/select zone boundary **67** is preferably raised for tactile feedback, or the enter/select zone **29** may be textured. The scroll zone **61** and the relative cursor positioning zone **27** may also have textured or raised portions for providing tactile feedback in addition to, or instead of the tactile feedback provided over the enter/select zone **67**.

Alternatively, the tactile feedback **69** may be provided on the surface of the cover plate **31** (*see*, FIG. 4). As depicted in the embodiment of FIG. 4, the cover plate **31** rests immediately above the touch pad **21** and tactile feedback **69** preferably corresponds to the appropriate zones on the touch pad's touch-sensitive surface **26**. The enter/select zone **29** may also be indicated to the user by a printed pattern on the reverse side of the cover plate **31**, away from the operator's touch, marked preferably with the word "enter" in red ink and a circle indicating the boundary of the enter/select zone (*see*, FIG. 3). Similarly, the scroll zone **61** can be indicated by an ink drawing in the location of the scroll zone **61**. Ink on the cover plate **31** may also be used to provide decorative designs or a logo.

In a preferred embodiment, the cover plate **31** is a thin sheet of glass, the front surface of which is frosted by blasting, acid etching or other well-known process. The frosted texture is comfortable to the touch by reducing the friction between the finger and the glass surface. In this case, a pattern in the etching may be used to indicate the enter/select zone **29** or the scroll zone **61**. This etching pattern may be combined with the use of an ink pattern on the back side of the glass. The back side of the glass is preferably frosted to increase adhesion of the ink pattern and increase the adhesive effectiveness if adhesive is used to affix the cover plate **31** to the touch pad **21**.

A thin overlay of plastic, such as is commonly used on touch pads, may alternatively be used as a cover plate **31** instead of glass. In this case, the enter/select zone **29** and scroll zone **61** may be indicated either by a change in the texture of the surface as described in International Publication Number WO 9718546 to Gerpheide (filed 11/12/96,) or by an embossing or debossing process used to create a ridge in the plastic. Either of these approaches has the advantage of being easily detected by an operator's touch. Alternatively, the zones may be indicated by ink printing, preferably on the reverse side of the clear plastic overlay.

FIG. 4 depicts an embodiment of the touch pad **21** where the touch pad's electronic components **45** are mounted on the reverse side of the touch pad **21**. This embodiment also includes an optional speaker **71** for auditory feedback. The speaker **71** is preferably a piezo alarm or other device known in the art which can be directly attached to the touch pad **21** for immediate response when a pre-designated region of the touch pad's touch-sensitive surface **26** is selected. By directly attaching the speaker to the touch pad **21** such that the auditory feedback is not subject to a main microprocessor's processing speed, a user is truly given immediate feedback. It is contemplated, however, that the main processor may also be used to produce a sound for auditory feedback. Optionally, a device programmed to emit a flash of light or illuminate as visual feedback could also be incorporated into the embodiment to indicate when a zone has been selected for additional useful feedback. An example of such visual feedback is given in co-owned, co-pending U.S. Patent Application 08/923,677 to Glad (filed Sept. 4, 1997). FIG. 4 also depicts a touch pad cable **57** for communication with the main microprocessor. It is further contemplated that a given system can employ multiple forms of sensory feedback simultaneously; auditory, tactile and visual.

FIG. 5 depicts a preferred embodiment of the invention for use with a system requiring both graphical user interface and alphanumeric interface, but lacking the space required for a keyboard. The depicted embodiment would also work in an application requiring a completely sealed system as described in relation to the embodiment shown in FIG. 2. Such a system would be useful in an industrial plant, a scientific lab, a hospital, a kitchen, or even a kiosk exposed to the weather where the nature of the environment is such that space is premium and the possibility for contamination or contact with fluids is high.

Depicted in FIG. 5 is a panel **73** comprising a monitor **25**, a touch pad **21** and a cover plate **31**. The touch pad's programmable touch-sensitive surface **26** comprises a relative cursor positioning zone **27** and an enter/select zone **29**, similar to previously described embodiments, but also including other absolute positioning zones **75**. These absolute positioning zones **75**, similar to the enter/select zone **29**, each directly correspond to a given function which is communicated to the microprocessor when a corresponding zone **75** is selected. An example of absolute positioning zones is described in co-owned, co-pending U.S. Patent Application 08/923,677 to Glad (filed 9/4/97). These zones can correspond to familiar functions such as alphanumeric, or numeric entry functions, or to other functions specific for a given system. As will be clear to one of skill in the art, tactile feedback is also beneficial with regard to this embodiment to distinguish between each of the above described zones. An absolute positioning zone may also be programmed to correspond to a function which toggles the operating mode of the touch pad so that a portion of the touch pad operates either as a relative positioning zone, or an absolute positioning zone to increase the functionality and applicability of the touch pad. It is further contemplated that an embodiment of the present invention may include multiple absolute positioning zones programmed to communicate "hold", "drag lock", "release", or numerous other commands when touched.

FIG. 6 depicts the front view of a preferred embodiment of a touch pad **21** having a cover plate **31** marked for use with a touch pad programmed to respond as an alphanumeric keypad. For a touch pad **21** used with the cover shown, the touch pad touch-sensitive surface **26** comprises multiple absolute positioning zones **29**, each programmed to respond independently to a touch within the zone **29** by submitting the function indicated within the zone **29** to a microprocessor (not shown) associated with the touch pad. The directional zone **81** shown in this embodiment preferably operates as a relative positioning zone, but may alternatively be programmed to respond as four-independent cursor positioning zones such as those found on a standard keyboard. Alternatively, or additionally, a function key (not shown) may be provided so that the touch-sensitive surface, or a portion of it, can functionally toggle between multiple absolute positioning zones and a single relative positioning zone. Preferably, the boundaries of each zone are raised for tactile feedback in distinguishing between the zones. As with the other embodiments discussed in conjunction with this disclosure, other forms of sensory feedback may also be used to assist a touch pad operator with use of this touch pad embodiment.

FIG. 7 depicts an embodiment of the invention for use as an information kiosk. FIG. 7 shows a kiosk panel **73** housing a monitor **25** having graphic symbols **39** corresponding to assigned functions, a touch pad **21**, and a cover plate **31**. An advantage of this embodiment for use in an information kiosk is its simplicity and low cost. Information kiosks using graphical user interface require an operator to select an object on the screen to access specific information. After an operator selects specific information, the operator often needs to scroll up or down to view all of it. A typical example of an application where this embodiment would be particularly useful is an operator viewing a web page. Where there is a web link an operator wishes to follow, the operator can simply navigate the screen cursor using the touch pad until the cursor points to the desired link. The operator then simply needs to touch the enter/select zone and the kiosk will provide the next linked screen full of information. Such a simplified touch pad **21**, having only a relative cursor positioning zone **27**, a touch sensitive enter/select zone **29**, and a scroll zone **61** is easy to use for both beginners and experts, and considerably less expensive than a touch screen. It is contemplated that this invention need not only be used in public or frequently used systems. A desktop or portable computer which needs a simplified user interface will similarly benefit from such a device.

As will be clear to one of ordinary skill in the art, the touch pad may be programmed to operate with standard, familiar graphical user interfaces (*e.g.*, Microsoft WINDOWS or an internet browser) without special driving software. Similarly, the touch pad may contain all that is needed to function in any given system without the special software required for touch screen interface.

FIG. 8 depicts another embodiment of the invention for use with a kiosk such as an ATM. FIG. 8 shows a monitor **25**, a touch pad **21**, a cover plate **31** and a stylus **77**. The touch pad **21** for this embodiment includes a relative cursor positioning zone **27**, an enter/select zone **29**, several absolute positioning zones **75** arranged for use in part as a numeric pad, and a signature recognition zone **79**.

FIG. 9 depicts a block diagram depicting a method of operating a touch-sensitive absolute positioning zone associated with a microprocessor. First, the z-value (surface area touched) of the zone is monitored. Second, when the z-value of the zone exceeds a predetermined level, a function command associated with the zone is relayed to the microprocessor. The function command continues to be relayed until the z-value, which is still being monitored, drops below the predetermined level. In this way, the absolute positioning zone responds much like a mechanical button. For example, using the embodiment of a touch pad depicted in FIG. 7, if the absolute positioning zone **29**, is programmed to operate as a "select" function button, when the zone **29** is touched with sufficient z-value, the select function will continue, or select and keep selecting, until the touch is released to a point below the predetermined z-value. Thus, to operate the touch pad **21**, a user moves or "glides" a finger across the relative positioning zone

27 to control the corresponding movement of a cursor shown on the monitor 25. When the cursor is near a desired icon 39 to select, the user removes the finger from the touch pad relative positioning zone surface 27, at which point cursor movement stops, and touches the absolute positioning zone 29 to make a selection. For the duration of time the finger is continuously touching the touch pad surface after touching the absolute positioning zone 29, the cursor will preferably not move and a select function will be relayed to the microprocessor. When the finger is again placed in the relative positioning zone 27, the cursor again responds to the relative finger movement.

As will be clear to one of ordinary skill in the art, the invention as disclosed is not limited to one particular touch pad type or embodiment. Examples of standard touch pads which can be adapted to work well with the present invention are the Model TSM 920 touch pad manufactured by CIRQUE of Salt Lake City, Utah, as well as touch pads manufactured by ALPS of San Jose, California, the SYNAPTICS of San Jose, California, LOGITECH of Freemont, Californa, or others such as those disclosed herein. For simplified operation, standard touch pads can be adapted to provide the touch sensitive enter/select zone function by one of skill in the art either by modifying the touch pad microprocessor program or writing software in the main processor. One of skill in the art can write software or configure hardware to detect the touch of a finger with absolute coordinate location indicating that the finger has touched down within an enter/select zone. The software may optionally and preferably also include routines to confirm the finger does not merely "tap" the enter/select zone as required by standard touch pads to ensure only intentional touches are executed. The software may also optionally and preferably include routines to confirm there is no significant finger motion after the touch to ensure only intentional touches are executed. Furthermore, cursor motion is preferably inhibited after the touch is detected within the zone to assist a user in making an accurate selection.

The enter/select zone is particularly advantageous because many users have difficulty creating the proper "down and up" timing of a tap motion on standard touch pads. Because of this difficulty and the reassuring mechanical "click" sound accompanying mechanical buttons, touch pads are often been accompanied with mechanical buttons which can be depressed by an operator to generate a "mouse button click" command. The enter/select zone of the present invention is simple, and easy to use so mechanical buttons are not needed. This configuration is a tremendous advantage in terms of reliability, cost savings, and easier design for manufacturers of kiosks.

It is contemplated that the touch pad of the current invention may be used with a monitor either with or without touch screen capabilities. Preferably, however, the different embodiments of the touch pad described in relation to the foregoing figures will be used as an inexpensive substitute for a touch screen monitor in a graphical interface system. It is also contemplated, due to the ability to completely seal the system described above from contamination and fluids, this invention will be useful in conjunction with many applications not specifically described herein.

CLAIMS

What is claimed is:

1. A touch pad comprising a touch-sensitive surface having a plurality of programmable input zones, each programmable input zone programmed to transfer, independently, input to a microprocessor operably associated with said touch pad, wherein at least one of said plurality of programmable input zones is programmed to simulate a mechanical button when a conductive object comes into proximity with said at least one of said plurality of programmable input zones.

2. The touch pad of claim 1, wherein said plurality of programmable input zones is a plurality of programmable touch responsive zones.

3. The touch pad of claim 1, wherein said plurality of programmable input zones comprises a relative cursor positioning zone and an enter/select zone.

4. The touch pad of claim 3, wherein said plurality of input zones further comprises a scroll zone.

5. The touch pad of claim 3, wherein cursor motion is inhibited when said conductive object comes into proximity with said at least one of said plurality of programmable input zones.

6. The touch pad of claim 1, wherein said touch-sensitive surface further comprises sensory feedback corresponding to at least one of said plurality of programmable input zones.

7. The touch pad of claim 6, wherein said sensory feedback comprises tactile feedback comprising texture.

8. The touch pad of claim 6, wherein said sensory feedback comprises tactile feedback comprising a raised ridge corresponding to the boundary of said at least one of said plurality of programmable input zones.

9. The touch pad of claim 6, wherein said sensory feedback comprises a speaker device programmed to emit a sound when said conductive object comes into proximity with said at least one of said plurality of programmable input zones.

10. The touch pad of claim 9, wherein said speaker device is integrated with said touch pad.

11. The touch pad of claim 9, wherein said speaker device is integrated with said microprocessor.

12. The touch pad of claim 6, wherein said sensory feedback comprises visual feedback comprising a light programmed to illuminate when said conductive object comes into proximity with said at least one of said plurality of programmable input zones.

13. The touch pad of claim 1, further comprising a glass cover plate disposed adjacent to said touch-sensitive surface.

14. The touch pad of claim 1, wherein said touch pad further comprises an enclosure comprising:

a base having a well sufficient to receive said touch pad, said touch pad disposed within the well;

a cover disposed above said touch pad and affixed to said base; and

at least one gasket sealingly associated with said cover, touch pad and base.

15. The touch pad of claim 14, wherein said enclosure completely seals said touch pad from an outside environment.

16. The touch pad of claim 1, wherein said plurality of programmable input zones comprises at least one zone programmed to respond as a numeric pad.

17. The touch pad of claim 1, wherein said plurality of programmable input zones comprises at least one zone programmed to respond as a alphanumeric pad.

18. The touch pad of claim 1, wherein said plurality of programmable input zones comprises at least one zone programmed to respond as a recognition zone.

19. The touch pad of claim 1, wherein said plurality of programmable input zones comprises at least one zone programmed to respond as a mode selection zone to toggle a portion of plurality of programmable input zones between absolute position recognition and relative position recognition functions.

20. The touch pad of claim 1, wherein said conductive object is a finger.

21. A touch pad interactive control system comprising:

a touch pad comprising a non-mechanical touch-sensitive surface having a plurality of programmable input zones programmed to transfer input to a microprocessor operably associated with said touch pad, wherein at least one of said plurality of programmable input zones is programmed to respond to a touch; and

a display device associated with said microprocessor.

22. The touch pad interactive control system of claim 21, wherein said at least one of said plurality of programmable input zones is an enter/select zone.

23. The touch pad interactive control system of claim 21, further comprising an enclosure, said enclosure housing said touch pad and said display device.

24. The touch pad interactive control system of claim 23, wherein said enclosure completely seals said touch pad and display device from an outside environment.

25. The touch pad interactive control system of claim 21, further comprising a glass cover plate disposed adjacent to said touch-sensitive surface.

26. The touch pad interactive control system of claim 21, wherein said touch pad operates a graphical user interface.

27. An improvement in a kiosk of the type having a housing containing a microprocessor associated with a monitor and a user input device such that a user can interact with the microprocessor to access and display information on the monitor, wherein the improvement comprises:

having, as the user input device for interacting with the microprocessor, a touch pad comprising a touch-sensitive surface having a plurality of programmable input zones, wherein at least one of said plurality of input zones is programmed to relay a function to said microprocessor when a touch is detected.

28. The improvement in a kiosk of claim 27, wherein said function is an enter/select command.

29. A method of operating a touch pad comprising:

providing a touch pad having a plurality of programmable input zones, wherein at least one of the plurality of programmable input zones is a relative positioning zone and at least one of the plurality of programmable input zones is an absolute positioning zone;

bringing a finger in contact with said relative positioning zone;

controlling movement of a cursor to a desired position by moving the finger across the relative positioning zone;

bringing a finger in contact with said absolute positioning zone, said absolute positioning zone responding by relaying a function command to an associated microprocessor.

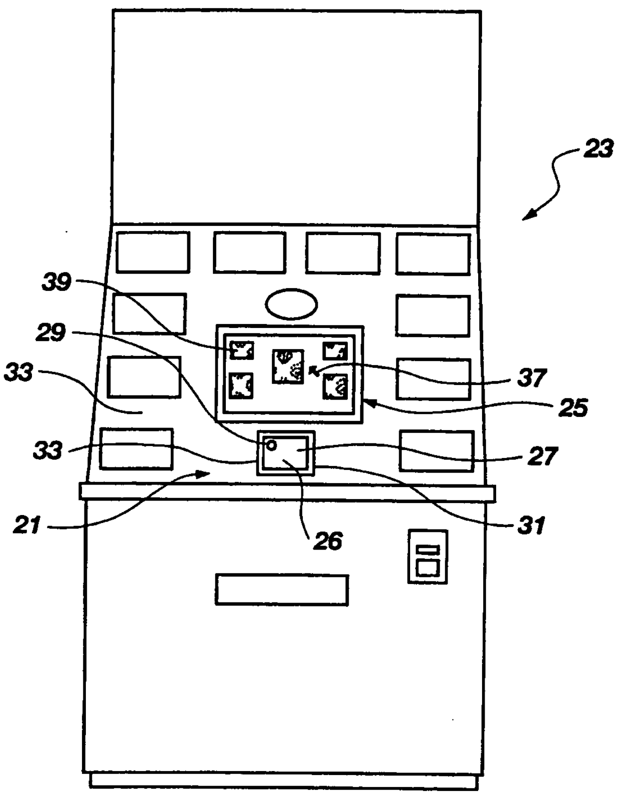


Fig. 1

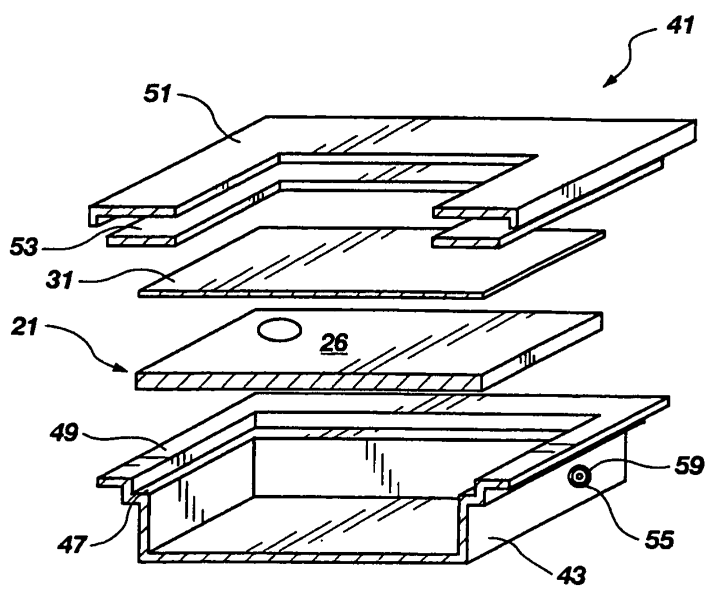


Fig. 2

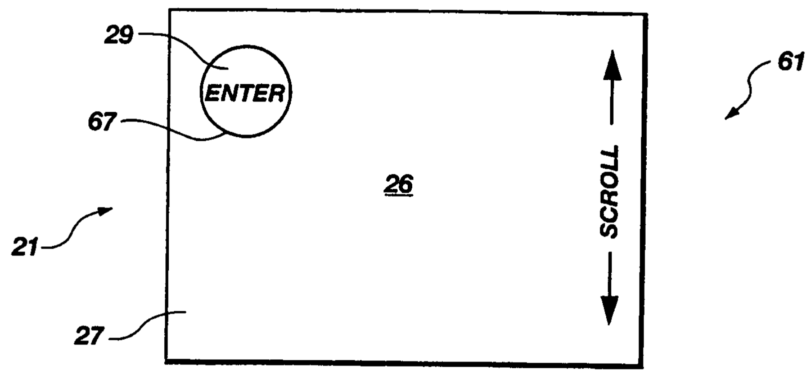


Fig. 3

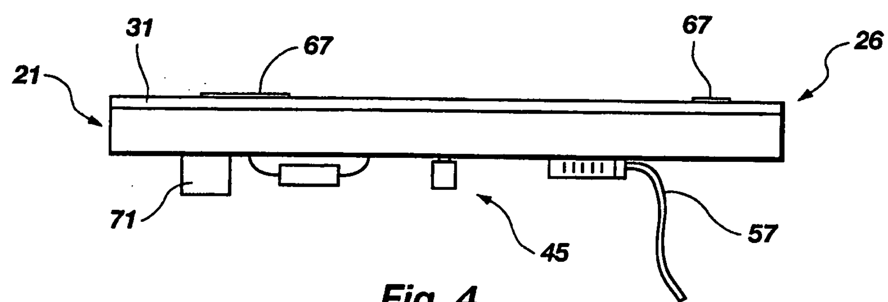


Fig. 4

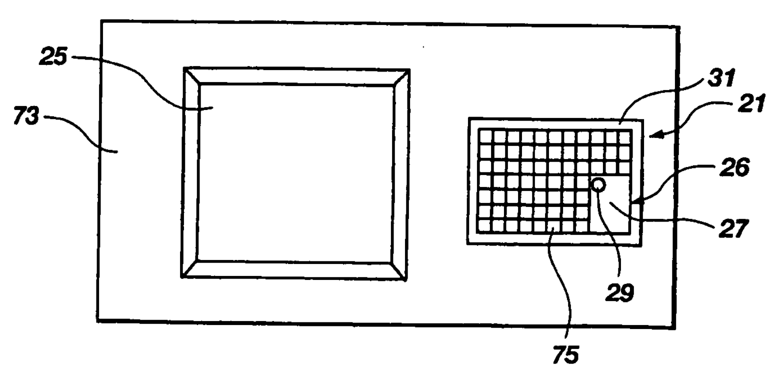


Fig. 5

3/4

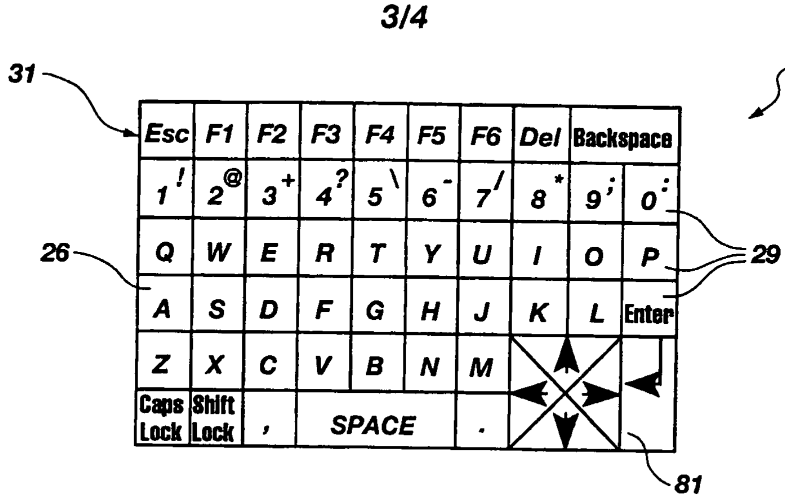


Fig. 6

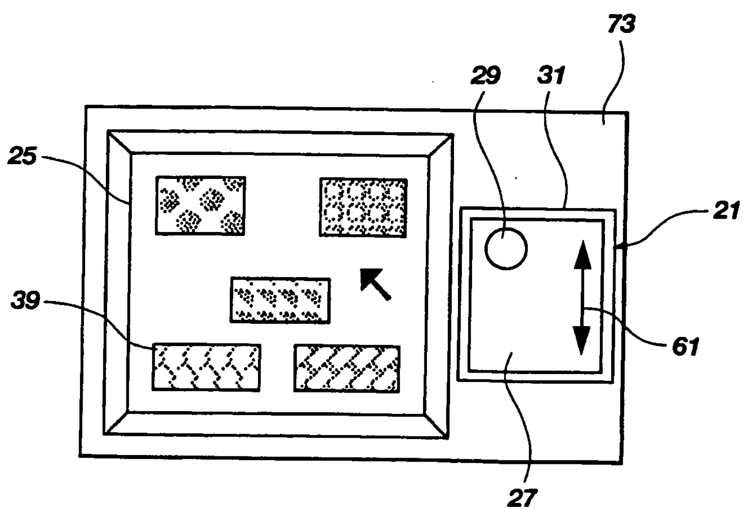
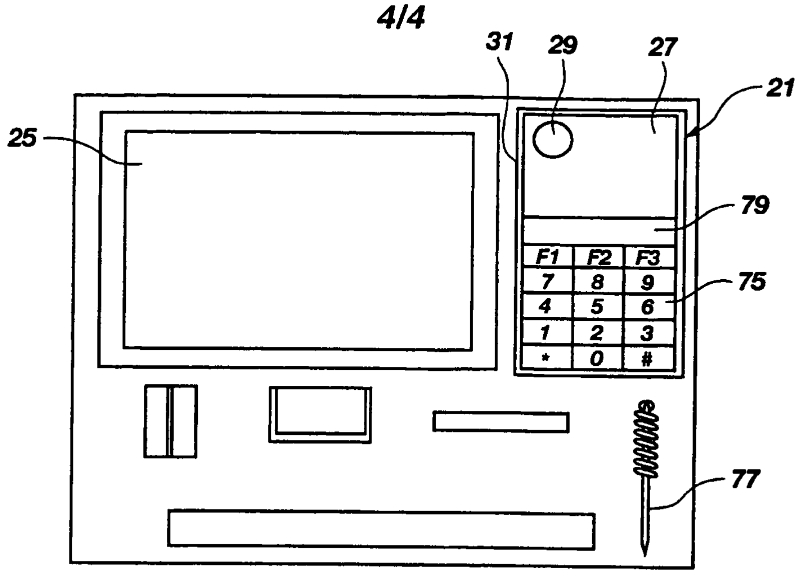


Fig. 7

SUBSTITUTE SHEET (RULE 26)


31
29
27
21
25
79
F1
F2
F3
7
8
9
4
5
6
1
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3
*
0
#
75
77

Fig. 8

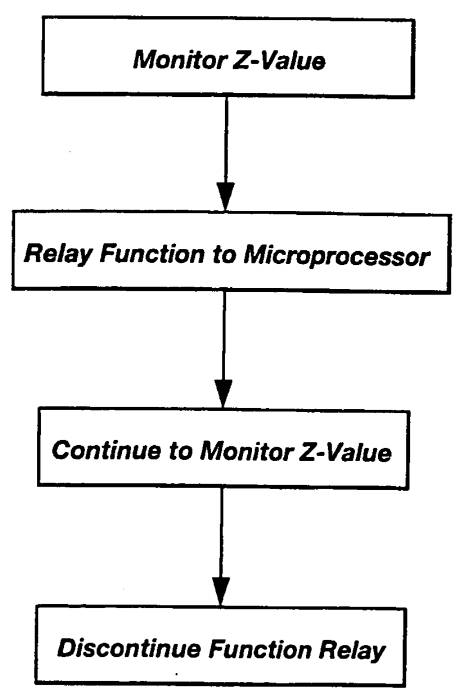
Monitor Z-Value
Relay Function to Microprocessor
Continue to Monitor Z-Value
Discontinue Function Relay

Fig. 9

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US99/15161

A. CLASSIFICATION OF SUBJECT MATTER
IPC(6) :G09G 5/00
US CL :345/156, 172, 173, 174, 175, 176, 177, 178, 179, 180, 181, 182
According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

U.S. : 345/156, 172, 173, 174, 175, 176, 177, 178, 179, 180, 181, 182

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

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X ---	US 5,748,185 A (STEPHAN et al.) 05 May 1998, see the entire document.	1-5, 13-29 -----------
Y		6-12
Y	US 5,730,602 A (GIERHART et al.) 24 March1998, see abstract.	6-12

☐ Further documents are listed in the continuation of Box C. ☐ See patent family annex.

* Special categories of cited documents:

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(54) Object position detector.

(57) A proximity sensor system includes a sensor matrix array having a characteristic capacitance between horizontal and vertical conductors connected to sensor pads. The capacitance changes as a function of the proximity of an object or objects to the sensor matrix. The change in capacitance of each node in both the X and Y directions of the matrix due to the approach of an object is converted to a set of voltages in the X and Y directions. These voltages are processed by analog circuitry to develop electrical signals representative of the centroid of the profile of the object, i.e., its position in the X and Y dimensions. The profile of position may also be integrated to provide Z-axis (pressure) information.

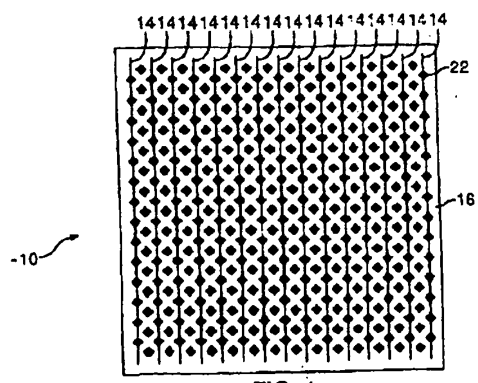

FIG. 1a

EP 0 574 213 A1

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BACKGROUND OF THE INVENTION

1. Field Of The Invention

The present invention relates to object position sensing transducers and systems. More particularly, the present invention relates to object position sensors useful in applications such as cursor movement for computing devices and other applications.

2. The Prior Art

Numerous devices are available or have been proposed for use as object position detectors for use in computer systems and other applications. The most familiar of such devices is the computer "mouse". While extremely popular as a position indicating device, a mouse has mechanical parts and requires a surface upon which to roll its position ball. Furthermore, a mouse usually needs to be moved over long distances for reasonable resolution. Finally, a mouse requires the user to lift a hand from the keyboard to make the cursor movement, thereby upsetting the prime purpose, which is usually typing on the computer.

Trackball devices are similar to mouse devices. A major difference, however is that, unlike a mouse device, a trackball device does not require a surface across which it must be rolled. Trackball devices are still expensive, have moving parts, and require a relatively heavy touch as do the mouse devices. They are also large in size and doe not fit well in a volume sensitive application like a laptop computer.

There are several available touch-sense technologies which may be employed for use as a position indicator. Resistive-membrane position sensors are known and used in several applications. However, they generally suffer from poor resolution, the sensor surface is exposed to the user and is thus subject to wear. In addition, resistive-membrane touch sensors are relatively expensive. A one-surface approach requires a user to be grounded to the sensor for reliable operation. This cannot be guaranteed in portable computers. An example of a one-surface approach is the UnMouse product by MicroTouch, of Wilmington, MA A two-surface approach has poorer resolution and potentially will wear out very quickly in time.

Surface Acoustic Wave (SAW) devices have potential use as position indicators. However, this sensor technology is expensive and is not sensitive to light touch. In addition, SAW devices are sensitive to residue buildup on the touch surfaces and generally have poor resolution.

Strain gauge or pressure plate approaches are an interesting position sensing technology, but suffer from several drawbacks. This approach may employ piezo-electric transducers. One drawback is that the piezo phenomena is an AC phenomena and may be sensitive to the user's rate of movement. In addition, strain gauge or pressure plate approaches are a somewhat expensive because special sensors are required.

Optical approaches are also possible but are somewhat limited for several reasons. All would require light generation which will require external components and increase cost and power drain. For example, a "finger-breaking" infra-red matrix position detector consumes high power and suffers from relatively poor resolution.

BRIEF DESCRIPTION OF THE INVENTION

The present invention comprises a position-sensing technology particularly useful for applications where finger position information is needed, such as in computer "mouse" or trackball environments. However the position-sensing technology of the present invention has much more general application than a computer mouse, because its sensor can detect and report if one or more points are being touched. In addition, the detector can sensa the pressure of the touch.

There are at least two distinct embodiments of the present invention. Both embodiments of the present invention include a sensor comprising a plurality of spaced apart generally parallel conductive lines disposed on a first surface.

According to a first embodiment of the present invention, referred to herein as a "finger pointer" embodiment, a position sensing system includes a position sensing transducer comprising a touch-sensitive surface disposed on a substrate, such as a printed circuit board, including a matrix of conductive lines. A first set of conductive lines runs in a first direction and is insulated from a second set of conductive lines running in a second direction generally perpendicular to the first direction. An insulating layer is disposed over the first and second sets of conductive lines. The insulating layer is thin enough to promote significant capacitive coupling between a finger placed on its surface and the first and second sets of conductive lines.

Sensing eledronics respond to the proximity of a finger to translate the capacitance changes between the conductors caused by finger proximity into position and touch pressure information. Its output is a simple X, Y and pressure value of the one object on its surface. The matrix of conductive lines are successively scanned, one at a time, with the capacitive information from that scan indicating how close a finger is to that node. That information provides a profile of the proximity of the finger to the sensor in each dimension. The centroid of the profile is computed with that value being the position of the finger in that dimension. The profile of position is also integrated with that result providing the Z (pressure) information. The position sensor of the first embodiment of the invention can only detect the position of one object on its sensor surface. If more than one object is present, the position sensor of this embodiment tries to compute the centroid position of the combined set of objects.

According to a second embodiment of the present invention, a position sensing system includes a position sensing transducer as described herein. Sensing electronics respond to the.proximity of a finger to translate the capacitance changes between the conductors running in one direction and those running in the other direction caused by finger proximity into position and touch pressure information. The sensing electronics of the second embodiment of the invention saves information for every node in its sensor matrix and can thereby give the full X/Y dimension picture of what it is sensing. It thus has much broader application for richer multi-dimensional sensing than does the first "finger pointer' embodiment. In this embodiment, referred to herein as the "position matrix" approach, the x,y coordinate information can be used as input to a on-chip neural network processor. This allows an operator to use multiple fingers, coordinated gestures, etc. for even more complex interactions.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1a is a top view of an object position sensor transducer according to a presently preferred embodiment of the invention showing the object position sensor surface layer including a top conductive trace layer and conductive pads connected to a bottom trace layer.

FIG. 1b is a bottom view of the object position sensor transducer of FIG. 1a showing the bottom conductive trace layer.

FIG. 1c is a composite view of the object position sensor transducer of FIGS. 1a and 1b showing both the top and bottom conductive trace layers.

FIG. 1d is a cross-sectional view of the object position sensor transducer of FIGS. 1a-1c.

FIG. 2 is a block diagram of sensor decoding electronics which may be used with the sensor transducer in accordance with a first embodiment of the present invention.

FIGS. 3a and 3b are graphs of output voltage versus matrix conductor position which illustrate the effect of the minimum detector.

FIG. 4 is a simplified schematic diagram of an integrating charge amplifier circuit suitable for use in the present invention.

FIG. 5 is a timing diagram showing the relative timing of control signals used to operate the object position sensor system of the present invention with an integrating charge amplifier as shown in FIG. 4.

FIG. 6a is a schematic diagram of a first alternate embodiment of an integrating charge amplifier circuit suitable for use in the present invention including additional components to bring the circuit to equilibrium prior to integration measurement.

FIG. 6b is a timing diagram showing the control and timing signals used to drive the integrating charge amplifier of FIG. 6a and the response of various nodes in the amplifier to those signals.

FIG. 7a is a schematic diagram of a second alternate embodiment of an integrating charge amplifier circuit suitable for use in the present invention including additional components to bring the circuit to equilibrium prior to integration measurement.

FIG. 7b is a timing diagram showing the control and timing signals used to drive the integrating charge amplifier of FIG. 7a and the response of various nodes in the amplifier to those signals.

FIG. 8 is a schematic diagram of a minimum detector circuit according to a presently preferred embodiment of the invention.

FIG. 9 is a schematic diagram of a maximum detector circuit according to a presently preferred embodiment of the invention.

FIG. 10 is a schematic diagram of a linear voltage-to-current converter circuit according to a presently preferred embodiment of the invention.

FIG. 11 is a schematic diagram of a position encoder centroid computing circuit according to a presently preferred embodiment of the invention.

FIG. 12 is a schematic diagram of a Z Sum circuit according to a presently preferred embodiment of the invention.

FIG. 13 is a schematic diagram of a multiplier circuit according to a presently preferred embodiment of the invention.

FIG. 14 is a schematic diagram of a combination driving-point impedance circuit and receiving-point impedance circuit according to a presently preferred position matrix embodiment of the invention.

FIG. 15 is a block diagram of a the structure of a portion of a sample/hold array suitable for use in the present invention.

FIG. 16a is a block diagram of a simple version of a position matrix embodiment of the present invention in which the matrix of voltage information is sent to a computer which processes the data.

FIG. 16b is a block diagram of a second version of a position matrix embodiment of the present invention employing a sample/hold array such as that depicted in FIG. 15.

DETAILED DESCRIPTION OF A PREFERRED EMBODIMENT

Those of ordinary skill in the art will realize that the following description of the present invention is illustrative only and not in any way limiting. Other embodiments of the invention will readily suggest themselves to such skilled persons.

The present invention brings together in combination a number of unique features which allow for new applications not before possible. Because the object position sensor of the present invention has very low power requirements, it is beneficial for use in battery operated or low power applications such as lap top or portable computers. It is also a very low cost solution, has no moving parts (and is therefore virtually maintenance free), and uses the existing printed circuit board traces for sensors. The sensing technology of the present invention can be integrated into a computer motherboard to even further lower its cost in computer applications. Similarly, in other applications the sensor can be part of an already existent circuit board.

Because of its small size and low profile, the sensor technology of the present invention is useful in lap top or portable applications where volume is important consideration. The sensor technology of the present invention requires circuit board space for only a single sensor interface chip that can interface directly to a microprocessor, plus the area needed on the printed circuit board for sensing.

The sensor material can be anything that allows creation of a conductive X/Y matrix of pads. This includes not only standard PC board, but also flexible PC board, conductive elastomer materials, and piezoelectric Kynar plastic materials. This renders it useful as well in any portable equipment application or in human interface where the sensor needs to be molded to fit within the hand.

The sensor can be conformed to any three dimensional surface. Copper can be plated in two layers on most any surface contour producing the sensor. This will allow the sensor to be adapted to the best ergonomic form needed for a application. This coupled with the "light-touch" feature will make it effortless to use in many applications. The sensor can also be used in an indirect manner, i.e it can have a conductive foam over the surface and be used to detect any object (not just conductive) that presses against it's surface.

Small sensor areas are practical, i.e., a presently conceived embodiment takes about 1.5"x 1.5" of area, however those of ordinary skill in the art will recognize that the area is scalable for different applications. The matrix area is scaleable by either varying the matrix trace spacing or by varying the number of traces. Large sensor areas are practical where more information is needed.

Besides simple X and Y position information, the sensor technology of the present invention also provides finger pressure information. This additional dimension of information may be used by programs to control special features such as "brush-width" modes in Paint programs, special menu accesses, etc., allowing provision of a more natural sensory input to computers.

The user will not even have to touch the surface to generate the minimum reaction. This feature can greatly minimize user strain and allow for more flexible use.

The sense system of the present invention depends on a transducer device capable of providing position and pressure information regarding the object contacting the transducer. Referring first to FIGS. 1a-1d, top, bottom, composite, and cross-sectional views, respectively, are shown of a presently-preferred touch sensor array for use in the present invention. Since capacitance is exploited by this embodiment of the present invention, the sensor surface is designed to maximize the capacitive coupling between top (X) trace pads to the bottom (Y) trace pads in a way that can be maximally perturbed and coupled to a finger or other object placed above the surface.

A presently preferred sensor array 10 according to the present invention comprises a substrate 12 including a set of first conductive traces 14 disposed on a top surface 16 thereof and run in a first direction to comprise rows of the array. A second set of conductive traces 18 are disposed on a bottom surface 20 thereof and run in a second direction preferably orthogonal to the first direction to form the columns of the array. The top and bottom conductive traces 14 and 18 are alternately in contact with periodic sense pads 22 comprising enlarged areas, shown as diamonds in FIGS. 1a-1c. While sense pads 22 are shown as diamonds in FIGS. 1a-1c, any shape, such as circles, which allows close packing of the sense pads, is equivalent for purposes of this invention.

The number and spacing of these sense pads 22 depends upon the resolution desired. For example, in an actual embodiment constructed according to the principles of the present invention, a 0.10 inch center-to-center diamond-shaped pattern of conductive pads disposed along a matrix of 15 rows and 15 columns of conductors is employed. Every other sense pad 22 in each direction in the pad pattern is connected to conductive traces on the top and bottom surfaces 16 and 20, respectively of substrate 12.

Substrate 12 may be a printed circuit board, a flexible circuit board or any of a number of available circuit interconnect technology structures. Its thickness is unimportant as long as contact may be made therethrough from the bottom conductive traces 18 to their sense pads 22 on the top surface 16. The printed circuit board comprising substrate 12 can be constructed using standard industry techniques. Board thickness is not important. Pad-to-pad spacing should preferably be minimized to something in the range of about 15 mils or less. Connections from the conductive pads 22 to the bottom traces 18 may be made employing standard plated-through hole techniques well known in the printed circuit board art.

An insulating layer 24 is disposed over the sense pads 22 on top surface 16 to insulate a human finger or other object therefrom. Insulating layer 24 is preferably a thin layer (i.e., approximately 5 mils) to keep capacitive coupling large and may comprise a material, such as mylar, chosen for its protective and ergonomic characteristics.

There are two different capacitive effects taking place when a finger approaches the sensor array 10. The first capacitive effect is trans-capacitance, or coupling between sense pads 22, and the second capacitive effect is self-capacitance (ground capacitance), or coupling to earth-ground. Sensing circuitry is coupled to the sensor array 10 of the present invention and responds to changes in either or both of these capacitances, This is important because the relative sizes of the two capacitances change greatly depending on the user environment. The ability of the present invention to detect changes in both self capacitance and trans-capacitance results in a very versatile system having a wide range of applications.

According to a first embodiment of the invention, a position sensor system including sensor array 10 and associated touch detector circuitry will detect a finger position on a matrix of printed circuit board traces via the capacitive effect of finger proximity to the sensor array 10. The position sensor system will report the X, Y position of a finger placed near the sensor array 10 to much finer resolution than the spacing between the row and column traces 14 and 18. The position sensor according to this embodiment of the invention will also report a Z value proportional to the outline of that finger and hence indicative of the pressure with which the finger contacts the surface of insulating layer 22 over the sensing array 10.

According to a presently preferred embodiment of the invention, a very sensitive, light-touch detector circuit may be provided using adaptive analog VLSI techniques. The circuit of the present invention is very robust and calibrates out process and systematic errors. The detector circuit of the present invention will process the capacitive input information and provide digital information to a microprocessor.

According to this embodiment of the invention, sensing circuitry is contained on a single sensor processor integrated circuit chip. The sensor processor chip can have any number of X and Y "matrix" inputs. The number of X and Y inputs does not have to be equal. The integrated circuit has a digital bus as output. In the illustrative example disclosed in FIGS. 1a-1d herein, the sensor array has 15 traces in both the Y and Y directions. The sensor processor chip thus has 15 X inputs and 15 Y inputs.

The X and Y matrix nodes are successively scanned, one at a time, with the capacitive information from that scan indicating how close a finger is to that node. The scanned information provides a profile of the finger proximity in each dimension. According to this aspect of the present invention, the profile centroid is derived in both the X and Y directions and is the position in that dimension. The profile curve of proximity is also integrated to provide the Z information.

Referring now to FIG. 2, a block diagram of presently preferred sensing circuitry 30 for use according to the present invention is shown. The sensing circuitry of this embodiment employs a driving-point impedance measurement for each X and Y line in the sensing matrix 10. The block diagram of FIG. 2 illustrates the portion of the sensing circuitry for developing signals from one direction (shown as X in the matrix). The circuitry for developing signals from the other direction in the matrix is identical and its interconnection to the circuitry shown in FIG. 2 will be disclosed herein. The circuitry of FIG. 2 illustratively discloses an embodiment in which information from six X matrix lines X1 . . . X6 are processed. Those of ordinary skill in the art will recognize that this embodiment is illustrative only, and that actual embodiments fabricated according to the present invention may employ an arbitrarily sized matrix, limited only by technology constraints.

The driving-point capacitance measurement for each of X lines X1 ... X6 is derived from an integrating charge amplifier circuit. These circuits are shown in block form at reference numerals 32-1 through 32-6. The function of each of integrating charge amplifier circuits 32-1 through 32-6 is to develop an output voltage proportional to the capacitance sensed on its corresponding X matrix line.

The driving-point capacitance measurement is made for all X (row) conductors 14 and all Y (column) conductors 18 in the sensor matrix array 10. A profile of the finger proximity mapped into the X and Y dimension is generated from the driving-point capacitance measurement data. This profile is then used to determine a centroid in both dimensions, thereby determining the X and Y position of the finger.

The output voltages of integrating charge amplifier circuits 32-1 through 32-6 are utilized by several other circuit elements and are shown for convenience in FIG. 2 as distributed by bus 34. Bus 34 is a six conductor bus, and those of ordinary skill in the art will recognize that each of its conductors comprises the output of one of integrating charge amplifiers 32-1 through 32-6.

The first of circuit elements driven by the outputs of integrating charge amplifier circuits 32-1 through 32-6 is linear voltage-to-current converter 36. The function of linear voltage-to-current converter 36 is to convert the output voltages of integrating charge amplifiers 32-1 through 32-6 to currents for subsequent processing.

The current outputs from linear voltage-to-current converter 36 are presented as inputs to X position encode circuit 38. The function of X position encode circuit 38 is to convert the input information into a signal representing object proximity in the X dimension of the sensor array matrix. According to a presently preferred embodiment of the invention, this circuit will provide a scaled weighted mean (centroid) of the set of input currents. The result is a circuit which is a linear position encoder,having an output voltage which varies between the power supply rails. Because it is a weighted mean, it averages all current inputs and can in turn generate an output voltage which represents an X position with a finer resolution than the spacing of the X matrix grid spacing.

The output voltage of X position encode circuit 38 is presented to sample/hold circuit 40, the output of which, as is well known in the art, either follows the input or holds a value present at the input depending on the state of its control input 42. The structure and operation of sample/hold circuits are well known in the art.

The output of sample/hold circuit 40 drives the input of analog-to-digital (A/D) converter 44. The output of A/D converter 44 is a digital value proportional to the position of the object in the X dimension of the sensor array matrix 10.

While the portion of the circuit described so far is useful for providing a digital signal indicating object position in one dimension, the addition of further circuit elements yields a more useful device which is more immune to noise, detects and subtracts the no-object-proximate signal from the outputs of the sensors, and provides threshold detection of an approaching object.

The first of these additional circuit elements is minimum detector circuit 46. The function of minimum detector circuit 46 is to determine the level of signal representing ambient no-object-proximate to the sensor array matrix 10 and to provide a signal which may be fed back to integrating charge amplifiers 32-1 through 32-6 to control their output voltages to effectively zero out the outputs of the amplifiers under the ambient condition. The output of minimum detector 46 circuit is a voltage. This voltage is compared in operational amplifier 48 with an adjustable voltage representing a minimum threshold value V_{Thmin}. Through feedback to the integrating charge amplifiers 32-1 through 32-6, amplifier 48 adjusts its output to balance the output voltage of Minimum detector circuit 46 with the voltage VThmin. Feedback'is controlled by P-channel MOS transistor 50, which allows the feedback to operate only when the PROCESS signal is active.

FIGS. 3a and 3b are graphs of output voltage versus matrix conductor position which illustrate the effect of the minimum detector circuit 46. In order to better illustrate the effect of offset cancellation, FIGS. 3a and 3b show the outputs of integrating charge amplifiers from a fifteen row matrix, rather than from a six row matrix as is implied by FIG. 2. FIG. 3a shows the offset component of the voltage outputs of integrating charge amplifiers without the operation of minimum detector 46, and FIG, 3b shows the voltage outputs with the offset having been zeroed out by the feedback loop comprising minimum detector circuit 46, P-channel MOS transistor 50, and feedback conductor 52.

Another additional circuit component is maximum detector circuit 54. The function of maximum detector circuit 54, working in co-operation with amplifier 56, OR gate 58, and AND gate 60 is to provide a MAX INTERRUPT signal. The MAX INTERRUPT signal alerts the microprocessor controlling the object sensor system of the present invention that an object is approaching the sensor array matrix 10. The amplifier 56 acts as a comparator which trips if the output voltage from maximum detector circuit 54 exceeds the threshold set by the voltage V_{Thmax}. When the output voltage from maximum detector circuit 54 exceeds the threshold, or the output voltage from the corresponding Y maximum detector (not shown) exceeds the threshold set for its corresponding amplifier, the output of OR gate 58 becomes true. That and a true SAMPLE signal at the second input of AND gate 60 causes a true MAX INTERRUPT signal at its output.

The Z Sum circuit 62 produces an output which is proportional to the pressure with which a finger is pressing on the sensor. This is done in both the X and Y dimensions by effectively integrating the areas under the curves of FIG. 3b. Referring again to FIG. 3b for illustration purposes, it can be seen that the width of the contact area in the X dimension of the sensor array 10 is from about X_2 to X_{10}.

According to a presently preferred embodiment of the invention, Z Sum circuit 62 is configured to produce an output voltage V_O. Output voltage V_O is a scaled function of all the input voltages.

Since the outputs of the Z Sum circuits 62 in both the X and Y directions are proportional to the width of the pointing finger or other flexible object in the two dimensions of the sensor array matrix 10, the area of the finger or other flexible object is a reliable measure of the pressure with which the finger is contacting the surface of the sensor array matrix 20. The area may be calculated by multiplier circuit 64, having the output of the Z Sum circuit in the X dimension as one of its inputs and the output of the Z Sum circuit in the Y dimension as the other one of its inputs.

A presently preferred embodiment of multiplier circuit takes two analog voltage inputs and performs an analog computation on those voltages to create a voltage output which is proportional to the product of the two input voltages. As shown in FIG. 2, a first input term is the output voltage of the X dimension Z Sum circuit 62 and a second input term is the output of the Y dimension Z Sum circuit (not shown). Those of ordinary skill in the art will recognize that since multiplication is commutative process and since the multiplier inputs are symmetrical, it does not matter which of the X and Y Z sum circuits contributes the first input term and which contributes the second input term.

The output of multiplier circuit 64 is a voltage and drives a sample/hold circuit 66. Sample/hold circuit 66 may be identical to sample/hold circuit 40 and may be driven by the same SAMPLE signal which drives sample/hold circuit 40.

The output of sample/hold circuit 66 drives the input of analog-to-digital (A/D) converter 68. A/D converter 68 may be identical to A/D converter 44. The output of A/D converter 68 is a digital value proportional to the pressure with which the finger (or other flexible object) is contacting the surface of sensor array matrix 10.

The object position sensor system of the present invention may be operated under the control of a microprocessor which provides the timing and other control signals necessary to operate the system. For example, the MAX INTERRUPT signal from the output of AND gate 60 may be used to interrupt the microprocessor and invoke an object sensing routine. The particular timing and control signals employed by any system constructed according to the present invention will vary according to the individual design. The following is therefore an illustrative disclosure providing circuit details of illustrative circuit components of a presently preferred system according to the present invention and including disclosure of typical timing and control signals for operating these circuits.

Referring now to FIG. 4, a simplified schematic diagram of an integrating charge amplifier circuit 70 operating in a driving-point capacitance measuring mode suitable for use in the present invention is shown. Integrating charge amplifier circuit 70 is derived from the common integrating amplifier seen in the literature, for example in Gregorian and Temes, Analog MOS Integrated Circuits, John Wiley & Sons (1986) pp. 270-271; Haskard and May, Analog VLSI Design, Prentice Hall (1988), pp. 105-106, and is built around amplifying element 72, which may comprise a common transconductance amplifier as described in Mead, Analog VLSI and Neural Systems, Addison-Wesley (1989) pp. 70-71. The inverting input of amplifying element is connected to an input node 74 through a switch 76 controlled by a SELECT(n) node 78. The input node is connected to one of the lines in the sensor array matrix of FIG. 1. While the disclosure herein illustrates the use of an integrating charge amplifier connected to a row line of the matrix, those of ordinary skill in the art will recognize that the operation of the integrating charge amplifiers connected to the column lines of the array is identical.

The non-inverting input of amplifying element 72 is connected to a Voltage step input node 80. A capacitor 82 is connected as an integrating feedback element between the output and inverting input of amplifying element 72. According to a presently preferred embodiment of the invention, capacitor 82 may have a capacitance of about 10 pF.

The output of amplifying element 72 is connected to an output node 84 through a switch 86. Switch 86 is controlled by the SELECT(n) node 78 which also controls switch 76. A capacitor 88, which may have a capacitance of about 3 pF, is connected between output node 84 and an offset adjust node 90. Those of ordinary skill in the art will recognize that switches 76 and 86 may comprise common CMOS pass gates, each including an N-channel and a P-channel MOS transistor connected in parallel with their gates driven by complimentary signals. Those of ordinary skill in the art will recognize that the combination of switch 86 and capacitor 88 form a simple sample/hold circuit the offset of which may be adjusted when the switch is in its off position via the voltage on node 90.

Amplifying element 72 also includes a BIAS input node 92, which may be connected to an on-chip current bias reference which may be used for all of the integrating charge amplifiers on the chip.

A driving-point capacitance measurement is made by closing switches 76 and 86 and stepping, by an amount Vstep, the input voltage on Voltage step input node 80 at the non-inverting input of amplifying element 72. Because of the negative feedback arrangement, the output of amplifying element 72 will then move to force the voltage at its inverting input to match the voltage at its non-inverting input. The result is that the voltage at the output node 84 changes to a value that injects enough charge into capacitor 82 to match the charge that is injected into the capacitance on the sensor array matrix line connected to input node 74. This change may be expressed as:

$$V_{out} = Vstep * (1 + C_{matrix}/C_{82})$$

where V_{out} is the output voltage, C_{matrix} is the capacitance on the row or column line of the sensor array matrix to which input node 74 is connected and C_{82} is capacitor 82..

When a finger approaches the sensor array matrix 10, C_{matrix} will increase in magnitude. The result is that Vout will also increase in a driving-point capacitance measurement made as the finger approaches. V_{out} is proportional to the proximity of a finger (conductive object) to the sensor array matrix line connected to input node 74. As described above, the driving-point capacitance measurement gives an output voltage change that is directly proportional to the sensor capacitance that is to be measured.

Subtracting the V_{out} value with no object present from the V_{out} value where there is an object present results in a V_{out} difference that is proportional to the change in capacitance at the row line of the sensor array matrix to which input node 74 is connected. Thus:

$$V_{out(final)} = V_{out\ (with\ finger)} - V_{out\ (no\ object)}$$

$$V_{out\ (with\ finger)} = V_{STEP} * (1 + ((C_{no\ object} + C_{finger})/C_{82}))$$

$$V_{out\ (no\ object)} = V_{STEP} * (1 + (C_{no\ object}/C_{82}))$$

$$V_{out\ (final)} = V_{STEP}\,(C_{finger}/C_{82})$$

According to a presently preferred embodiment of the invention, this subtraction operation may be performed by applying an the offset adjust voltage to capacitor 88 at offset adjust node 90. This voltage may be presented to the amplifier circuit via line 52 (FIG. 2) and is controlled by the Minimum Detect circuit 46 when the PROCESS control line is active. The Offset Adjust subtracts the "no object voltage" from the output node 84 and leaves an output voltage directly proportional to the change of the capacitance at the row line of the sensor array matrix to which input node 74 is connected caused by the approaching object.

To operate the object position sensing system of the present invention, the integrating charge amplifiers 70 are selected one at a time using their select nodes 78. This closes both switch 76 and 86 to start the integrator and to start sampling the results of this operation. The voltage at the Voltage step input node 80 is stepped, and the circuit is allowed to settle. After sufficient settling time the select signal is disabled, switches 76 and 86 are opened and the sampled result is left stored at the output node 84 on capacitor 88.

After all of the row and column lines of the sensor array matrix 10 have been scanned, a PROCESS cycle takes place, and the minimum Detect circuits 46 in both the X and Y dimensions adjust the output voltages on capacitors 88 in all integrating charge amplifiers 70 via the common input line 52 to all amplifiers.

Referring now to FIG. 5 a timing diagram shows the relationship between the timing and control signals used to operate the object position sensor system of the present invention utilizing the integrating charge amplifier of FIG. 4. In the embodiment illustrated in FIG. 5, first all X and Y integrating charge amplifiers are sequentially selected, followed by a PROCESS signal and then a SAMPLE signal.

Additional components may be added to integrating charge amplifiers 70, largely to bring the circuits to equilibrium before the integration takes place. Referring now to FIG. 6a, in an alternate embodiment of an integrating charge amplifier 100, all components of the embodiment of FIG. 4 are present. In the embodiment of FIG. 6a, the portion of the cycle in which a global RESET node is true is used to equilbrilate the circuit by discharging the integrating feedback capacitor to zero volts. The voltage V_{STEP} is then provided to the non-inverting input of the amplifying element 72 in a manner which allows easily controlled stepping between the two designated voltages, V_{LOW} and V_{HIGH}.

The additional components in integrating charge amplifier 100 include a switch 102 connected across capacitor 82 connected to a RESET node 104 connected to all of the integrating charge amplifiers in the system. When the RESET signal is true at the beginning of each scanning cycle, switch 102 turns on and discharges the capacitor 82 to zero volts.

A switch 106 is connected between the input node 74 and ground has a control element connected to a RESET1(n) node 108. The RESET1(n) node 108 is active for all integrating charge amplifiers except for the one selected by its SELECT(n) node to perform the driving-point impedance measurement. Its function is to discharge any voltage present on those nodes due to the capacitive coupling to the other nodes which have been driven by the scanning process and thereby eliminate or minimize the error which such voltages would introduce into the measurement process.

Finally, the V_{STEP} voltage may be provided to the non-inverting input of amplifying element 72 by employing switches 110 and 112. Switch 110 is connected between a V_{HIGH} voltage node 114 and the non-inverting input of amplifying element 72, and is controlled by a STEP node 116. Switch 112 is connected between a V_{LOW} voltage node 118 and the non-inverting input of amplifying element 72, and is controlled by a STEP\ node 120. Switches 102, 106,110, and 112 may comprise common CMOS pass gates.

Referring now to FIG. 6b, a timing diagram shows the relationships between the various control signals and the voltages present on selected nodes of the integrating charge amplifier circuit 100 of FIG. 6a during scan cycles (n-1), (n), and (n+1). As can be seen from FIG. 6b, the global RESET signal at node 104 discharges the capacitors 82 of all integrating charge amplifiers 100 in the system at the beginning of each scanning cycle. The RESET1(n) signal at node 108 is coincident with the RESET signal during scanning cycles (n-1) and (n+1) but does not appear at the node 108 of the integrating charge amplifier 100 which is making the driving-point impedance measurement during scanning cycle (n). As those of ordinary skill in the art will readily appreciate from the description herein, the RESET1(n) signal for any integrating charge amplifier 100n may be generated by simple logic circuitry to implement the logic function RESET1(n) = RESET · SELECT(n)\.

FIG. 6b also shows the STEP and STEP\ signals drive the non-inverting input of amplifying element 72 first to V_{LOW} and then to V_{HIGH} during each scanning cycle. The signals N1, N2, and N3 represent the voltages present at the inverting input, the non-inverting input, and the output, respectively, of amplifying element 72. As can be seen from FIG. 6b, the voltage V_{meas}, the voltage of interest, remains at the output node of integrating charge amplifier 100 even after the end of scan cycle (n) in which it was developed.

Referring now to FIG. 7a, an embodiment of an integrating charge amplifier 130 according to the present invention is an approach that provides a larger operating range for the integration. The embodiment of FIG. 7a is nearly identical in its structure and operation to the embodiment of FIG. 6a, except that instead of switch 102 acting to discharge capacitor 82 to zero volts when the RESET input 104 is true, switch 132, which may comprise a common CMOS pass gate, is used to force the output of amplifying element 72 to ground (zero volts) instead of to V_{LOW} as in the embodiment of FIG. 6a. A switch 134, also controlled by RESET input 104, is used to short together the inverting and non-inverting inputs of amplifier 72, forcing them both to an equilibrium voltage of V_{LOW}. In low power supply-voltage applications, such as found in notebook computers, this circuit increases the signal sensitivity by a factor of two.

FIG. 7b is a timing diagram which shows the relationships between the various control signals and the voltages present on selected nodes of the integrating charge amplifier circuit 130 of FIG. 7a during scan cycles (n-1), (n), and (n+1). As can be seen from FIG. 7b, the global RESET signal at node 104 forces the outputs of all integrating charge amplifiers 100 in the system to zero volts at the beginning of each scanning cycle. As in the embodiment of FIG. 7a, the RESET1(n) signal at node 108 is coincident with the RESET signal during scanning cycles (n-1) and (n+1) but does not appear at the node 108 of the integrating charge amplifier 130 which is making the driving-point impedance measurement during scanning cycle (n).

Like the embodiment of FIG. 6a, in the embodiment of FIG. 7a the STEP and STEP\ signals drive the non-inverting input of amplifying element 72 first to V_{LOW} and then to V_{HIGH} during each scanning cycle. The signals N1, N2, and N3 represent the voltages present at the inverting input, the non-inverting input, and the output, respectively, of amplifying element 72. As can be seen from FIG. 7b, the voltage V_{meas}, the voltage of interest, remains at the output node of integrating charge amplifier 130 even after the end of scan cycle (n) in which it was developed.

Referring now to FIG. 8, a schematic diagram is presented of a minimum detector circuit 46 of FIG. 2. While the X dimension minimum detector circuit 46 is illustratively disclosed herein, those of ordinary skill in the art will understand that the Y dimension minimum detector circuit functions in the same manner.

According to a presently preferred embodiment of the invention, minimum detector circuit 46 includes a P-channel bias transistor 142 having its source connected to a voltage source V_{DD} and its gate connected to a bias voltage V_{BIAS}. The inputs of the minimum detector circuit are connected to the output nodes 84 of the respective integrating charge amplifiers. In the minimum detector circuit illustrated in FIG. 8, there are (n) inputs. Each input section comprises a series pair of MOS transistors connected between the drain of P-channel bias transistor 142 and ground.

Thus, the input section for In_1 comprises P-channel MOS input transistor 144 having its source connected to the drain of P-channel MOS bias transistor 142 and N-channel MOS current-limiting transistor 146 having its drain connected to the drain of P-channel MOS input transistor 144 and its source connected to ground. The gate of P-channel MOS input transistor 144 is connected to In_1 input node 148 and the gate of N-channel MOS current-limiting transistor 146 is connected to a source of limiting bias voltage VL_{BIAS} at node 150.

Similarly, the input section for In_2 comprises P-channel MOS input transistor 152 having its source connected to the drain of P-channel MOS bias transistor 142 and N-channel MOS current-limiting transistor 154 having its drain connected to the drain of N-channel MOS input transistor 152 and its source connected to ground. The gate of P-channel MOS input transistor 152 is connected to In_2 input node 156 and the gate of N-channel MOS current-limiting transistor 154 is connected to node 150.

The input section for In_3 comprises P-channel MOS input transistor 158 having its source connected to the drain of P-channel MOS bias transistor 142 and N-channel MOS current-limiting transistor 160 having its drain connected to the drain of P-channel MOS input transistor 158 and its source connected to ground. The gate of P-channel MOS input transistor 158 is connected to In_3 input node 162 and the gate of N-channel MOS current-limiting transistor 160 is connected to node 150.

The input section for $In_{(n)}$ comprises P-channel MOS input transistor 164 having its source connected to the drain of P-channel MOS bias transistor 142 and N-channel MOS current-limiting transistor 166 having its drain connected to the drain of P-channel MOS input transistor 164 and its source connected to ground. The gate of P-channel MOS input transistor 164 is connected to $In_{(n)}$ input node 168 and the gate of N-channel MOS current-limiting transistor 146 is connected to node 150. The output of minimum detector circuit 46 is node 170.

Without averaging control, V_{BIAS} and V_{LBIAS} would be set so that the saturation currents in any one of transistors 146, 154, 160 .. 166 is much larger than the saturation current in transistor 142. In this mode, assume that In1 is the smallest voltage of all n inputs. In this case transistor 144 is turned on strongly with transistor 146 taking all the current from transistor 142. As a result, output node 170 moves down until transistor 144 is on just enough to sink all the current from transistor 142. In this case all other transistor pairs (152/154, 158/160, ...164/166) turn off because their p-channel devices have an input voltage drive of less than that of transistor 144. The result is that the output is directly related to the minimum input voltage and is offset therefrom by a gate bias voltage.

Operating the minimum detector circuit 46 of FIG. 8 in an averaging mode provides substantial noise rejection in the system. If for some reason one input was noisy and gave a much smaller value than all other values it could cause the generation of an erroneous output voltage. According to the present invention, the goal is to detect the "background level" of an input with no input stimulus. This would be the true minimum value. Since there are typically more than one input in this state, several inputs can be averaged to form the minimum signal. This is done via the averaging mode, which is enabled by setting the VL_{BIAS} current of each transistor 146, 154, 160, ... 166 to be some fraction of the current from transistor 142.

For this invention the current set by V_{LBIAS} is approximately one-third of the current from transistor 142. Therefore, in order to sink all of the current from transistor 142, at least three input pairs (144/146, ...164/166) must be turned on. For that to happen the output node 170 must then be sitting at a voltage equal to a p-channel bias voltage above the third lowest input. It has thus, in effect, filtered out and ignored the two lower values.

The present embodiment of the minimum detect circuit of FIG. 8 has been described in terms of separately deriving an X minimum signal and a Y minimum signal and separately computing their weighted minima. Those of ordinary skill in the art will recognize that, pursuant to an equivalent embodiment, the weighted minima of the combined X and Y signals could be computed utilizing the principles disclosed herein.

Referring again to FIG. 2, the output of amplifier 48 (a transconductance amplifier operating as a comparator) and the bottom of capacitor 88 in the integrating charge amplifiers 70, 100, and 130 of FIGS. 4, 6a, and 7a has been held high by MOS transistor 50 during the scan operation or non-PROCESS cycles when the global PROCESS signal (FIG. 5) is low. When the PROCESS cycle starts, the PROCESS line goes high and MOS transistor 50 is turned off, thus enabling the action of minimum detector circuit 46. If the output of minimum detector circuit 46 is greater than the V_{Thmin} at the input of amplifier 48, the output of amplifier 48 is driven low. This is a feedback loop because when the bottom of capacitor 88 in the integrating charge amplifiers drives low it pulls the outputs of all integrating charge amplifiers (32-1 through 32-6) low also. This in turn pulls the output of minimum detector circuit 46 low. This feedback-settling process continues until the minimum detector circuit 46 output equals the V_{Thmin} (FIG. 3b).

The V_{Thmin} voltage is chosen so that when the integrating charge amplifiers (32-1 through 32-6) outputs are shifted down, the minimum charge amplifier output will generate no current in the voltage-to-current converter circuits 36.

Referring now to FIG. 9, the maximum detector circuit 54 will be disclosed. According to a presently preferred embodiment of the invention, maximum detector circuit 54 includes an N-channel bias transistor 182 having its source connected to ground and its gate connected to a bias voltage V_{BIAS} at node 184. The inputs of the maximum detector circuit are connected to the output nodes 84 of the respective integrating charge amplifiers in the maximum detector circuit illustrated in FIG. 9, there are (n) inputs. Each input section comprises a series pair of MOS transistors connected between the drain of N-channel bias transistor 182 and a voltage source V_{DD}.

Thus, the input section for In_1 comprises P-channel MOS current-limiting transistor 186 having its source connected to V_{DD} and its drain connected to the drain of N-channel MOS input transistor 188. The gate of N-channel MOS input transistor 188 is connected to In_1 input node 190 and the gate of P-channel MOS current-limiting transistor 186 is connected to a source of bias voltage VL_{BIAS} at node 192. Similarly, the input section for In_2 comprises P-channel MOS current-limiting transistor 194 having its source connected to V_{DD} and its drain connected to the drain of N-channel MOS input transistor 196. The gate of N-channel MOS input transistor 196 is connected to In_2 input node 198 and the gate of P-channel MOS current-limiting transistor 194 is connected to node 192. The input section for In_3 comprises P-channel MOS current-limiting transistor 200 having its source connected to VDD and its drain connected to the drain of N-channel MOS input transistor 202. The gate of N-channel MOS input transistor 202 is connected to In_3 input node 204 and the gate of R-channel MOS current-limiting transistor 200 is connected to node 192. The input section for $In_{(n)}$ comprises P-channel MOS current-limiting transistor 206 having its source connected to VDD and its drain connected to the drain of N-channel MOS input transistor 208. The gate of N-channel MOS input transistor 208 is connected to $In_{(n)}$ input node 210 and the gate of N-channel MOS current-limiting transistor 206 is connected to node 192. The sources of N-channel MOS input transistors 188, 196, 202, and 208 are connected together to the drain of N-channel MOS bias transistor 182. The output of maximum detector circuit 54 is node 212 at the common connection of the drain of N-channel bias transistor 182 and the sources of the N-channel input transistors.

The maximum detector circuit 54 acts analogously to the minimum detector circuit 46. The difference is that an N-channel bias transistor is used instead of a P-channel bias transistor and an N-channel transconductance amplifier is used in place of a P-channel transconductance amplifier. The result is the output will now track approximately an N-channel bias drop below the largest input (in non-averaging mode), since that much difference is needed to guarantee at least one input pair is on (186/188, 194/196, ... 206/208).

However for this circuit the output is not used for feedback, but is instead used to drive a comparator 56 (FIG. 2) which is set to trip if the input is greater than the voltage V_{Thmax}. If tripped, a MAX INTERRUPT signal is generated. The MAX INTERRUPT is used to "wake-up" a microprocessor and tell it that there is an object detected at the sensor. The signal is prevented from appearing on the MAX INTERRUPT line by gate AND gate 60 and the SAMPLE signal. The SAMPLE signal only allows the interrupt signal to pass after the circuit has settled completely. As shown in FIG. 2 by OR gate 58, either the X or the Y dimension maximum detector circuit may be used to enable the MAX INTERRUPT signal.

Referring now to FIG. 10, a presently preferred embodiment of linear voltage-to-current circuit 36 is shown in schematic form. In the presently preferred embodiment of the invention, block 36 in FIG. 2 actually contains one voltage to current converter circuit of FIG. 10 for each output of an integrating charge amplifier.

In the circuit of FIG. 10, a current mirror comprises diode-connected P-channel MOS transistor 222 having its source connected to voltage source V_{DD}, and P-channel MOS transistor 224 having its source connected to voltage source V_{DD} and its gate connected to the gate and drain of transistor 222. An N-channel MOS input transistor 226 has its drain connected to the drain of P-channel transistor 222, its gate connected to a voltage input node 228, and its source connected to the drain of N-channel bias transistor 230. The source of N-channel bias transistor 230 is connected to ground and its gate is connected to bias input 232. The drain of P-channel MOS transistor 224 is connected to the gate and drain of diode connected N-channel MOS transistor 234. The source of diode connected N-channel MOS transistor 234 is connected to ground. The common gate and drain connection of diode- connected N-channel MOS transistor 234 is an N Bias current output node 236 and the common connection of the gate of P-channel MOS transistor 224 and the drain of P-channel MOS transistor 222 is a P Bias current output node 236 of the voltage-to-current-converter.

To generate a linear transformation N-channel MOS bias transistor 230 is biased in it's linear region by setting V_{BIAS} to be a value which is much greater than the largest value expected on the voltage input node 228. This will guarantee it is always operating in its linear region. For this invention the voltage to be expected at the voltage input 228 of the voltage-to-current converter circuit is typically less than half of the power supply, so it will operate linearly if V_{BIAS} is set to the power supply or greater.

The transconductance of N-channel input transistor 226 is designed to be as large as reasonable. The result is that N-channel input transistor 226 will operate like a follower with a resistor in it's source, and hence will give a linear change of output current versus a linear change in input voltage.

The current is sourced by diode-connected P-channel MOS transistor 222 which acts as half of a CMOS P-channel current mirror and provides a reference for P Bias Output node 236 for the position encoder circuit. The current is mirrored thru P-channel MOS transistor 224 and diode connected MOS transistor 232 generating a reference at N Bias Output node 238 for the position encoder circuit.

For the purposes of this embodiment, a linear transfer function between voltage and current has been selected. Those of ordinary skill in the art will recognize that, under certain circumstances, a non-linear transfer function will be desired.

The linear voltage-to-current converter of FIG. 10 is disclosed in U.S. Patent No. 5,096,284 operating in the weak inversion region.. This circuit is used in the strong inversion region in the present invention, however, for certain applications, the weak inversion mode may be preferred.

Referring now to FIG. 11, a presently preferred embodiment of a position encoder circuit 38 of FIG. 2 is shown in schematic diagram form. The circuits in the X and Y dimensions are identical. The position encoder circuit 38 is shown having six inputs, but those of ordinary skill in the art will recognize that, due to its symmetry, it may be arbitrarily expanded.

As presently preferred, position encoder circuit 38 includes a plurality of transconductance amplifiers 242-1 through 242-6 connected as followers. The outputs of all amplifiers 242-1 through 242-6 are connected together to a common node 244, which comprises the output node of the circuit.

The non-inverting inputs of amplifiers 242-1 through 242-6 are connected to a resistive voltage divider network comprising resistors 246, 248, 250, 252, 254, 256, and 258, shown connected between V_{DD} and ground.

Amplifiers 242-1 through 242-3 have P-channel bias transistors and differential pair inputs due to the input operating range between zero volts and $V_{DD}/2$, and amplifiers 242-4 through 242-6 have N-channel bias transistors and differential pair inputs due to the input operating range between $V_{DD}/2$ and V_{DD}. Those of ordinary skill in the art will readily recognize that amplifiers 242-4 through 242-6 will be configured exactly like amplifiers 242-1 through 242-3, except that all transistor and supply voltage polarities are reversed. The input nodes I_{in1} through I_{in6} (reference numerals 260, 262, 264, 266, 268, and 270) of the circuit are connected to the gates of the bias transistors of the transconductance amplifiers 242-1 through 242-6, respectively. The inputs I_{in1} through I_{in3} are driven by the P Bias output nodes 236 of their respective linear voltage-to-current converters and the inputs I_{in4} through I_{in6} are driven by the N Bias output nodes 238 of their respective linear voltage-to-current converters.

The position encoder circuit of FIG. 11 will provide a weighted mean (centroid) of the input currents weighted by the voltages on the resistor divider circuit to which the inputs of the amplifiers are connected. If the resistors 246, 248, 250, 252, 254, 256, and 258 are all equal then the result is a circuit which is a linear position encoder, with its output voltage varying between the power supply rails. Because it is a weighted mean, it averages all current inputs which in turn generates an interpolated output. This arrangement affords finer resolution than the voltage spacing of voltage nodes "n" at the input. This is key to making a dense circuit function. This circuit is an improvement of a circuit described in DeWeerth, Stephen P., Analog VLSI Circuits For Sensorimotor Feedback, Ph.D Thesis, California Institute of Technology, 1991.

Referring now to FIG. 12, a presently preferred embodiment of a Z Sum circuit 62 of FIG. 2 is shown. For purposes of illustration, Z Sum circuit 62 is shown to include four inputs. Those of ordinary skill in the art will readily understand how to provide additional inputs.

The four input sections for the Z Sum circuit illustrated in FIG. 12 each comprise two N-channel MOS transistors connected in series. Thus a first input section comprises N-channel MOS input transistor 290, having its drain connected to the drain of P-channel MOS bias transistor 282 and its source connected top the drain of N-channel MOS transistor 292. The gate of N-channel MOS input transistor 290 is connected to input node In_1 at reference numeral 294. The gate of N-channel MOS bias transistor 292 is connected to bias input node 296.

A second input section comprises N-channel MOS input transistor 298, having its drain connected to the drain of P-channel MOS bias transistor 282 and its source connected top the drain of N-channel MOS transistor 300. The gate of N-channel MOS input transistor 298 is connected to input node In_2 at reference numeral 302. The gate of N-channel MOS bias transistor 300 is connected to bias input node 296.

A third input section comprises N-channel MOS input transistor 304, having its drain connected to the drain of P-channel MOS bias transistor 282 and its source connected top the drain of N-channel MOS transistor 306. The gate of N-channel MOS input transistor 304 is connected to input node In_3 at reference numeral 308. The gate of N-channel MOS bias transistor 306 is connected to bias input node 296.

A fourth input section comprises N-channel MOS input transistor 310, having its drain connected to the drain of P-channel MOS bias transistor 282 and its source connected top the drain of N-channel MOS transistor 312. The gate of N-channel MOS input transistor 310 is connected to input node In_4 at reference numeral 314. The gate of N-channel MOS bias transistor 312 is connected to bias input node 296. The common drain connections of N-channel MOS input transistors 290, 298, 304, and 310 are connected to the gate of P-channel MOS transistor 316.

The Z sum circuit FIG. 12 is analogous to the Linear voltage-to-current converter circuit 36 of FIG. 10. However in this case there are multiple circuit sections which have their currents all summed together (transistors 290/292, 298/300, 304/306, ... 310/312) into the P-channel MOS transistor 282.

P-channel MOS transistors 282 and 316 form a current mirror. Their sources are connected to voltage source V_{DD} and their gates are connected together to the drain P-channel MOS of transistor 282. The drain of P-channel MOS transistor 316 is connected to the drain of N-channel MOS transistor 318, which has its source connected to ground. The common connection of the drains of MOS transistors 316 and 318 forms a voltage output node 288 for the circuit.

MOS transistor 316 drives MOS transistor 318 which is operating in its linear region. The result is a voltage which is proportional to the current from transistor 316. Therefore the voltage at voltage output node 320 is a scaled sum of all the input voltages, and is utilized by the multiplier circuit.

Referring now to FIG. 13, a presently preferred embodiment of the multiplier circuit 64 of FIG. 2 is presented in schematic form. P-channel MOS transistors 332 and 334 form a current mirror. N-channel MOS transistor 336 has its drain connected to the drain of P-channel MOS transistor 332, its gate connected to first voltage input node 338, and its source connected to the drain of N-channel MOS transistor 340. The gate of N-channel MOS transistor 340 is connected to second voltage input node 342 and its source is connected to ground. N-channel MOS transistor 344 has its drain connected to the gate and drain of P-channel MOS transistor 332. The gate of N-channel MOS transistor 344 is connected to second voltage input node 342 and its source is connected to the drain of N-channel MOS transistor 346. The gate of N-channel MOS transistor 346 is connected to first voltage input node 338 and its source is connected to ground. The sources of P-channel MOS transistors 332 and 334 are connected to voltage source V_{DD}. The drain of P-channel MOS transistor 334 is connected to output node 348 and to the drain of N-channel MOS transistor 350. The gate of N-channel MOS transistor 350 is connected to input bias node 352.

The multiplier circuit of FIG. 13 is a symmetrized extension of the multiplier described in U.S. Patent 5,095,284 and is a wide input range, voltage-input, voltage-output multiplier circuit. Because of the symmetrical input stage, the multiplier can be operated both above and below the threshold voltages of transistors 340 and 346.

The currents from the two transistor pairs 336/340 and 344/346 are summed into the current mirror of transistors 332 and 334 and appear at the drain of transistor 334. Transistor 350 is biased to be in its linear region by bias input 352. Therefore, the output voltage at output node 348 will be proportional to the conductance of device 350 multiplied by the current driven by device 334. The bias voltage at input 352 is adjusted to scale the range of Vout values at node 348 and, once set, is left constant. Thereafter, the output voltage is proportional to the current injected from device 334, and hence is proportional to the product of the two input voltages at input nodes 338 and 342.

According to another aspect of the present invention, a position matrix sensing system is disclosed herein. The position matrix embodiment of the present invention is a straightforward extension of the finger position invention and uses much the same circuitry and basic signal flow. The main differences are in the measurement technique and the amount of information stored. The goal is to provide a matrix of voltages, V(x,y), that represent the proximity of the object to every node (x,y) on the sensor matrix. Instead of using this sel of voltages to drive position encoders in the X and Y dimensions separately, as in the finger position embodiment, the information is instead sent to the input of a neural network circuit, which uses this multi-dimensional information to help it make decisions about what the input means.

In the finger position embodiment, the driving-point capacitance information is used for position detection. However, because the driving-point capacitance looks at the total capacitive effect on the node being measured, it is incapable of resolving what is happening at each X and Y location on the sensor.

The position matrix embodiment of the present invention has the capability of resolving the capacitive effect at each X and Y location of the sensor. In this embodiment the driving-point capacitance circuit is only used to inject charge into the X matrix node. The trans-capacitance (i.e., the capacitance between a selected X node and a selected Y node in the sensor matrix) causes some of that charge to in turn be injected into a Y node. This injected charge is measured by the charge-sensitive amplifier connected to the Y node, thus forming a receiving-point capacitance circuit.

Referring now to FIG. 14, a presently preferred combination driving-point capacitance circuit and receiving-point capacitance circuit is shown in schematic diagram form. A representative X node $X_{(n)}$ at reference numeral 14 and a selected Y node $Y_{(n)}$ at reference numeral 18, are shown each having a self capacitance C_X and C_Y, respectively. Transcapacitance between nodes $X_{(n)}$ $Y_{(n)}$ is represented by capacitor C_{XY}.

A driving-point capacitance measurement is made of row line $X_{(n)}$ by a circuit which, as shown, may be one of the integrating charge amplifier circuits of either FIG. 6a or FIG. 7a, equipped with switches to zero out the matrix prior to injecting charge onto the matrix. The output of this circuit need not be used for anything. After the driving-point measurement has been made for a particular X line, charge is injected into all of the Y receiving-point impedance measuring circuits (the integrating charge amplifier). If all Y outputs are monitored simultaneously then for one X node, a profile of all the trans-capacitive effects at all the Y nodes that cross it will be created as a set of voltages V(x,1), V(x,2), ... V(x,m) that are a profile of the object (or objects) proximity on that X node. This sequence is done for every X node in the matrix resulting in a complete matrix of voltages whose values are proportional to the proximity of nearby objects.

As shown in FIG. 14, the receiving-point circuit can be an integrating charge amplifier identical to that used in the driving-point circuit. However, there are three differences in the way that the Y receiving circuit is used. First, the V_{STEP} node is left at a constant voltage, V_{LOW}, by disabling the STEP input such that switch 112 (FIGS. 6a and 7a) is always on and switch 110 is always off. Second, the Y receiving circuits are not individually selected, but instead are all selected simultaneously. Hence, there is only one Y select line for all Y inputs. Third, the RESET1 line is not used in the receiving-point circuit, and switch 106 (FIGS. 6a and 7a) is always off. These circuits will give an output voltage which is proportional to the amount of charge injected onto the Y node. Since the trans-capacitance varies with the proximity of an object, the voltage is proportional to the proximity of an object.

The position matrix embodiment requires storage of all of the output signals from the receiving-point impedance circuits in both the X and Y directions. This may be a accomplished by providing a sample/hold circuit matrix or a charge-coupled device (CCD) array as is known in the art. The structure of an illustrative sample/hold matrix is disclosed in FIG. 15, which shows a portion of a sample/hold array 350 suitable for use in the present invention. The array 350 is arranged as a plurality of rows and columns of individual sample/hold circuits. The number of rows is equal to the number of Y positions in the sensor matrix and the number of columns is equal to the number of X positions in the sensor matrix. For example, a 15x15 sensor matrix requires 15 rows and 15 columns. All of the voltage data inputs in a row are wired together and the sample/hold control inputs of all the sample/hold circuits in a column are connected to one of the select signals (FIG. 5) such that the select inputs from the X direction drive the sample/hold circuits in the matrix storing the Y data. Those of ordinary skill in the art will note that the roles of X and Y may be reversed.

Referring now to FIGS. 16a and 16b two possible embodiments of the position matrix system of the present invention are illustrated. In the simplest embodiment, the matrix of voltage information is sent to a computer which processes the data. This simple embodiment is shown in FIG. 16a. The approach of FIG. 16a is feasible if the input profile shapes change no faster than about every millisecond.

In the embodiment of position matrix system (reference numeral 360) illustrated in FIG. 16a, the X dimension integrating charge amplifiers (reference numerals 362-1 through 362-n) are used to perform the driving-point capacitance measurements disclosed herein for all X lines in the matrix. For each X line driven, the Y dimension integrating charge amplifiers (reference numerals 364-1 through 364-n) are used to perform the receiving-point capacitance measurements disclosed herein. The sample/hold matrix of FIG. 15 is not required. Instead, one sample/hold amplifier (366-1 through 366-n) is required per Y output to sample the output voltages from the Y dimension integrating charge amplifiers 364-1 through 364-n at the end of each X select period.

These outputs are digitized by A/D converters 368-1 through 368-n respectively. In the illustrative embodiment of FIG. 16a, the digital resolution will be of the order of 8 bits. The 8-bit data words from each A/D converter 368-1 through 368-n are multiplexed down to a bus width that is more easily handled by a computer by multiplexer 370. Multiplexer 370 is a conventional multiplexer device known to those of ordinary skill in the art. The output of multiplexer 370 is presented to a computer which may then process the data in an appropriate manner.

A second illustrative embodiment of position matrix system (reference numeral 380) is shown in FIG. 16b. As in the embodiment of FIG. 16a, the X dimension integrating charge amplifiers (reference numerals 362-1 through 362-n) are used to perform the driving-point capacitance measurements disclosed herein for all X lines in the matrix. For each X line driven, the Y dimension integrating charge amplifiers (reference numerals 364-1 through 364-n) are used to perform the receiving-point capacitance measurements disclosed herein.

The sample/hold array 350 of FIG. 15 is employed and describes the extraction of derivation of the n by m array of voltages applications (V(1,1) to V(n,m)). These voltages are then sent to the input of a single or multiple level neural network 382. Each input neuron will have to have n*m input nodes to support the full size of the sensor array voltage matrix V(n,m).

An example of a single level neural network array circuitry 382, including the pre-processing and sample/hold circuitry 350 required, is disclosed in U.S. Patent No. 5,083,044. This circuit could be used as is or could be replicated and built into two or three layers giving more power and functionality. These variations and many others are well described in the literature, such as Hertz, Krogh, and Palmer, A Lecture Notes Volume in the Santa Fe Institute Studies in the Sciences of Complexity, Allen M. Wilde, Publ. (1991).

The typical application of this embodiment would require a neural network or computer program that at the primitive level can discern objects (finger touch points). This is the basic symbol, the presence of a finger, that is manipulated. From that point there may be predetermined gestures that the system looks for which indicate action. Motion may also need to be detected. A possible solution for this may be found in Mead, Analog VLSI and Neural Systems, Addison-Wesley (1989), Chapter 14, Optical Motion Sensor.

Because of the unique physical features of the present invention, there are several ergonomically interesting applications that were not previously possible. Presently a Mouse or Trackball is not physically convenient to use on portable computers. The present invention provides a very convenient and easy-to-use cursor position solution that replaces those devices.

In mouse-type applications, the sensor of the present invention may be placed in a convenient location, e.g., below the "space bar" key in a portable computer. When placed in this location, the thumb of the user may be ysed as the position pointer on the sensor to control the cursor position on the computer screen. The cursor may then be moved without the need for the user's fingers to leave the keyboard. Ergonomically, this is similar to the concept of the Macintosh Power Book with it's trackball, however the present invention provides a significant advantage in size over the track ball. Extensions of this basic idea are possible in that two sensors could be placed below the "space bar" key for even more feature control.

The computer display with it's cursor feedback is one small example of a very general area of application where a display could be a field of lights or LED's, a LCD display, or a CRT. Examples include touch controls on laboratory equipment where present equipment uses a knob/button/touch screen combination. Because of the articulating ability of this interface, one or more of those inputs could be combined into one of our inputs.

Consumer Electronic Equipment (stereos, graphic equalizers, mixers) applications often utilize significant front panel surface area for slide potentiometers because variable control is needed. The present invention can provide such control in one small touch pad location. As Electronic Home Systems become more common, denser and more powerful human interface is needed. The sensor technology of the present invention permits a very dense control panel. Hand Held TV/VCR/Stereo controls could be ergonomically formed and allow.for more powerful features if this sensor technology is used.

The sensor of the present invention can be conformed to any surface and can be made to detect multiple touching points, making possible a more powerful joystick. The unique pressure detection ability of the sensor technology of the present invention is also key to this application. Computer games, "remote" controls (hobby electronics, planes) , and machine tool controls are a few examples of applications which would benefit from the sensor technology of the present invention.

Musical keyboards (synthesizers, electric pianos) require velocity sensitive keys which can be provided by the pressure sensing ability of this sensor. There are also pitch bending controls, and other slide switches that could be replaced with this technology. An even more unique application comprises a musical instrument that creates notes as a function of the position and pressure of the hands and fingers in a very articulate 3-d interface.

The sensor technology of the present invention can best detect any conducting material pressing against it. By adding a conductive foam material on top of the sensor the sensor of the present invention may also indirectly detect pressure from any object being handled, regardless of its electrical conductivity.

Because of the amount of information available from this sensor it will serve very well as an input device to virtual reality machines. It is easy to envision a construction that allows position-monitoring in three dimensions and some degree of response (pressure) to actions.

While embodiments and applications of this invention have been shown and described, it would be apparent to those skilled in the art that many more modifications than mentioned above are possible without departing from the inventive concepts herein. The invention, therefore, is not to be restricted except in the spirit of the appended claims.

Claims

1. An object proximity sensor, including:

   a plurality of spaced-apart conductive sensor pads disposed in a matrix of rows and columns on a first face of a substrate;

   a plurality of row conductive lines disposed on said substrate and generally aligned with said rows, each of said row conductive lines electrically contacting certain ones of said sensor pads in one of said rows;

   a plurality of column conductive lines disposed on said substrate, insulated from said row conductors and generally aligned with said columns, each of said column conductive lines electrically contacting the ones of said sensor pads in one of said columns which are not contacted by said row conductive lines;

   capacitance-sensing means for sensing the capacitance of each of said row conductive lines and the capacitance of each of said column conductive lines in the presence of an object to be sensed and for producing a set of object-sensed electrical signals related thereto.

2. The object proximity sensor of claim 1 wherein said row conductive lines are disposed on said first face of said substrate and said column conductive lines are disposed on a second face of said substrate opposite said first face.

3. The object proximity sensor of claim 1, wherein said capacitance-sensing means comprises means for injecting a step voltage onto each of said row conductive lines and said column conductive lines, and means for sensing the charge required to inject said step voltage onto each of said row conductive lines and said column conductive lines.

4. The object proximity sensor of claim 3, further including:

   means for sensing a no-object-present capacitance of each of said row conductive lines and sensing a no-object-present capacitance of each of said column conductive lines, for producing a set of no-object-present electrical signals related thereto; and

   means for subtracting said set of no-object-present electrical signals from said set of object-sensed electrical signals.

5. The object proximity sensor of claim 4 wherein said means for producing a set of no-object-present electrical signals related to said no-object-present capacitance of each of said row conductive lines and said no-object-present capacitance of each of said column conductive lines comprises means for computing weighted minima of said object-sensed electrical signals thereof.

6. An object proximity sensor, including:

   a plurality of spaced-apart conductive sensor pads disposed in a matrix of rows and columns on a first side of a substrate;

   a plurality of row conductive lines disposed on said substrate and generally aligned with said rows, each of said row conductive lines electrically contacting certain ones of said sensor pads in one of said rows;

   a plurality of column conductive lines disposed on said substrate, insulated from said row conductive lines and generally aligned with said columns, each of said column conductive lines electrically contacting the ones of said sensor pads in one of said columns which are not contacted by said row conductive lines;

   capacitance-sensing means for sensing the capacitance between each of said row conductive lines and each of said column conductive lines in the presence of an object to be sensed and for producing set of object-sensed electrical signals related thereto.

7. The object proximity sensor of claim 6 wherein said row conductive lines are disposed on said first face of said substrate and said column conductive lines are disposed on a second face of said substrate opposite said first face.

8. The object proximity sensor of claim 6, wherein said capacitance-sensing means comprises means for injecting a step voltage onto each of said row conductive lines, and means for sensing the charge injected onto each of said column conductive lines by said step voltage.

9. The object proximity sensor of claim 6, further including:

means for sensing a no-object-present capacitance of each intersection of one of said row conductive lines and one of said column conductive lines, for producing a set of no-object-present electrical signals related thereto; and

means for subtracting said set of no-object-present electrical signals from said set of object-sensed electrical signals.

10. The object proximity sensor of claim 9 wherein said means for producing a set of no-object-present electrical signals related to said no-object-present capacitance of each of said row conductive lines and said no-object-present capacitance of each of said column conductive lines comprises means for computing weighted minima of said object-sensed electrical signals thereof.

11. An object proximity sensor, including:

a plurality of spaced-apart conductive sensor pads disposed in a plurality of rows on a first side of a substrate, the ones of said sensor pads in odd numbered ones of said rows disposed along a first set of column positions and the ones of said sensor pads in even numbered ones of said rows disposed at a second set of column positions offset from said first set of column positions such that said sensor pads form a repetitive diamond pattern;

a plurality of row conductive lines disposed on said substrate and generally aligned with said rows, each of said row conductive lines electrically contacting every one of said sensor pads in one of said odd-numbered rows;

a plurality of column conductive lines disposed on said substrate, insulated from said row conductive lines and generally aligned with said offset column positions, each of said column conductive lines electrically contacting through said substrate the ones of said sensor pads in one of said offset column positions;

capacitance-sensing means for sensing the capacitance of each of said row conductive lines and the capacitance of each of said column conductive lines in the presence of an object to be sensed and for producing a set of object-sensed electrical signals related thereto.

12. The object proximity sensor of claim 11 wherein said row conductive lines are disposed on said first face of said substrate and said column conductive lines are disposed on a second face of said substrate opposite said first face.

13. The object proximity sensor of claim 11, wherein said capacitance-sensing means comprises means for injecting a step voltage onto each of said row conductive lines and said column conductive lines, and means for sensing the charge required to inject said step voltage onto each of said row conductive lines and said column conductive lines.

14. The object proximity sensor of claim 11, further including:

means for sensing a no-object-present capacitance of each of said row conductive lines and sensing a no-object-present capacitance of each of said column conductive lines, for producing a set of no-object-present electrical signals related thereto; and

means for subtracting said set of no-object-present electrical signals from said set of object-sensed electrical signals.

15. The object proximity sensor of claim 14 wherein said means for producing a set of no-object-present electrical signals related to said no-object-present capacitance of each of said row conductive lines and said no-object-present capacitance of each of said column conductive lines comprises means for computing weighted minimums of said object-sensed electrical signals thereof.

16. An object proximity sensor, including:

a plurality of spaced-apart conductive sensor pads disposed in a plurality of rows on a first side of a substrate, the ones of said sensor pads in odd numbered ones of said rows disposed along a first set of column positions and the ones of said sensor pads in even numbered ones of said rows disposed at a second set of column positions offset from said first set of column positions and said rows spaced apart such that said sensor pads form a closely packed repetitive pattern wherein each pad is not in contact with adjoining pads;

a plurality of row conductive lines disposed on said substrate and generally aligned with said rows, each of said row conductive lines electrically contacting every one of said sensor pads in one of said odd-numbered rows;

a plurality of column conductive lines disposed on said substrate, insulated from said row conductive lines and generally aligned with said offset column positions, each of said column conductive lines electrically contacting the ones of said sensor pads in one of said offset column positions;

capacitance-sensing means for sensing the capacitance between each of said row conductive lines and each of said column conductive lines in the presence of an object to be sensed and for producing set of object-sensed electrical signals related thereto.

17. The object proximity sensor of claim 16 wherein said row conductive lines are disposed on said first face of said substrate and said column conductive lines are disposed on a second face of said substrate opposite said first face.

18. The object proximity sensor of claim 16, wherein said capacitance-sensing means comprises means for injecting a step voltage onto each of said row conductive lines, and means for sensing on each of said column conductive lines the charge injected thereinto by said step voltage onto each of said row conductive lines.

19. The object proximity sensor of claim 16, further including:

means for sensing a no-object-present capacitance of each intersection of one of said row conductive lines and one of said column conductive lines, for producing a set of no-object-present electrical signals related thereto; and

means for subtracting said set of no-object-present electrical signals from said set of object-sensed electrical signals.

20. The object proximity sensor of claim 19 wherein said means for producing a set of no-object-present electrical signals related to said no-object-present capacitance of each of said row conductive lines and said no-object-present capacitance of each of said column conductive lines comprises means for computing weighted minimums of said object-sensed electrical signals thereof.

21. A method for providing an electrical signal representative of the position of an object in a two dimensional plane, including the steps of:

providing a sensing plane including a matrix of conductors arranged as a plurality of rows and columns of spaced apart conductors, said sensing plane characterized by an inherent capacitance between the various ones of said row and column conductors, said capacitance varying with the proximity of an object to said row and column conductors;

developing for each conductor in both the row and column dimensions a first electrical signal proportional to the value of said capacitance when no object is located proximate to said sensing plane;

developing for each conductor in both the row and column dimensions a second electrical signal proportional to the value of said capacitance when an object is located proximate to said sensing plane; and

encoding said set of row electrical signals and said set of column electrical signals into electrical signals indicating the position of said object in said row dimension and said column dimension.

22. The method of claim 21, further including the step of subtracting said first electrical signal from said second electrical signal for each conductor to form a set of row and a set of column electrical signals defining a profile of the proximity of said object in both said row and column dimensions.

23. The method of claim 21 further including the step of processing said set of row electrical signals and said set of column electrical signals to create an area electrical signal proportional to the area of proximity of said object to said processing plane.

24. The method of claim 21 wherein the step of encoding said set of row electrical signals and said set of column electrical signals into electrical signals indicating the position of said object in said row dimension and said column dimension comprises separately encoding said set of row electrical signals into a first digital signal and encoding said set of column electrical signals into a second digital signal.

25. The method of claim 24 wherein the step of encoding said set of row electrical signals and said set of column electrical signals into electrical signals indicating the position of said object in said row dimension and said column dimension comprises separately encoding said set of row electrical signals into a first digital signal and encoding said set of column electrical signals into a second digital signal, and further including the step of encoding said area electrical signal into a third digital signal.

26. The method of claim 21 further including the step of providing a signal when said first electrical signal for any of said row or column conductors exceeds a predetermined threshold.

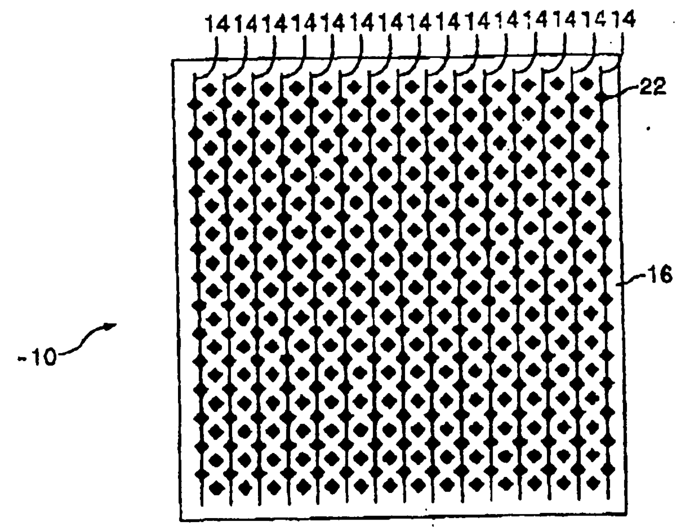


FIG. 1a

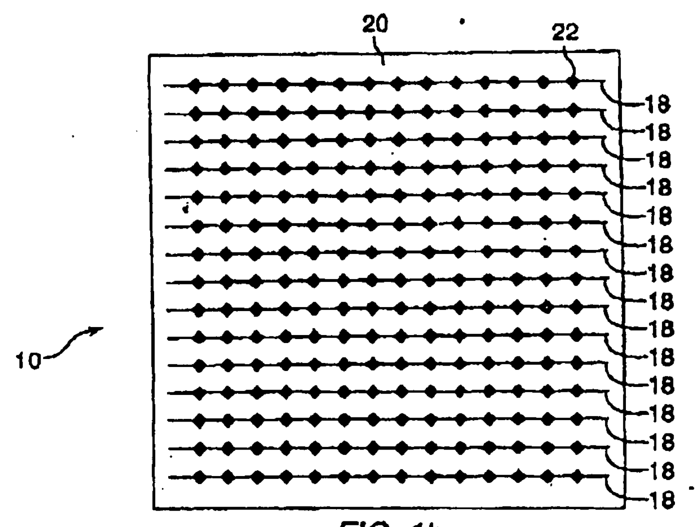


FIG. 1b

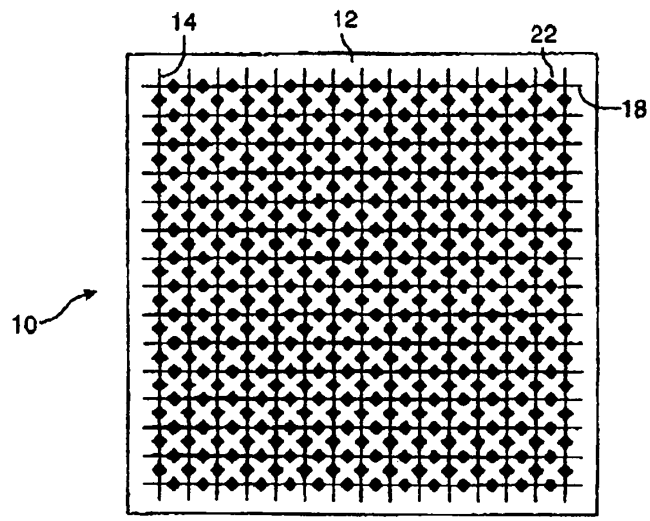


FIG. 1c

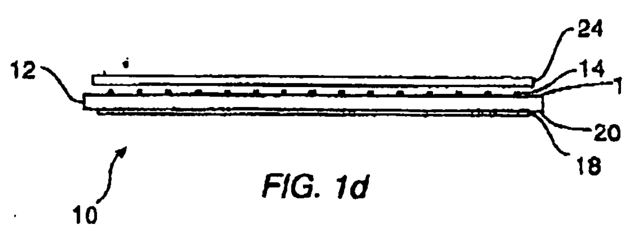
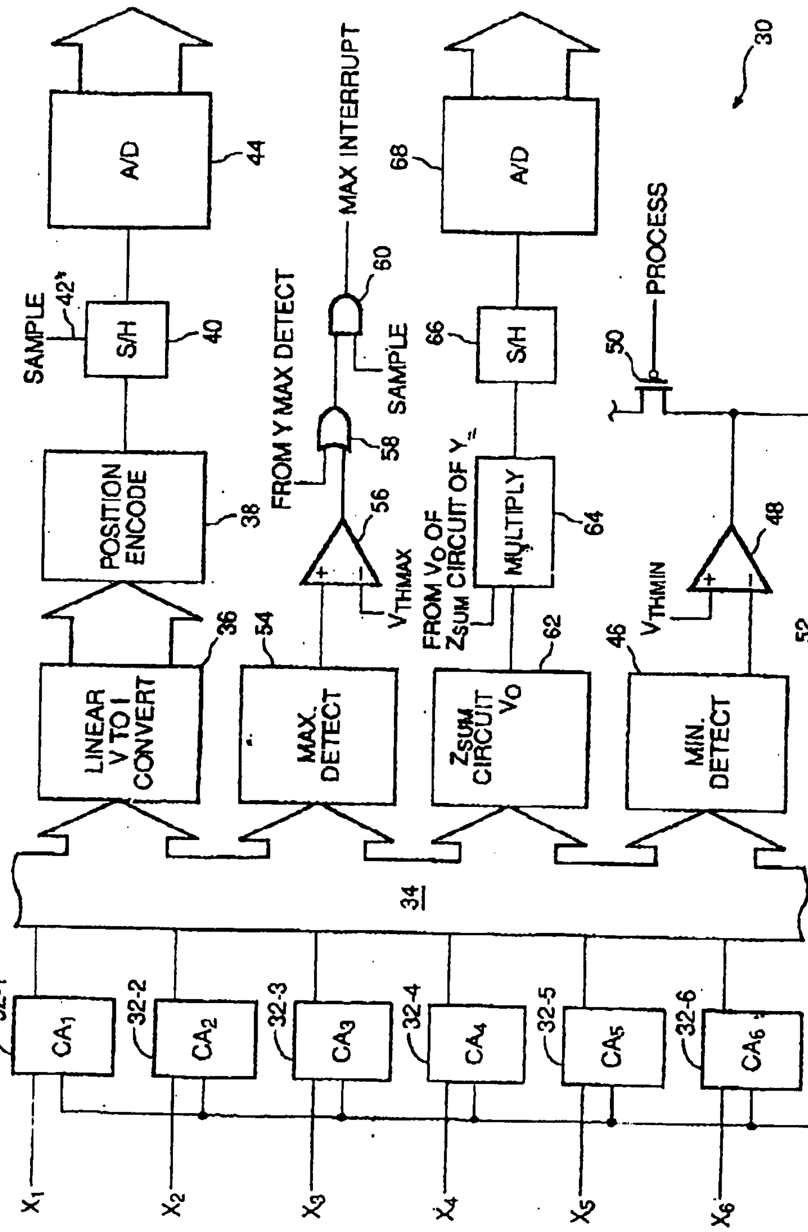


FIG. 1d


A/D
44
A/D
68
MAX INTERRUPT
SAMPLE
42
S/H
40
60
SAMPLE
66
S/H
POSITION ENCODE
38
FROM Y MAX DETECT
58
56
V_{THMAX}
FROM V_O OF Z_{SUM} CIRCUIT OF Y
MULTIPLY
64
50
PROCESS
48
V_{THMIN}
LINEAR V TO I CONVERT
36
MAX. DETECT
54
Z_{SUM} CIRCUIT V_O
62
MIN. DETECT
46
52
30
34
CA_1
CA_2
CA_3
CA_4
CA_5
CA_6
32-1
32-2
32-3
32-4
32-5
32-6
X_1
X_2
X_3
X_4
X_5
X_6
FIG. 2

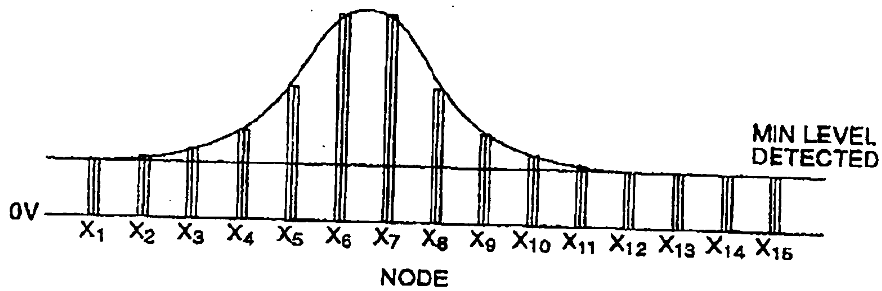


FIG. 3a

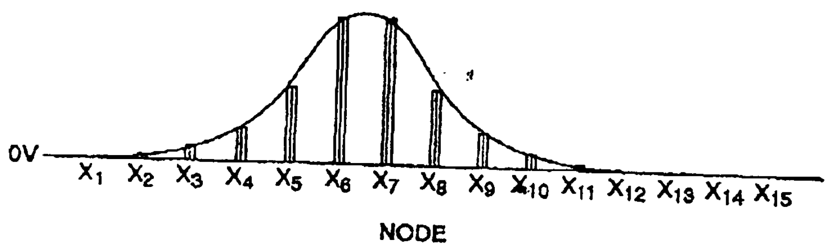


FIG. 3b

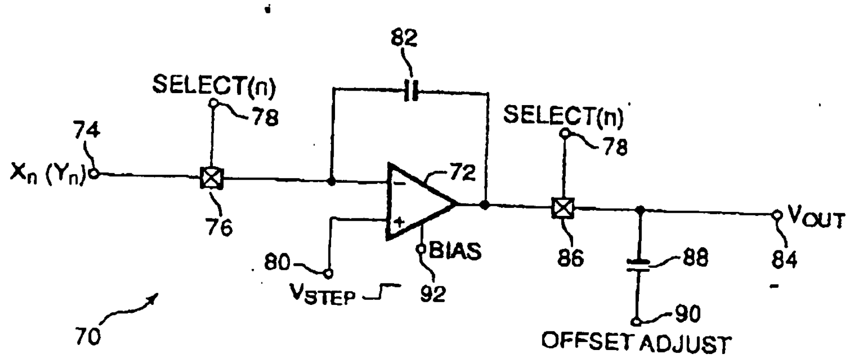


FIG. 4

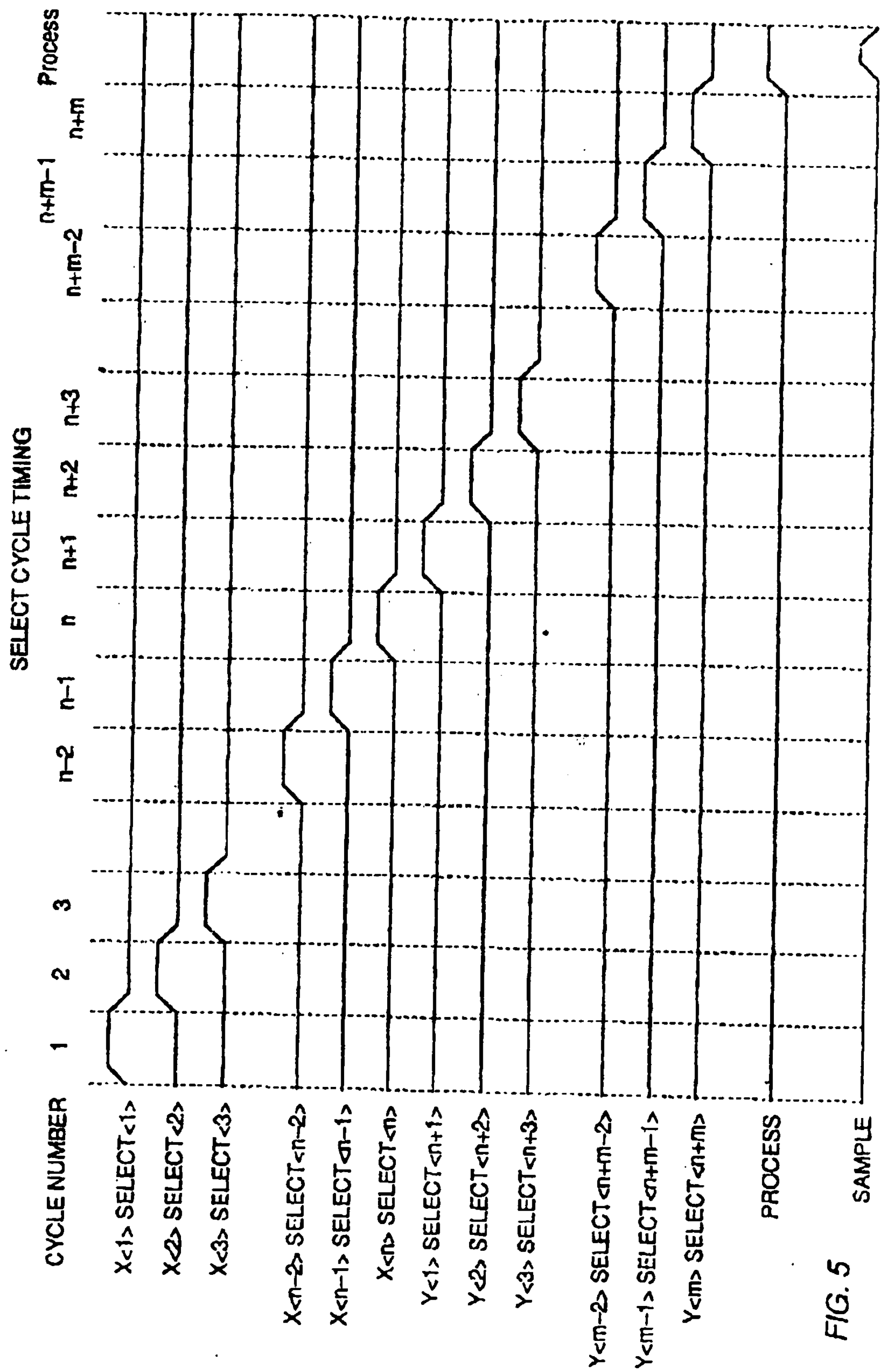

SELECT CYCLE TIMING
CYCLE NUMBER
1
2
3
n-2
n-1
n
n+1
n+2
n+3
n+m-2
n+m-1
n+m
Process
X<1> SELECT<1>
X<2> SELECT<2>
X<3> SELECT<3>
X<n-2> SELECT<n-2>
X<n-1> SELECT<n-1>
X<n> SELECT<n>
Y<1> SELECT<n+1>
Y<2> SELECT<n+2>
Y<3> SELECT<n+3>
Y<m-2> SELECT<n+m-2>
Y<m-1> SELECT<n+m-1>
Y<m> SELECT<n+m>
PROCESS
SAMPLE

FIG. 5

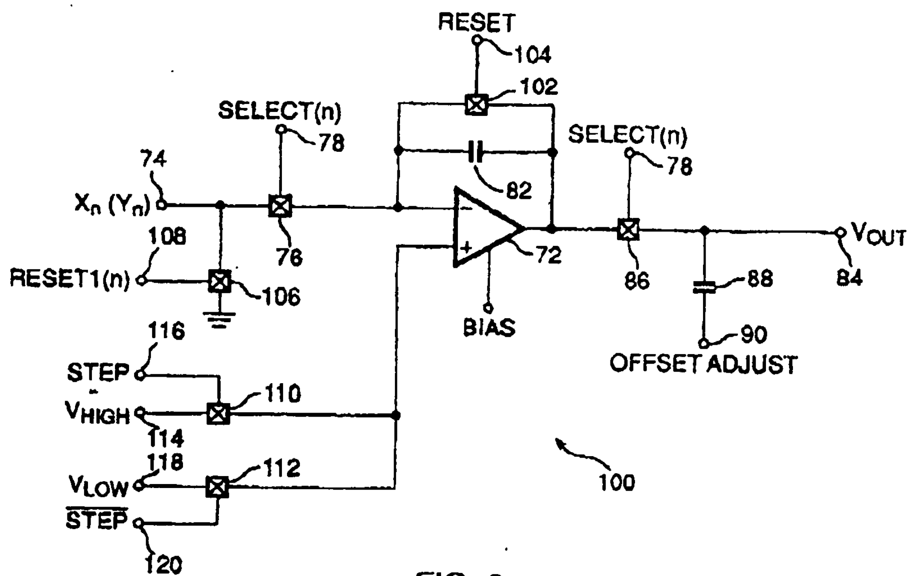

RESET
104
102
SELECT(n)
78
SELECT(n)
78
74
82
Xn (Yn)
76
72
108
RESET1(n)
106
86
88
84
VOUT
BIAS
90
OFFSET ADJUST
116
STEP
110
VHIGH
114
118
VLOW
112
STEP
120
100

FIG. 6a

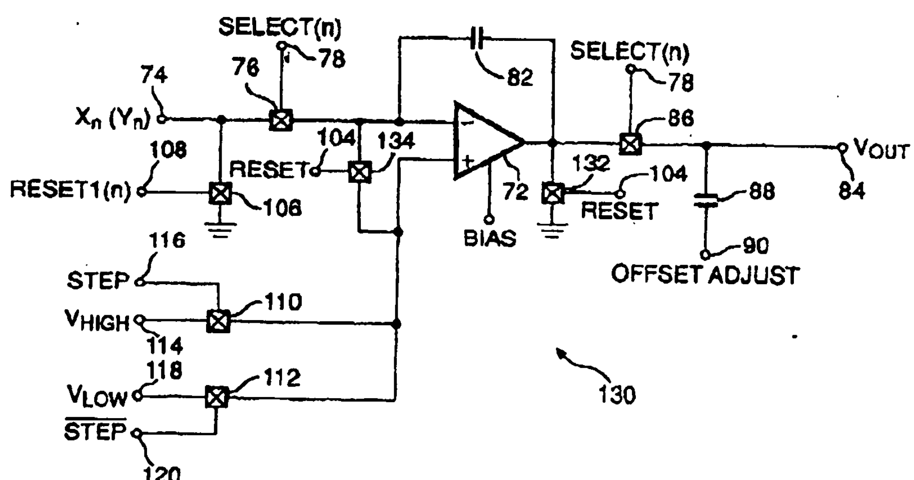

SELECT(n)
78
82
SELECT(n)
78
74
76
Xn (Yn)
104
134
86
108
RESET
RESET1(n)
106
132
104
VOUT
72
RESET
88
84
BIAS
116
90
STEP
OFFSET ADJUST
110
VHIGH
114
118
112
VLOW
STEP
120
130

FIG. 7a

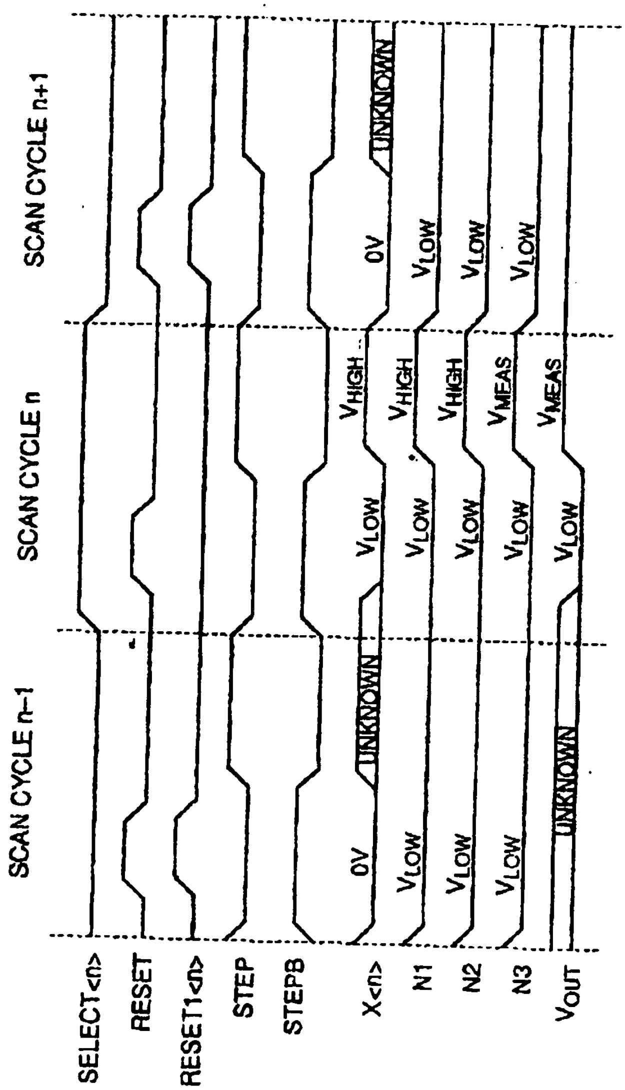

SCAN CYCLE n-1
SCAN CYCLE n
SCAN CYCLE n+1
SELECT<n>
RESET
RESET1<n>
STEP
STEPB
X<n>
N1
N2
N3
V_{OUT}
0V
V_{LOW}
UNKNOWN
V_{HIGH}
V_{MEAS}

FIG. 6b

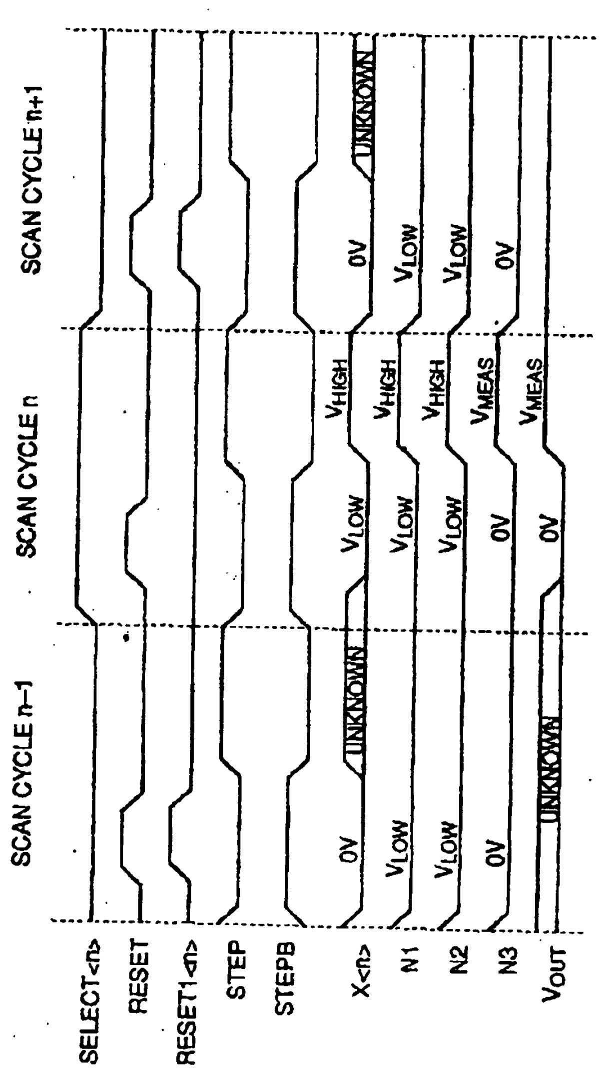
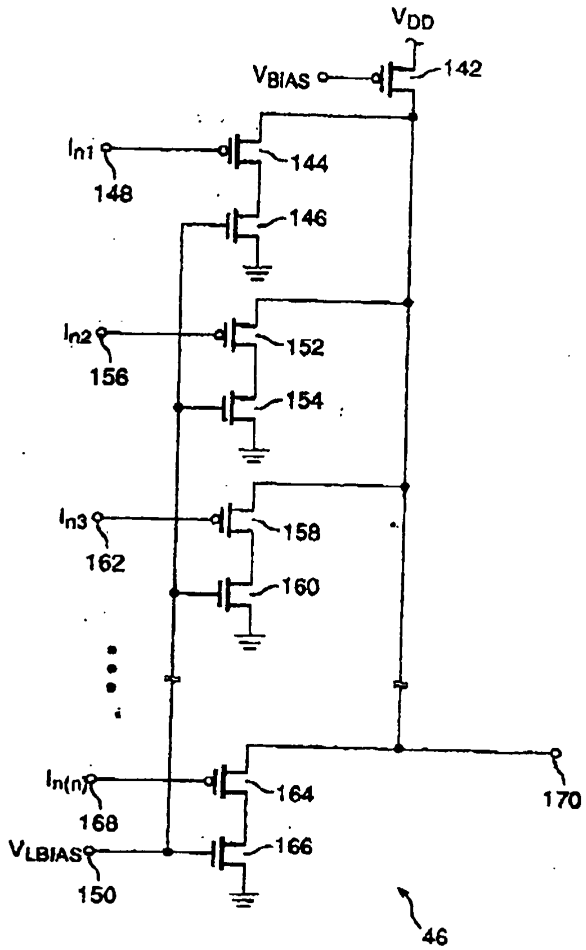
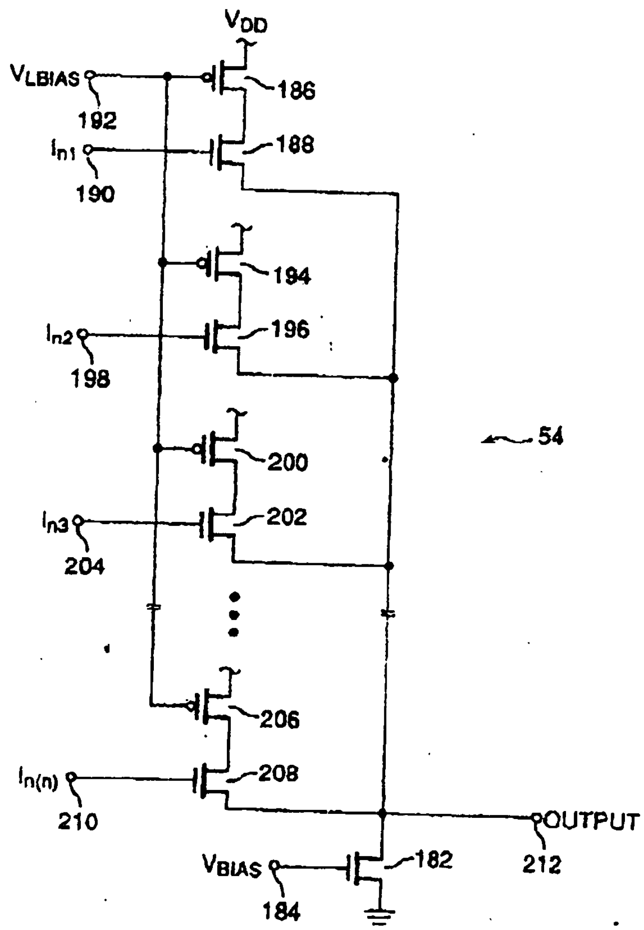

SCAN CYCLE n–1
SCAN CYCLE n
SCAN CYCLE n+1
SELECT<n>
RESET
RESET1<n>
STEP
STEPB
X<n>
N1
N2
N3
V_{OUT}
0V
V_{LOW}
V_{LOW}
0V
UNKNOWN
V_{LOW}
V_{LOW}
V_{LOW}
0V
0V
V_{HIGH}
V_{HIGH}
V_{HIGH}
V_{MEAS}
V_{MEAS}
0V
V_{LOW}
V_{LOW}
0V
UNKNOWN
UNKNOWN

FIG. 7b



V_{DD}
V_{BIAS}
142
I_{n1}
144
148
146
I_{n2}
152
156
154
I_{n3}
158
162
160
$I_{n(n)}$
164
168
V_{LBIAS}
166
150
170
46

FIG. 8



VDD
VLBIAS
192
186
In1
190
188
194
In2
198
196
54
200
In3
204
202
206
In(n)
210
208
OUTPUT
212
VBIAS
184
182

FIG. 9

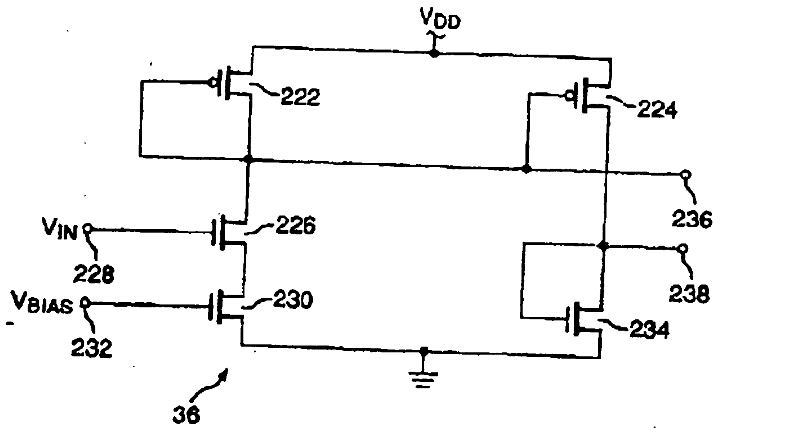

VDD
222
224
236
VIN
226
228
238
VBIAS
230
232
234
36

FIG. 10

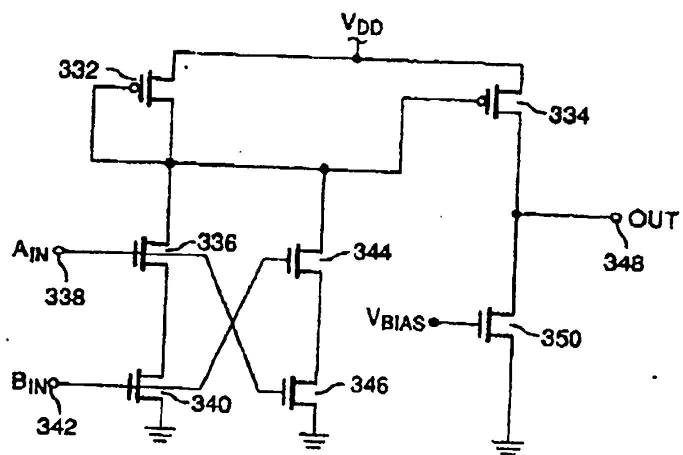

VDD
332
334
OUT
AIN
336
344
338
348
VBIAS
350
BIN
340
346
342

FIG. 13

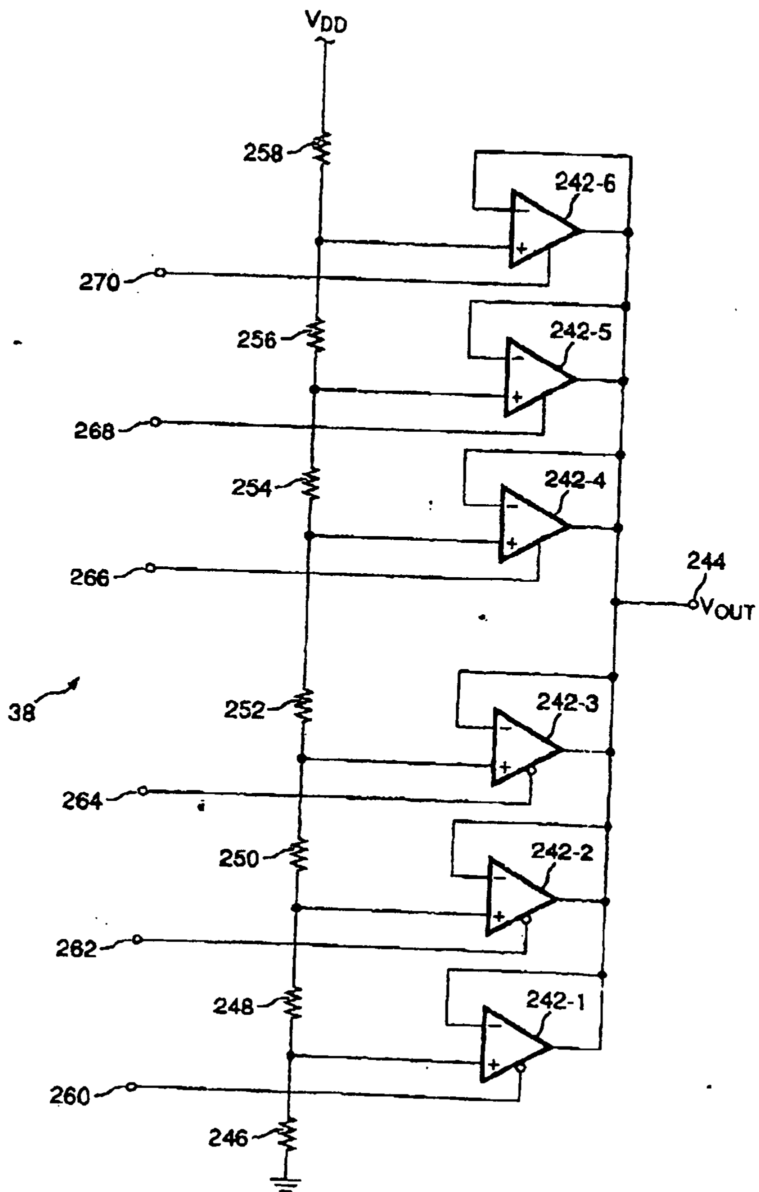

VDD
258
242-6
270
256
242-5
268
254
242-4
266
244
VOUT
38
252
242-3
264
250
242-2
262
248
242-1
260
246

FIG. 11

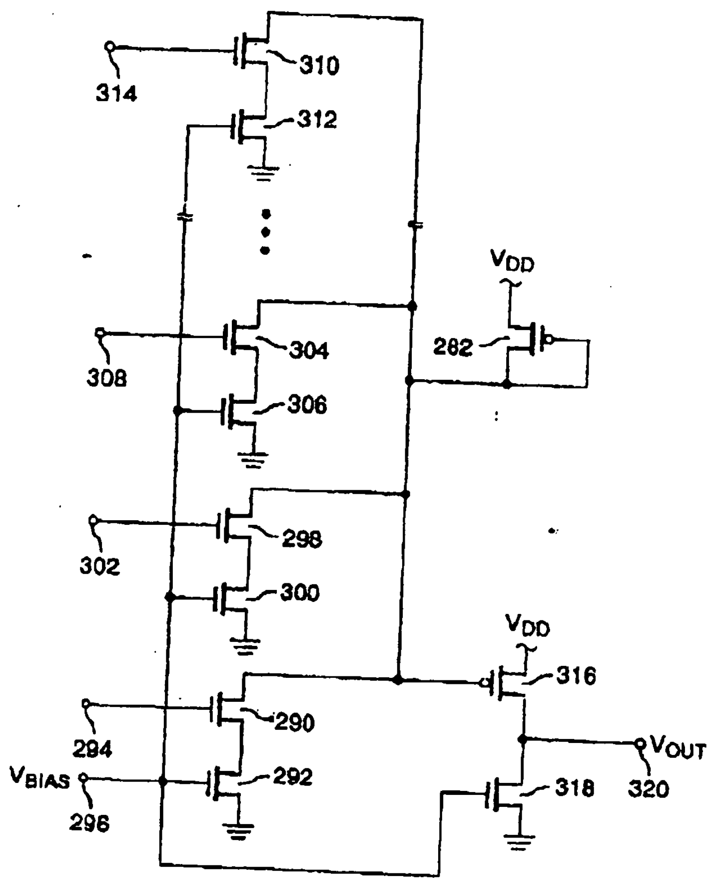

314
310
312
308
304
306
VDD
282
302
298
300
VDD
316
294
290
VBIAS
296
292
VOUT
318
320

FIG. 12

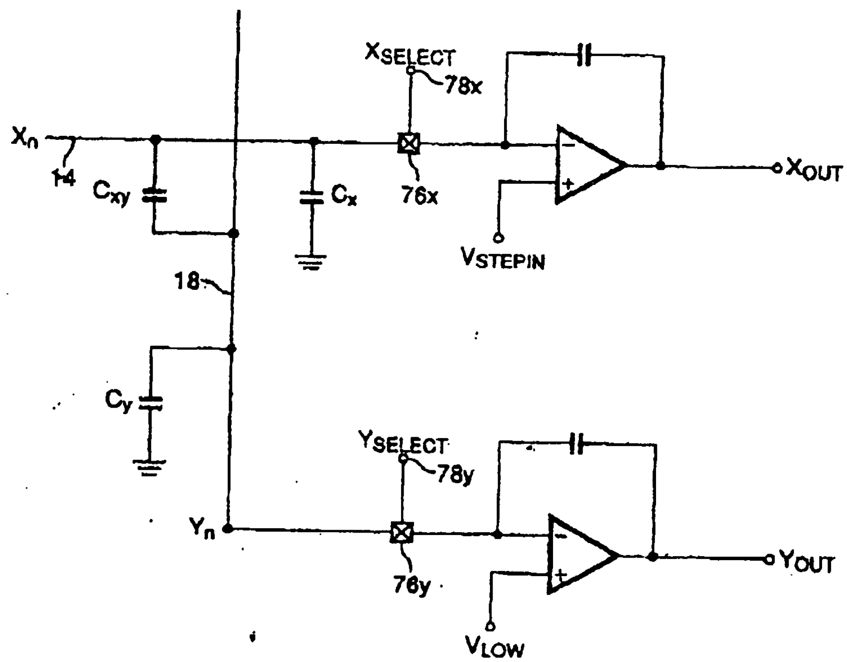

XSELECT
78x
Xn
14
Cxy
Cx
76x
XOUT
VSTEPIN
18
Cy
YSELECT
78y
Yn
76y
YOUT
VLOW

FIG. 14

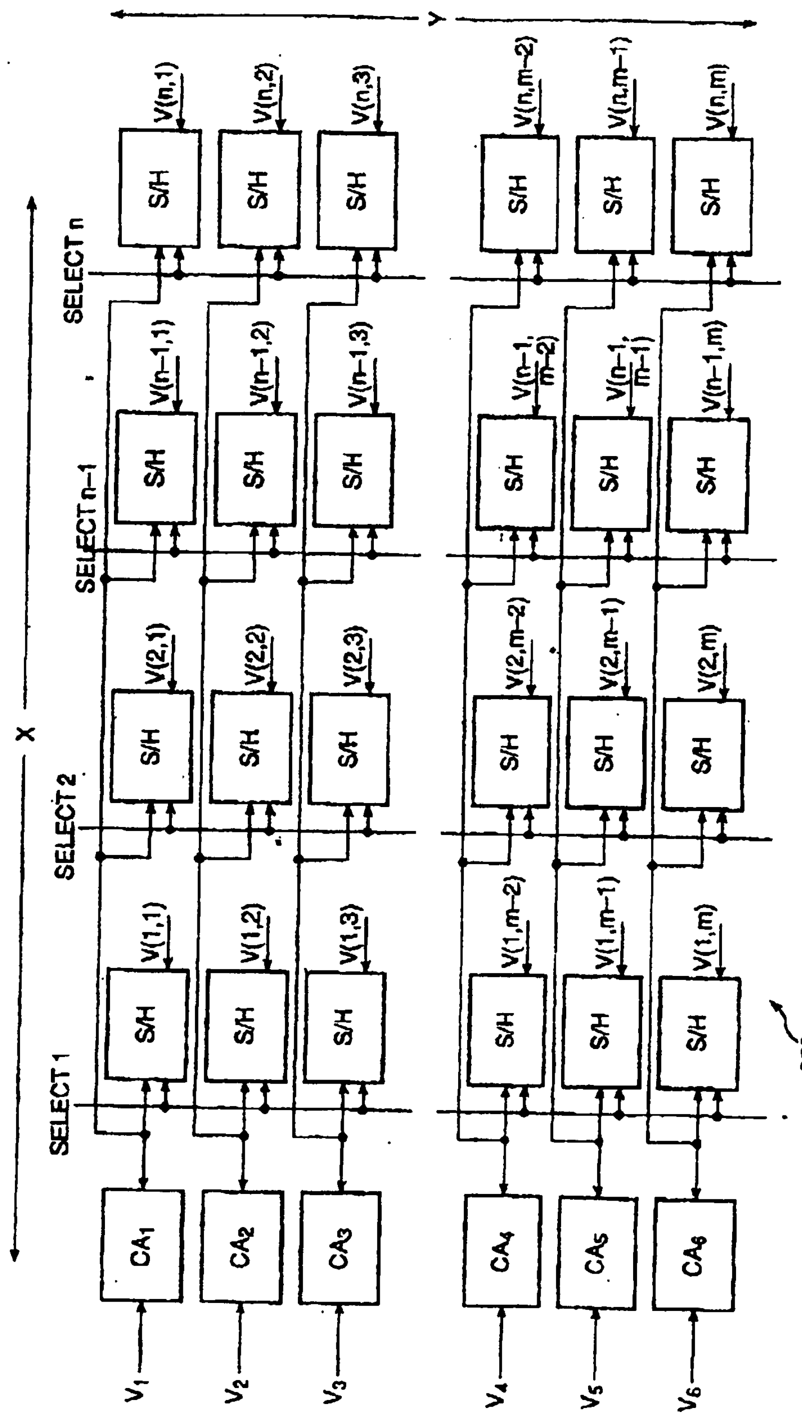

SELECT 1
SELECT 2
SELECT n-1
SELECT n
X
Y
V(1,1)
V(1,2)
V(1,3)
V(1,m-2)
V(1,m-1)
V(1,m)
V(2,1)
V(2,2)
V(2,3)
V(2,m-2)
V(2,m-1)
V(2,m)
V(n-1,1)
V(n-1,2)
V(n-1,3)
V(n-1, m-2)
V(n-1, m-1)
V(n-1,m)
V(n,1)
V(n,2)
V(n,3)
V(n,m-2)
V(n,m-1)
V(n,m)
S/H
CA$_1$
CA$_2$
CA$_3$
CA$_4$
CA$_5$
CA$_6$
V$_1$
V$_2$
V$_3$
V$_4$
V$_5$
V$_6$
350

FIG. 15

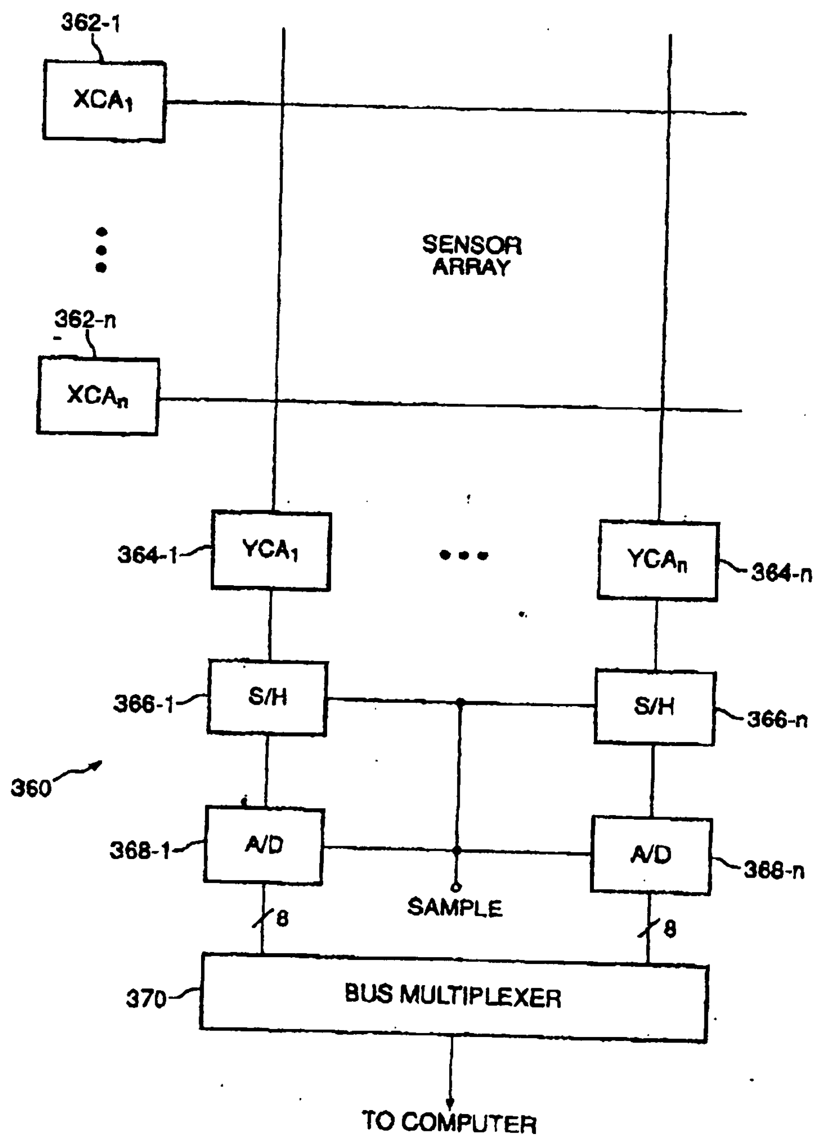

362-1
XCA1
SENSOR
ARRAY
362-n
XCAn
364-1
YCA1
YCAn
364-n
366-1
S/H
S/H
366-n
360
368-1
A/D
A/D
368-n
8
SAMPLE
8
370
BUS MULTIPLEXER
TO COMPUTER

FIG. 16a

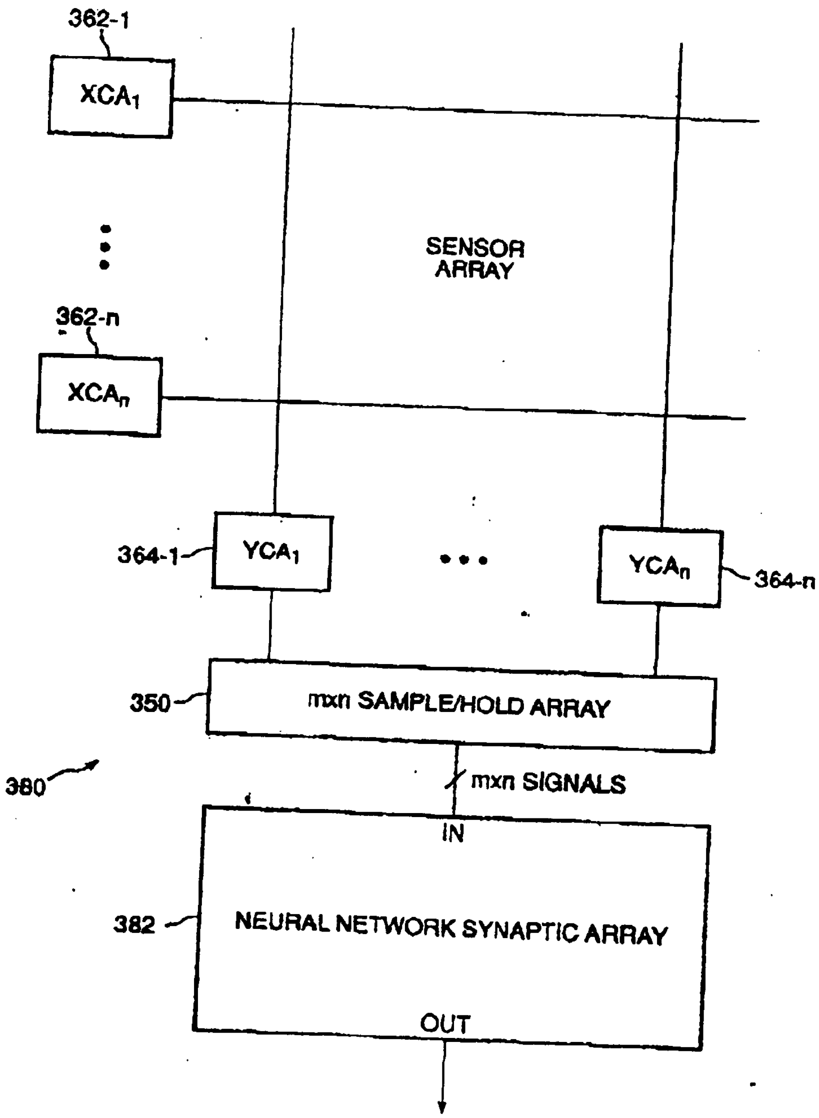

362-1
XCA1
362-n
XCAn
SENSOR ARRAY
364-1
YCA1
YCAn
364-n
350
mxn SAMPLE/HOLD ARRAY
380
mxn SIGNALS
IN
382
NEURAL NETWORK SYNAPTIC ARRAY
OUT

FIG. 16b

European Patent Office

EUROPEAN SEARCH REPORT

Application Number
EP 93 30 4403

DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int. Cl.5)
X	US-A-4 550 221 (MABUSTH)	1,2,11, 12,14, 21,22,24	G06K11/16
Y	* column 2, line 41 - line 68 *	3,4,6-8, 13, 16-18, 23,25	
A	* column 3, line 42 - column 7, line 50 * * column 8, line 46 - column 9, line 57; figures 1-5,7 * ---	9,19	
X	FR-A-2 662 528 (SEXTANT AVIONIQUE)	21,22,24	
A	* page 3, line 1 - page 8, line 24; figures * ---	1,2,6,7, 11,12, 16,17,25	
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A	* page 1196, right column, line 34 - page 1197, left column, line 38 * * page 1198, left column, line 4 - page 1199, left column, line 12; figures 1-4 * ---	1,11,21	G06K
Y	US-A-4 736 191 (MATZKE ET AL.)	23,25	
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The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	06 SEPTEMBER 1993	SEMPLE M.

CATEGORY OF CITED DOCUMENTS

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