FILE HISTORY
US 8,519,973

PATENT:	8,519,973
INVENTORS:	XiaoPing, Jiang
TITLE:	Apparatus and methods for detecting a conductive object at a location
APPLICATION NO:	US13442716A
FILED:	09 APR 2012
ISSUED:	27 AUG 2013
COMPILED:	14 JAN 2014

EXHIBIT 1011
IPR Petition for U.S. Patent No. 8,519,973

8,519,973

APPARATUS AND METHODS FOR DETECTING A CONDUCTIVE OBJECT AT A LOCATION

Transaction History

Date	Transaction Description
4/9/2012	PGPubs nonPub Request
4/9/2012	IFW Scan & PACR Auto Security Review
4/9/2012	Initial Exam Team nn
4/12/2012	Cleared by OIPE CSR
4/26/2012	Filing Receipt
4/26/2012	Notice Mailed--Application Incomplete--Filing Date Assigned
5/31/2012	Preliminary Amendment
5/31/2012	A self-addressed post card (having the applicant's address) received with a patent application for t
6/8/2012	Notice of Incomplete Reply
6/18/2012	Payment of additional filing fee/Preexam
6/18/2012	A statement by one or more inventors satisfying the requirement under 35 USC 115, Oath of the Applic
6/22/2012	Application Is Now Complete
6/22/2012	Application Dispatched from OIPE
6/22/2012	Filing Receipt - Updated
8/7/2012	Case Docketed to Examiner in GAU
9/7/2012	Non-Final Rejection
9/19/2012	Mail Non-Final Rejection
11/16/2012	Terminal Disclaimer Filed
11/16/2012	Response after Non-Final Action
11/22/2012	Date Forwarded to Examiner
11/26/2012	PARALEGAL OR ELECTRONIC TERMINAL DISCLAIMER APPROVED
11/30/2012	Change in Power of Attorney (May Include Associate POA)
12/14/2012	Reasons for Allowance
12/21/2012	Mail Notice of Allowance
12/21/2012	Notice of Allowance Data Verification Completed
12/21/2012	Document Verification
1/8/2013	Filing Receipt - Corrected
1/15/2013	Information Disclosure Statement considered
1/15/2013	Information Disclosure Statement (IDS) Filed
1/15/2013	Request for Continued Examination (RCE)
1/15/2013	Information Disclosure Statement (IDS) Filed
1/15/2013	Workflow - Request for RCE - Begin
1/16/2013	Disposal for a RCE / CPA / R129
4/8/2013	Document Verification
4/8/2013	Notice of Allowance Data Verification Completed
4/8/2013	Reasons for Allowance
4/22/2013	Electronic Review
4/22/2013	Email Notification
4/22/2013	Mail Notice of Allowance
5/17/2013	Information Disclosure Statement considered
5/17/2013	Electronic Information Disclosure Statement
5/17/2013	Request for Continued Examination (RCE)
5/17/2013	Information Disclosure Statement (IDS) Filed
5/17/2013	Workflow - Request for RCE - Begin

5/18/2013	Disposal for a RCE / CPA / R129
6/12/2013	Reasons for Allowance
6/18/2013	Document Verification
6/18/2013	Notice of Allowance Data Verification Completed
6/24/2013	Electronic Review
6/24/2013	Email Notification
6/24/2013	Mail Notice of Allowance
7/29/2013	Issue Fee Payment Verified
7/29/2013	Issue Fee Payment Received
7/30/2013	Dispatch to FDC
7/30/2013	Application Is Considered Ready for Issue
8/7/2013	Issue Notification Mailed
8/8/2013	Email Notification
8/27/2013	Recordation of Patent Grant Mailed
8/27/2013	Patent Issue Date Used in PTA Calculation

Issue Classification	**Application/Control No**	**Applicant(s)/Patent Under Reexamination**
	13442716	XIAOPING JIANG
	Examiner	**Art Unit**
	BENYAM KETEMA	2696

ORIGINAL		**INTERNATIONAL CLASSIFICATION**									
CLASS	**SUBCLASS**	**CLAIMED**					**NON CLAIMED**				
345	173	G	0	6	F	3 / 041 (2006 0)					
		G	0	6	F	3 / 045 (2006 0)					
		G	0	6	F	3 / 033 (2006 0)					

CROSS REFERENCE(S)

CLASS	SUBCLASS (ONE SUBCLASS PER BLOCK)				
345	174	179			
178	18 01	18 06			

☐ 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	Final	Original
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14	34														
15	35														
16	36														

/BENYAM KETEMA/ Examiner Art Unit 2696 (Assistant Examiner)	12/12/2012 (Date)	**Total Claims Allowed** 20	
/BIPIN SHALWALA/ Supervisory Patent Examiner Art Unit 2696 (Primary Examiner)	12/14/2012 (Date)	O G Print Claim(s) 1	O G Print Figure 6B

Issue Classification	**Application/Control No**	**Applicant(s)/Patent Under Reexamination**
	13442716	
	Examiner	**Art Unit**
	BIPIN SHALWALA	2696

CPC

Symbol					Type	Version
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CPC Combination Sets

Symbol					Type	Set	Ranking	Version
			/					
			/					

US ORIGINAL CLASSIFICATION	
CLASS	SUBCLASS
345	173

CROSS REFERENCE(S)

CLASS	SUBCLASS (ONE SUBCLASS PER BLOCK)				
345	174	179			
178	18 01	18 06			

INTERNATIONAL CLASSIFICATION

CLAIMED					NON CLAIMED
G	0	6	F	3 / 041 (2006 01 01)	
G	0	6	F	3 / 045 (2006 01 01)	
G	0	6	F	3 / 033 (2006 01 01)	

/BENYAM KETEMA/ Examiner Art Unit 2696 (Assistant Examiner)	04/06/2013 (Date)	**Total Claims Allowed** 20
/BIPIN SHALWALA/ Supervisory Patent Examiner Art Unit 2696 (Primary Examiner)	04/07/2013 (Date)	O G Print Claim(s): 1 — O G Print Figure: 6B

Issue Classification	Application/Control No	Applicant(s)/Patent Under Reexamination
	13442716	
	Examiner	**Art Unit**
	BIPIN SHALWALA	2696

/BENYAM KETEMA/ Examiner Art Unit 2696 (Assistant Examiner)	04/06/2013 (Date)	**Total Claims Allowed** 20	
/BIPIN SHALWALA/ Supervisory Patent Examiner Art Unit 2696 (Primary Examiner)	04/07/2013 (Date)	O G Print Claim(s) 1	O G Print Figure 6B

Issue Classification	**Application/Control No** 13442716	**Applicant(s)/Patent Under Reexamination**
	Examiner BIPIN SHALWALA	**Art Unit** 2696

☐ **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	Final	Original
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/BENYAM KETEMA/ Examiner Art Unit 2696 (Assistant Examiner)	04/06/2013 (Date)	**Total Claims Allowed** 20	
/BIPIN SHALWALA/ Supervisory Patent Examiner Art Unit 2696 (Primary Examiner)	04/07/2013 (Date)	O G Print Claim(s) 1	O G Print Figure 6B

Issue Classification	Application/Control No	Applicant(s)/Patent Under Reexamination
	13442716	
	Examiner	Art Unit
	BIPIN SHALWALA	2696

CPC		
Symbol	Type	Version

CPC Combination Sets				
Symbol	Type	Set	Ranking	Version

US ORIGINAL CLASSIFICATION	
CLASS	SUBCLASS
345	173

CROSS REFERENCE(S)

CLASS	SUBCLASS (ONE SUBCLASS PER BLOCK)				
345	174	179			
178	18 01	18 06			

INTERNATIONAL CLASSIFICATION

CLAIMED					NON CLAIMED
G	0	6	F	3 / 041 (2006 01 01)	
G	0	6	F	3 / 045 (2006 01 01)	
G	0	6	F	3 / 033 (2013 01 01)	

/BENYAM KETEMA/ Examiner Art Unit 2696 (Assistant Examiner)	06/11/2013 (Date)	Total Claims Allowed 20	
/Bipin Shalwala/ Supervisory Patent Examiner Art Unit 2696 (Primary Examiner)	(Date)	O G Print Claim(s) 1	O G Print Figure 6B

Issue Classification	Application/Control No	Applicant(s)/Patent Under Reexamination
	13442716	
	Examiner	**Art Unit**
	BIPIN SHALWALA	2696

/BENYAM KETEMA/ Examiner Art Unit 2696 (Assistant Examiner)	06/11/2013 (Date)	**Total Claims Allowed** 20	
/Bipin Shalwala/ Supervisory Patent Examiner Art Unit 2696 (Primary Examiner)	(Date)	O G Print Claim(s) 1	O G Print Figure 6B

U S Patent and Trademark Office

Part of Paper No 20130611

CY00001920

Issue Classification	Application/Control No	Applicant(s)/Patent Under Reexamination
	13442716	
	Examiner	Art Unit
	BIPIN SHALWALA	2696

☐ 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	Final	Original
1	21	17	37												
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/Bipin Shalwala/ Supervisory Patent Examiner Art Unit 2696 (Primary Examiner)	(Date)	O G Print Claim(s) 1	O G Print Figure 6B

Index of Claims	Application/Control No 13442716	Applicant(s)/Patent Under Reexamination XIAOPING JIANG
	Examiner BENYAM KETEMA	Art Unit 2629

✓	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	09/04/2012								
	21	✓								
	22	✓								
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	35	✓								
	36	✓								
	37	✓								
	38	✓								
	39	✓								
	40	✓								

Search Notes	Application/Control No 13442716	Applicant(s)/Patent Under Reexamination XIAOPING JIANG
	Examiner BENYAM KETEMA	Art Unit 2629

SEARCHED

Class	Subclass	Date	Examiner
345	173 174	9/4/2012	BK

SEARCH NOTES

Search Notes	Date	Examiner
inventor Search	9/4/2012	BK
See attached EAST search	9/4/2012	BK

INTERFERENCE SEARCH

Class	Subclass	Date	Examiner

Search Notes	Application/Control No 13442716	Applicant(s)/Patent Under Reexamination XIAOPING JIANG
	Examiner BENYAM KETEMA	**Art Unit** 2629

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SEARCH NOTES

Search Notes	Date	Examiner
inventor Search	9/4/2012	BK
See attached EAST search	9/4/2012	BK
above search have been updated	12/12/2012	BK

INTERFERENCE SEARCH

Class	Subclass	Date	Examiner
	all of the above have been searched	12/12/2012	BK

/B K / Examiner Art Unit 2696	

Search Notes	Application/Control No	Applicant(s)/Patent Under Reexamination
	13442716	XIAOPING JIANG
	Examiner	Art Unit
	BENYAM KETEMA	2629

CPC- SEARCHED

Symbol	Date	Examiner

CPC COMBINATION SETS - SEARCHED

Symbol	Date	Examiner

US CLASSIFICATION SEARCHED

Class	Subclass	Date	Examiner
345	173 174	9/4/2012	BK

SEARCH NOTES

Search Notes	Date	Examiner
inventor Search	9/4/2012	BK
See attached EAST search	9/4/2012	BK
above search have been updated	12/12/2012	BK
Above search have been updated	4/5/2013	BK

INTERFERENCE SEARCH

US Class/ CPC Symbol	US Subclass / CPC Group	Date	Examiner
	all of the above have been searched	12/12/2012	BK

/B K / Examiner Art Unit 2696	

Search Notes	Application/Control No	Applicant(s)/Patent Under Reexamination
	13442716	XIAOPING JIANG
	Examiner	**Art Unit**
	BENYAM KETEMA	2629

CPC- SEARCHED		
Symbol	**Date**	**Examiner**

CPC COMBINATION SETS - SEARCHED		
Symbol	**Date**	**Examiner**

US CLASSIFICATION SEARCHED			
Class	**Subclass**	**Date**	**Examiner**
345	173 174	9/4/2012	BK

SEARCH NOTES		
Search Notes	**Date**	**Examiner**
inventor Search	9/4/2012	BK
See attached EAST search	9/4/2012	BK
above search have been updated	12/12/2012	BK
Above search have been updated	4/5/2013	BK
Above East search have been updated	6/11/2013	BK

INTERFERENCE SEARCH			
US Class/ CPC Symbol	**US Subclass / CPC Group**	**Date**	**Examiner**
	all of the above have been searched	12/12/2012	BK

/B K / Examiner Art Unit 2696	

EAST Search History

EAST Search History (Prior Art)

Ref #	Hits	Search Query	DBs	Default Operator	Plurals	Time Stamp
S1	0	13442716	US-PGPUB USPAT USOCR FPRS EPO JPO DERWENT IBM_TDB	ADJ	ON	2012/09/04 18 03
S8	17	XIAOPING-JIANG in	US PGPUB USPAT USOCR FPRS EPO JPO DERWENT IBM_TDB	ADJ	ON	2012/09/05 16 30
S9	3	XIAOPING-JIANG in and ((first and sensing adj areas) clm and(second and sensing adj areas) clm)	US-PGPUB USPAT USOCR FPRS EPO JPO DERWENT IBM_TDB	ADJ	ON	2012/09/05 16 30
S10	90	345/173 ccls and capacitance and button and (sensing adj areas)	US-PGPUB USPAT USOCR FPRS EPO JPO DERWENT IBM_TDB	ADJ	ON	2012/09/05 16 31
S11	56	345/173 ccls and capacitance and button and (sensing adj areas) and (touch adj pad)	US-PGPUB USPAT USOCR FPRS EPO JPO DERWENT IBM_TDB	ADJ	ON	2012/09/05 16 31
S12	98	(Capacitive and sensor) and (sensing near areas) same buttons	US-PGPUB USPAT USOCR FPRS EPO JPO DERWENT IBM_TDB	ADJ	ON	2012/09/05 16 31
S13	198	cypress as and (Capacitive and sensor)	US-PGPUB USPAT USOCR FPRS EPO JPO DERWENT IBM_TDB	ADJ	ON	2012/09/05 16 32
S14	3034	(touch near screen or pad) and (capacit$6 and sens$3 and button) and (sens$3 and area) and 345 /$ ccls and portable	US PGPUB USPAT USOCR FPRS EPO JPO DERWENT IBM_TDB	ADJ	ON	2012/09/05 16 32
S15	60	(touch near screen) and (Capacitive and sensor) and (sensing near areas) same buttons	US PGPUB USPAT USOCR FPRS EPO JPO DERWENT IBM_TDB	ADJ	ON	2012/09/05 16 32
S16	1051	(touch (screen or pad)) same (capacit$6 same sens$3) same (button)	US PGPUB USPAT USOCR FPRS EPO JPO DERWENT IBM_TDB	ADJ	ON	2012/09/05 16 33

S17	164	345 /$ ccls and (capacitance near sensor) and (touch near screen) and multi$touch	US-PGPUB USPAT USOCR FPRS EPO JPO DERWENT IBM_TDB	ADJ	ON	2012/09/05 16 33
S18	69	(touch near screen) and (Capacit$6 and sens$3) and (sensing near areas) same buttons	US PGPUB USPAT USOCR FPRS EPO JPO DERWENT IBM_TDB	ADJ	ON	2012/09/05 16 33
S19	259	345/173 ccls and capacit$6 same sens$3 near (second or third)	US-PGPUB USPAT USOCR FPRS EPO JPO DERWENT IBM_TDB	ADJ	ON	2012/09/05 16 34
S20	987	(touch near screen or pad) same (capacit$6 and sens$3 and button) and (sens$3 and area) and 345 /$ ccls and portable	US-PGPUB USPAT USOCR FPRS EPO JPO DERWENT IBM_TDB	ADJ	ON	2012/09/05 16 34
S21	180	345 /$ ccls and (touch (screen or pad)) same (capacit$6 sens$3) same (button)	US PGPUB USPAT USOCR FPRS EPO JPO DERWENT IBM_TDB	ADJ	ON	2012/09/05 16 34
S22	82	345 /173 ccls and (touch (screen or pad)) same (capacit$6 sens$3) same (button)	US-PGPUB USPAT USOCR FPRS EPO JPO DERWENT IBM_TDB	ADJ	ON	2012/09/05 16 35
S23	507	(sens$4 near button$2) and (touch near screen) and (capacit$4)	US-PGPUB USPAT USOCR FPRS EPO JPO DERWENT IBM_TDB	ADJ	ON	2012/09/05 16 35
S24	64	(sens$4 near button$2) same (touch near screen) same (capacit$4)	US-PGPUB USPAT USOCR FPRS EPO JPO DERWENT IBM_TDB	ADJ	ON	2012/09/05 16 36

9/6/2012 3 34 57 PM
C \ Users\ bketema\ Documents\ EAST\ Workspaces\ 13442716\ 13442716 wsp

EAST Search History

EAST Search History (Prior Art)

Ref #	Hits	Search Query	DBs	Default Operator	Plurals	Time Stamp
L1	8	XIAOPING-JIANG in and ((first and second) and (sensing adj areas))	US-PGPUB USPAT USOCR FPRS EPO JPO DERWENT IBM_TDB	ADJ	ON	2012/12/12 18 10
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L3	599	((first and sensing adj areas) clm same(second and sensing adj areas) clm)	US-PGPUB USPAT USOCR FPRS EPO JPO DERWENT IBM_TDB	ADJ	ON	2012/12/12 18 11
L4	599	((first and sensing adj areas) clm same (second and sensing adj areas) clm)	US-PGPUB USPAT USOCR FPRS EPO JPO DERWENT IBM_TDB	ADJ	ON	2012/12/12 18 12
L5	101	345 clas and ((first and sensing adj areas) clm same (second and sensing adj areas) clm)	US-PGPUB USPAT USOCR FPRS EPO JPO DERWENT IBM_TDB	ADJ	ON	2012/12/12 18 12
L8	71	(sens$4 near button$2) same (touch near screen) same (capacit$4)	US-PGPUB USPAT USOCR FPRS EPO JPO DERWENT IBM_TDB	ADJ	ON	2012/12/12 18 13
L9	84	345 /173 ccls and (touch (screen or pad)) same (capacit$6 sens$3) same (button)	US-PGPUB USPAT USOCR FPRS EPO JPO DERWENT IBM_TDB	ADJ	ON	2012/12/12 18 15
L10	120	(touch near screen or pad) same	US-PGPUB	ADJ	ON	2012/12/12

CY00001929

		(capacit$6 and sens$3 and button) same(sens$3 and area) and 345 /$ ccls and portable	USPAT USOCR FPRS EPO JPO DERWENT IBM_TDB			18 15
L11	122	178/18 01 18 11 ccls and capacit$6 same sens$3 near (second or third)	US-PGPUB USPAT USOCR FPRS EPO JPO DERWENT IBM_TDB	ADJ	ON	2012/12/12 18 18
L12	82	(Capacit$6 and sens$3) and (sensing near areas) and (input near button)	US-PGPUB USPAT USOCR FPRS EPO JPO DERWENT IBM_TDB	ADJ	ON	2012/12/12 18 18
L13	45	345/173 ccls and cypress as	US-PGPUB USPAT USOCR FPRS EPO JPO DERWENT IBM_TDB	ADJ	ON	2012/12/12 18 19
L14	4	(Multiple near sens$4 near button$2) and (capacitance)	US-PGPUB USPAT USOCR FPRS EPO JPO DERWENT IBM_TDB	ADJ	ON	2012/12/12 18 20
L15	0	l13 and l14	US-PGPUB USPAT USOCR FPRS EPO JPO DERWENT IBM_TDB	ADJ	ON	2012/12/12 18 21
L16	3251	(touch near screen or pad) and (capacit$6 and sens$3 and button) and (sens$3 and area) and 345 /$ ccls and portable	US-PGPUB USPAT USOCR FPRS EPO JPO DERWENT IBM_TDB	ADJ	ON	2012/12/12 18 22
L17	286	345/173 ccls and capacit$6 same sens$3 near (second or third)	US-PGPUB USPAT USOCR FPRS EPO JPO DERWENT IBM_TDB	ADJ	ON	2012/12/12 18 22
L18	1070	(touch near screen or pad) same (capacit$6 and sens$3 and button) and (sens$3 and area) and 345 /$ ccls and portable	US-PGPUB USPAT USOCR FPRS EPO JPO DERWENT	ADJ	ON	2012/12/12 18 23

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S8	17	XIAOPING-JIANG in	US-PGPUB USPAT USOCR FPRS EPO JPO DERWENT IBM_TDB	ADJ	ON	2012/09/05 16 30
S9	3	XIAOPING-JIANG in and ((first and sensing adj areas) clm and(second and sensing adj areas) clm)	US-PGPUB USPAT USOCR FPRS EPO JPO DERWENT IBM_TDB	ADJ	ON	2012/09/05 16 30
S10	90	345/173 ccls and capacitance and button and (sensing adj areas)	US-PGPUB USPAT USOCR FPRS EPO JPO DERWENT IBM_TDB	ADJ	ON	2012/09/05 16 31
S11	56	345/173 ccls and capacitance and button and (sensing adj areas) and (touch adj pad)	US-PGPUB USPAT USOCR FPRS EPO JPO DERWENT IBM_TDB	ADJ	ON	2012/09/05 16 31
S12	98	(Capacitive and sensor) and (sensing near areas) same buttons	US-PGPUB USPAT USOCR FPRS EPO JPO DERWENT IBM_TDB	ADJ	ON	2012/09/05 16 31
S13	198	cypress as and (Capacitive and sensor)	US-PGPUB USPAT USOCR FPRS EPO JPO DERWENT IBM_TDB	ADJ	ON	2012/09/05 16 32
S14	3034	(touch near screen or pad) and (capacit$6 and sens$3 and button) and (sens$3 and area) and 345 /$ ccls and portable	US-PGPUB USPAT USOCR FPRS EPO JPO DERWENT	ADJ	ON	2012/09/05 16 32

			IBM_TDB			
S15	60	(touch near screen) and (Capacitive and sensor) and (sensing near areas) same buttons	US-PGPUB USPAT USOCR FPRS EPO JPO DERWENT IBM_TDB	ADJ	ON	2012/09/05 16 32
S16	1051	(touch (screen or pad)) same (capacit$6 same sens$3) same (button)	US-PGPUB USPAT USOCR FPRS EPO JPO DERWENT IBM_TDB	ADJ	ON	2012/09/05 16 33
S17	164	345 /$ ccls and (capacitance near sensor) and (touch near screen) and multi$touch	US-PGPUB USPAT USOCR FPRS EPO JPO DERWENT IBM_TDB	ADJ	ON	2012/09/05 16 33
S18	69	(touch near screen) and (Capacit$6 and sens$3) and (sensing near areas) same buttons	US-PGPUB USPAT USOCR FPRS EPO JPO DERWENT IBM_TDB	ADJ	ON	2012/09/05 16 33
S19	259	345/173 ccls and capacit$6 same sens$3 near (second or third)	US-PGPUB USPAT USOCR FPRS EPO JPO DERWENT IBM_TDB	ADJ	ON	2012/09/05 16 34
S20	987	(touch near screen or pad) same (capacit$6 and sens$3 and button) and (sens$3 and area) and 345 /$ ccls and portable	US-PGPUB USPAT USOCR FPRS EPO JPO DERWENT IBM_TDB	ADJ	ON	2012/09/05 16 34
S21	180	345 /$ ccls and (touch (screen or pad)) same (capacit$6 sens$3) same (button)	US-PGPUB USPAT USOCR FPRS EPO JPO DERWENT IBM_TDB	ADJ	ON	2012/09/05 16 34
S22	82	345 /173 ccls and (touch (screen or pad)) same (capacit$6 sens$3) same (button)	US-PGPUB USPAT USOCR FPRS EPO JPO DERWENT IBM_TDB	ADJ	ON	2012/09/05 16 35
S23	507	(sens$4 near button$2) and (touch near screen) and (capacit$4)	US-PGPUB USPAT USOCR FPRS	ADJ	ON	2012/09/05 16 35

			EPO JPO DERWENT IBM_TDB			
S24	64	(sens$4 near button$2) same (touch near screen) same (capacit$4)	US-PGPUB USPAT USOCR FPRS EPO JPO DERWENT IBM_TDB	ADJ	ON	2012/09/05 16 36

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			USPAT USOCR FPRS EPO JPO DERWENT IBM_TDB			18 23
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L17	139	(20030091220 | 20040178989 | 20040217945 | 20040239616 | 20050031175 | 20050159126 | 20060038793 | 20060097992 | 20060197750 | 20060227117 | 20060232559 | 20060262101 | 20070076897 | 20070247443 | 20070257894 | 20070268265 | 20070268273 | 20070268274 | 20070268275 | 20070291013 | 20070296709 | 20080007534 | 20080024455 | 20080036473 | 20080041639 | 20080041640 | 20080042986 | 20080042987 | 20080042988 | 20080042989 | 20080042994 | 20080068100 | 20080111714 | 20080116904 | 20080128182 | 20080179112 | 20080278178 | 3979745 | 4039940 | 4113378 | 4145748 | 4193063 | 4238711 | 4264903 | 4266144 | 4292604 | 4305135 | 4586260 | 4614937 | 4728932 | 4736191 | 4825147 | 4831325 | 5008497 | 5214388 | 5237879 | 5305017 | 5323158 | 5373245 | 5386219 | 5518078 | 5541580 | 5670915 | 5760852 | 5801340 | 5920309 | 5942733 | 6037929 | 6060957 | 6145850 | 6184871 | 6188391 | 6191723 | 6297811 | 6353200 | 6366099 | 6377129 | 6380931 | 6448911 | 6490203 | 6535200 | 6577140 | 6583632 | 6700392 | 6781577 | 6806693 | 6825673 | 6838887 | 6859159 | 6882338 | 6888536 | 6891531 | 6914547 | 6933873 | 6940291 | 6946853 | 6958594 | 6970120 | 6970126 | 7006078 | 7031886 | 7032051 | 7046230 | 7068039 | 7075316 | 7078916 | 7098675 | 7129935 | 7148704 | 7158125 | 7235983 |	US-PGPUB USPAT USOCR	ADJ	OFF	2013/04/05 18 27

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S8	17	XIAOPING-JIANG in	US-PGPUB USPAT USOCR FPRS EPO JPO DERWENT IBM_TDB	ADJ	ON	2012/09/05 16 30
S9	3	XIAOPING-JIANG in and ((first and sensing adj areas) clm and(second and sensing adj areas) clm)	US-PGPUB USPAT USOCR FPRS EPO JPO DERWENT IBM_TDB	ADJ	ON	2012/09/05 16 30
S10	90	345/173 ccls and capacitance and button and (sensing adj areas)	US-PGPUB USPAT USOCR FPRS EPO JPO DERWENT IBM_TDB	ADJ	ON	2012/09/05 16 31
S11	56	345/173 ccls and capacitance and button and (sensing adj areas) and (touch adj pad)	US-PGPUB USPAT USOCR FPRS EPO JPO DERWENT IBM_TDB	ADJ	ON	2012/09/05 16 31
S12	98	(Capacitive and sensor) and (sensing near areas) same buttons	US-PGPUB USPAT USOCR FPRS EPO JPO DERWENT IBM_TDB	ADJ	ON	2012/09/05 16 31
S13	198	cypress as and (Capacitive and sensor)	US-PGPUB USPAT USOCR	ADJ	ON	2012/09/05 16 32

			FPRS EPO JPO DERWENT IBM_TDB			
S14	3034	(touch near screen or pad) and (capacit$6 and sens$3 and button) and (sens$3 and area) and 345 /$ ccls and portable	US-PGPUB USPAT USOCR FPRS EPO JPO DERWENT IBM_TDB	ADJ	ON	2012/09/05 16 32
S15	60	(touch near screen) and (Capacitive and sensor) and (sensing near areas) same buttons	US-PGPUB USPAT USOCR FPRS EPO JPO DERWENT IBM_TDB	ADJ	ON	2012/09/05 16 32
S16	1051	(touch (screen or pad)) same (capacit$6 same sens$3) same (button)	US-PGPUB USPAT USOCR FPRS EPO JPO DERWENT IBM_TDB	ADJ	ON	2012/09/05 16 33
S17	164	345 /$ ccls and (capacitance near sensor) and (touch near screen) and multi$touch	US-PGPUB USPAT USOCR FPRS EPO JPO DERWENT IBM_TDB	ADJ	ON	2012/09/05 16 33
S18	69	(touch near screen) and (Capacit$6 and sens$3) and (sensing near areas) same buttons	US-PGPUB USPAT USOCR FPRS EPO JPO DERWENT IBM_TDB	ADJ	ON	2012/09/05 16 33
S19	259	345/173 ccls and capacit$6 same sens$3 near (second or third)	US-PGPUB USPAT USOCR FPRS EPO JPO DERWENT IBM_TDB	ADJ	ON	2012/09/05 16 34
S20	987	(touch near screen or pad) same (capacit$6 and sens$3 and button) and (sens$3 and area) and 345 /$ ccls and portable	US-PGPUB USPAT USOCR FPRS EPO JPO DERWENT IBM_TDB	ADJ	ON	2012/09/05 16 34
S21	180	345 /$ ccls and (touch (screen or pad)) same (capacit$6 sens$3) same (button)	US-PGPUB USPAT USOCR FPRS EPO JPO DERWENT IBM_TDB	ADJ	ON	2012/09/05 16 34
S22	82	345 /173 ccls and (touch (screen or	US-PGPUB	ADJ	ON	2012/09/05

		pad)) same (capacit$6 sens$3) same (button)	USPAT USOCR FPRS EPO JPO DERWENT IBM_TDB			16 35
S23	507	(sens$4 near button$2) and (touch near screen) and (capacit$4)	US-PGPUB USPAT USOCR FPRS EPO JPO DERWENT IBM_TDB	ADJ	ON	2012/09/05 16 35
S24	64	(sens$4 near button$2) same (touch near screen) same (capacit$4)	US-PGPUB USPAT USOCR FPRS EPO JPO DERWENT IBM_TDB	ADJ	ON	2012/09/05 16 36
S25	8	XIAOPING-JIANG in and ((first and second) and (sensing adj areas))	US-PGPUB USPAT USOCR FPRS EPO JPO DERWENT IBM_TDB	ADJ	ON	2012/12/12 18 10
S26	985	((first and sensing adj areas) clm and(second and sensing adj areas) clm)	US-PGPUB USPAT USOCR FPRS EPO JPO DERWENT IBM_TDB	ADJ	ON	2012/12/12 18 11
S27	599	((first and sensing adj areas) clm same(second and sensing adj areas) clm)	US-PGPUB USPAT USOCR FPRS EPO JPO DERWENT IBM_TDB	ADJ	ON	2012/12/12 18 11
S28	599	((first and sensing adj areas) clm same (second and sensing adj areas) clm)	US-PGPUB USPAT USOCR FPRS EPO JPO DERWENT IBM_TDB	ADJ	ON	2012/12/12 18 12
S29	101	345 clas and ((first and sensing adj areas) clm same (second and sensing adj areas) clm)	US-PGPUB USPAT USOCR FPRS EPO JPO DERWENT IBM_TDB	ADJ	ON	2012/12/12 18 12
S30	71	(sens$4 near button$2) same (touch near screen) same (capacit$4)	US-PGPUB USPAT USOCR FPRS EPO JPO DERWENT	ADJ	ON	2012/12/12 18 13

			IBM_TDB			
S31	84	345 /173 ccls and (touch (screen or pad)) same (capacit$6 sens$3) same (button)	US-PGPUB USPAT USOCR FPRS EPO JPO DERWENT IBM_TDB	ADJ	ON	2012/12/12 18 15
S32	120	(touch near screen or pad) same (capacit$6 and sens$3 and button) same(sens$3 and area) and 345 /$ ccls and portable	US-PGPUB USPAT USOCR FPRS EPO JPO DERWENT IBM_TDB	ADJ	ON	2012/12/12 18 15
S33	122	178/18 01 18 11 ccls and capacit$6 same sens$3 near (second or third)	US-PGPUB USPAT USOCR FPRS EPO JPO DERWENT IBM_TDB	ADJ	ON	2012/12/12 18 18
S34	82	(Capacit$6 and sens$3) and (sensing near areas) and (input near button)	US-PGPUB USPAT USOCR FPRS EPO JPO DERWENT IBM_TDB	ADJ	ON	2012/12/12 18 18
S35	45	345/173 ccls and cypress as	US-PGPUB USPAT USOCR FPRS EPO JPO DERWENT IBM_TDB	ADJ	ON	2012/12/12 18 19
S36	4	(Multiple near sens$4 near button$2) and (capacitance)	US-PGPUB USPAT USOCR FPRS EPO JPO DERWENT IBM_TDB	ADJ	ON	2012/12/12 18 20
S37	0	S35 and S36	US-PGPUB USPAT USOCR FPRS EPO JPO DERWENT IBM_TDB	ADJ	ON	2012/12/12 18 21
S38	3251	(touch near screen or pad) and (capacit$6 and sens$3 and button) and (sens$3 and area) and 345 /$ ccls and portable	US-PGPUB USPAT USOCR FPRS EPO JPO DERWENT IBM_TDB	ADJ	ON	2012/12/12 18 22
S39	286	345/173 ccls and capacit$6 same sens$3 near (second or third)	US-PGPUB USPAT USOCR FPRS	ADJ	ON	2012/12/12 18 22

		`	EPO JPO DERWENT IBM_TDB			
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EAST Search History

EAST Search History (Prior Art)

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S12	98	(Capacitive and sensor) and (sensing near areas) same buttons	US-PGPUB USPAT USOCR FPRS EPO JPO DERWENT IBM_TDB	ADJ	ON	2012/09/05 16 31
S13	198	cypress as and (Capacitive and sensor)	US-PGPUB USPAT USOCR FPRS EPO JPO DERWENT IBM_TDB	ADJ	ON	2012/09/05 16 32
S14	3034	(touch near screen or pad) and (capacit$6 and sens$3 and button) and (sens$3 and area) and 345 /$ ccls and portable	US-PGPUB USPAT USOCR FPRS EPO JPO DERWENT IBM_TDB	ADJ	ON	2012/09/05 16 32
S15	60	(touch near screen) and (Capacitive and sensor) and (sensing near areas) same buttons	US-PGPUB USPAT USOCR FPRS EPO JPO DERWENT IBM_TDB	ADJ	ON	2012/09/05 16 32
S16	1051	(touch (screen or pad)) same (capacit$6 same sens$3) same (button)	US-PGPUB USPAT USOCR FPRS EPO JPO DERWENT IBM_TDB	ADJ	ON	2012/09/05 16 33
S17	164	345 /$ ccls and (capacitance near sensor) and (touch near screen) and multi$touch	US-PGPUB USPAT USOCR FPRS EPO JPO DERWENT IBM_TDB	ADJ	ON	2012/09/05 16 33
S18	69	(touch near screen) and (Capacit$6 and sens$3) and (sensing near areas) same buttons	US-PGPUB USPAT USOCR FPRS EPO JPO DERWENT IBM_TDB	ADJ	ON	2012/09/05 16 33
S19	259	345/173 ccls and capacit$6 same sens$3 near (second or third)	US-PGPUB USPAT USOCR FPRS	ADJ	ON	2012/09/05 16 34

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S21	180	345 /$ ccls and (touch (screen or pad)) same (capacit$6 sens$3) same (button)	US-PGPUB USPAT USOCR FPRS EPO JPO DERWENT IBM_TDB	ADJ	ON	2012/09/05 16 34
S22	82	345 /173 ccls and (touch (screen or pad)) same (capacit$6 sens$3) same (button)	US-PGPUB USPAT USOCR FPRS EPO JPO DERWENT IBM_TDB	ADJ	ON	2012/09/05 16 35
S23	507	(sens$4 near button$2) and (touch near screen) and (capacit$4)	US-PGPUB USPAT USOCR FPRS EPO JPO DERWENT IBM_TDB	ADJ	ON	2012/09/05 16 35
S24	64	(sens$4 near button$2) same (touch near screen) same (capacit$4)	US-PGPUB USPAT USOCR FPRS EPO JPO DERWENT IBM_TDB	ADJ	ON	2012/09/05 16 36
S25	8	XIAOPING-JIANG in and ((first and second) and (sensing adj areas))	US-PGPUB USPAT USOCR FPRS EPO JPO DERWENT IBM_TDB	ADJ	ON	2012/12/12 18 10
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S27	599	((first and sensing adj areas) clm same(second and sensing adj areas) clm)	US-PGPUB USPAT USOCR FPRS EPO JPO DERWENT IBM_TDB	ADJ	ON	2012/12/12 18 11
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S30	71	(sens$4 near button$2) same (touch near screen) same (capacit$4)	US-PGPUB USPAT USOCR FPRS EPO JPO DERWENT IBM_TDB	ADJ	ON	2012/12/12 18 13
S31	84	345 /173 ccls and (touch (screen or pad)) same (capacit$6 sens$3) same (button)	US-PGPUB USPAT USOCR FPRS EPO JPO DERWENT IBM_TDB	ADJ	ON	2012/12/12 18 15
S32	120	(touch near screen or pad) same (capacit$6 and sens$3 and button) same(sens$3 and area) and 345 /$ ccls and portable	US-PGPUB USPAT USOCR FPRS EPO JPO DERWENT IBM_TDB	ADJ	ON	2012/12/12 18 15
S33	122	178/18 01 18 11 ccls and capacit$6 same sens$3 near (second or third)	US-PGPUB USPAT USOCR FPRS EPO JPO DERWENT IBM_TDB	ADJ	ON	2012/12/12 18 18
S34	82	(Capacit$6 and sens$3) and (sensing near areas) and (input near button)	US-PGPUB USPAT USOCR FPRS EPO JPO DERWENT IBM_TDB	ADJ	ON	2012/12/12 18 18
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S36	4	(Multiple near sens$4 near button$2) and (capacitance)	US-PGPUB USPAT USOCR FPRS EPO JPO DERWENT IBM_TDB	ADJ	ON	2012/12/12 18 20

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S38	3251	(touch near screen or pad) and (capacit$6 and sens$3 and button) and (sens$3 and area) and 345 /$ ccls and portable	US-PGPUB USPAT USOCR FPRS EPO JPO DERWENT IBM_TDB	ADJ	ON	2012/12/12 18 22
S39	286	345/173 ccls and capacit$6 same sens$3 near (second or third)	US-PGPUB USPAT USOCR FPRS EPO JPO DERWENT IBM_TDB	ADJ	ON	2012/12/12 18 22
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(12) **Umted States Patent**
XiaoPmg

(10) **Patent No** **US 8,519,973 B1**
(45) **Date of Patent** ***Aug 27, 2013**

(54) **APPARATUS AND METHODS FOR DETECTING A CONDUCTIVE OBJECT AT A LOCATION**

(75) Inventor **Jiang XiaoPmg** Shanghai (CN)

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

(*) Notice Subject to any disclaimer the term of this patent is extended or adjusted under 35 U S C 154(b) by 0 days

This patent is subject to a terminal dis claimer

(21) Appl No **13/442,716**

(22) Filed **Apr 9, 2012**

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

(51) **Int Cl**
G06F 3/041 (2006 01)
G06F 3/045 (2006 01)
G06F 3/033 (2006 01)

(52) **U S Cl**
USPC **345/173** 345/174 345/179 178/18 01 178/18 06

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

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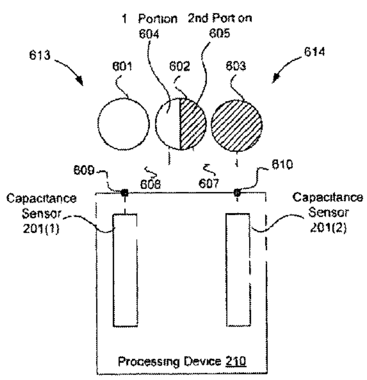
Primary Examiner — Bipin Shalwala
Assistant Examiner — Benyam Ketema

(57) **ABSTRACT**

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

20 Claims, 10 Drawing Sheets



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6 958 594	B2	10/2005	Redl et al	
6 970 120	B1	11/2005	Bjornsen	
6 970 126	B1	11/2005	O Dowd et al	
7 006 078	B2	2/2006	Kim	
7 031 886	B1	4/2006	Hargreaves	
7 032 051	B2	4/2006	Reay et al	
7 046 230	B2	5/2006	Zadesky et al	
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7 075 316	B2	7/2006	Umeda et al	
7 078 916	B2	7/2006	Denison	
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7 148 704	B2	12/2006	Philipp	
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7 417 441	B2	8/2008	Reynolds	
7 423 437	B2	9/2008	Hargreaves et al	
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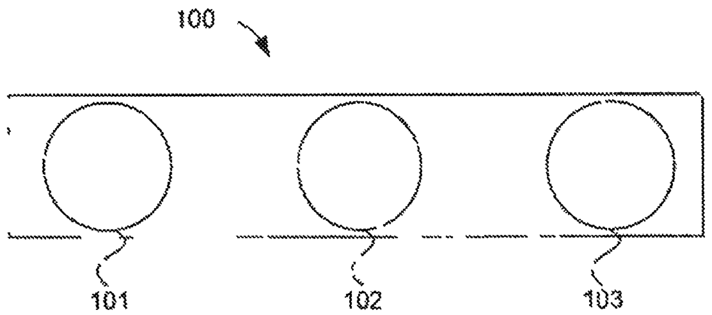

100
101
102
103

FIG 1A

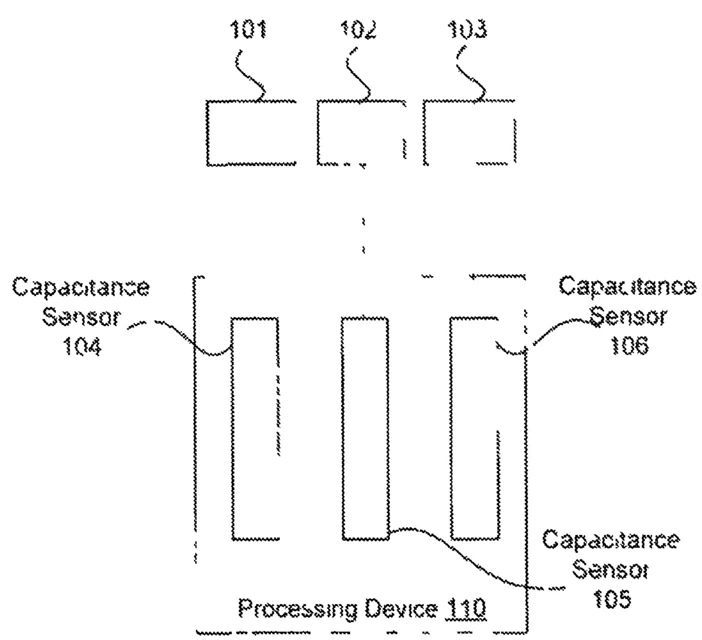

101
102
103
Capacitance Sensor 104
Capacitance Sensor 106
Capacitance Sensor 105
Processing Device 110

FIG 1B

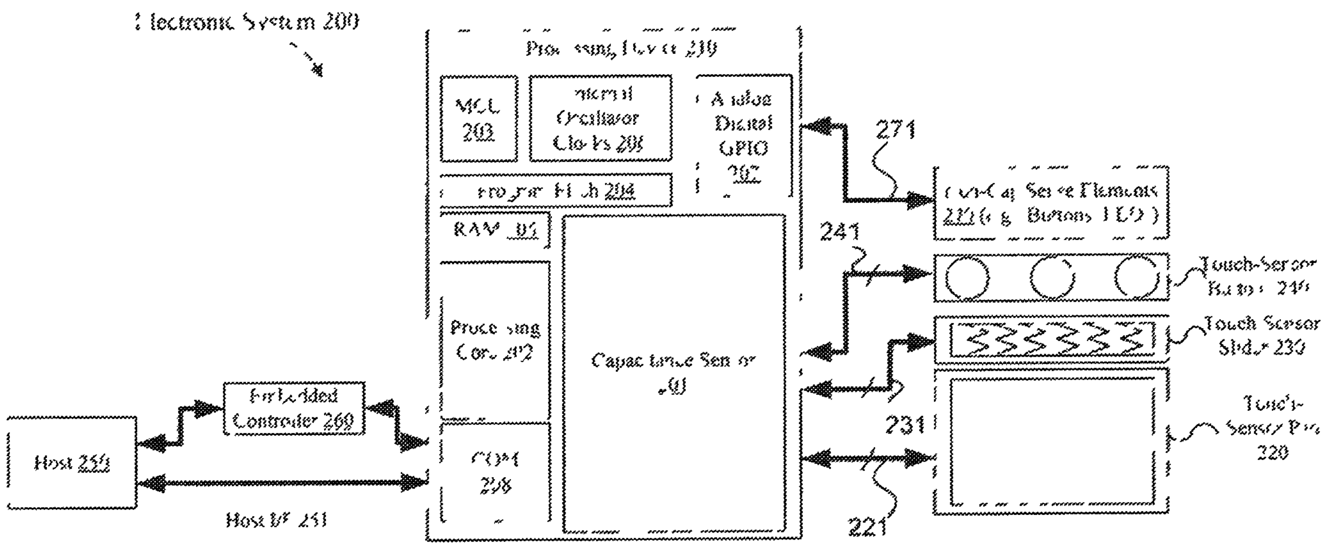


FIG 2

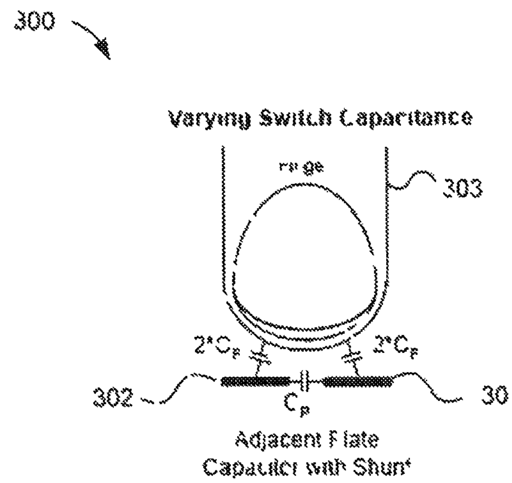

300
Varying Switch Capacitance
303
2*C_F
2*C_F
302
C_P
301
Adjacent Plate
Capacitor with Shunt

FIG 3A

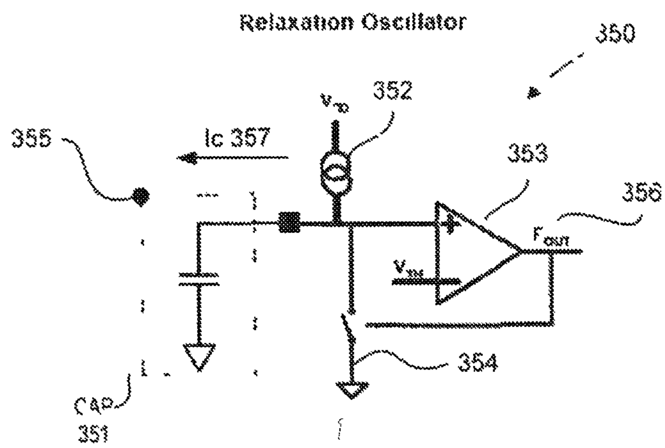

Relaxation Oscillator
350
352
355
Ic 357
353
356
F_OUT
354
CAP
351

FIG 3B

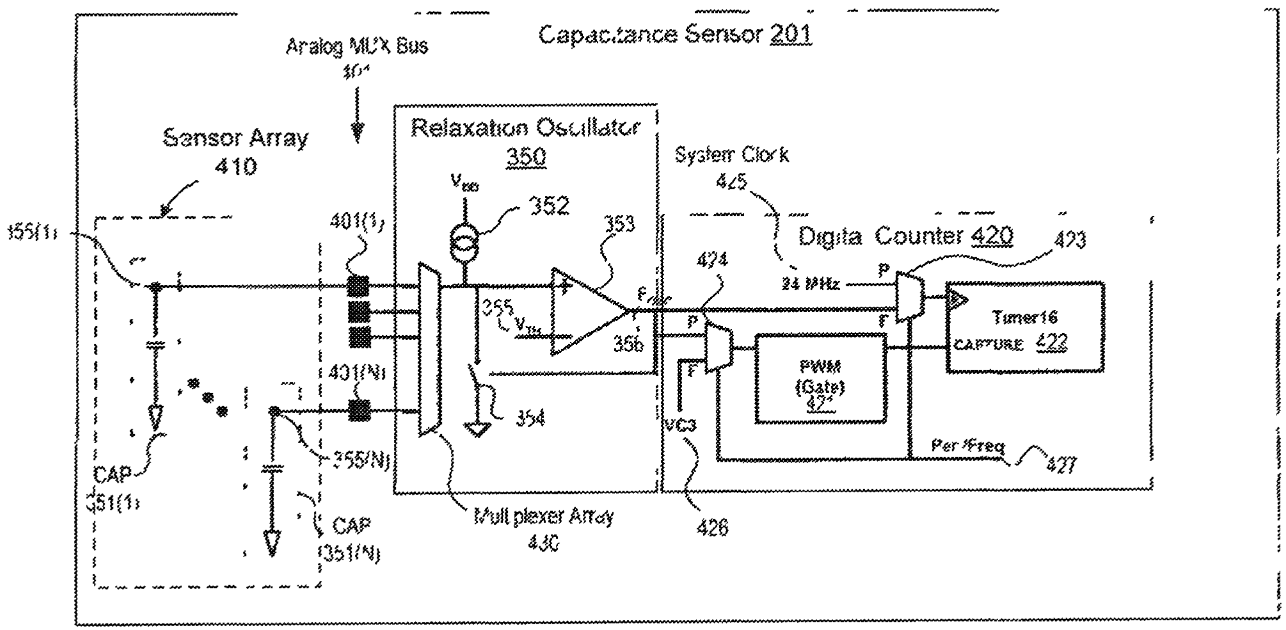

Capacitance Sensor 201
Analog MUX Bus
Sensor Array
410
Relaxation Oscillator
350
352
353
System Clock
425
Digital Counter 420
423
424
24 MHz
Timer16
CAPTURE 422
PWM
(Gate)
354
356
Per/Freq
427
VC3
426
401(1)
401(N)
355(N)
CAP
351(1)
CAP
351(N)
Multiplexer Array
430

FIG 4

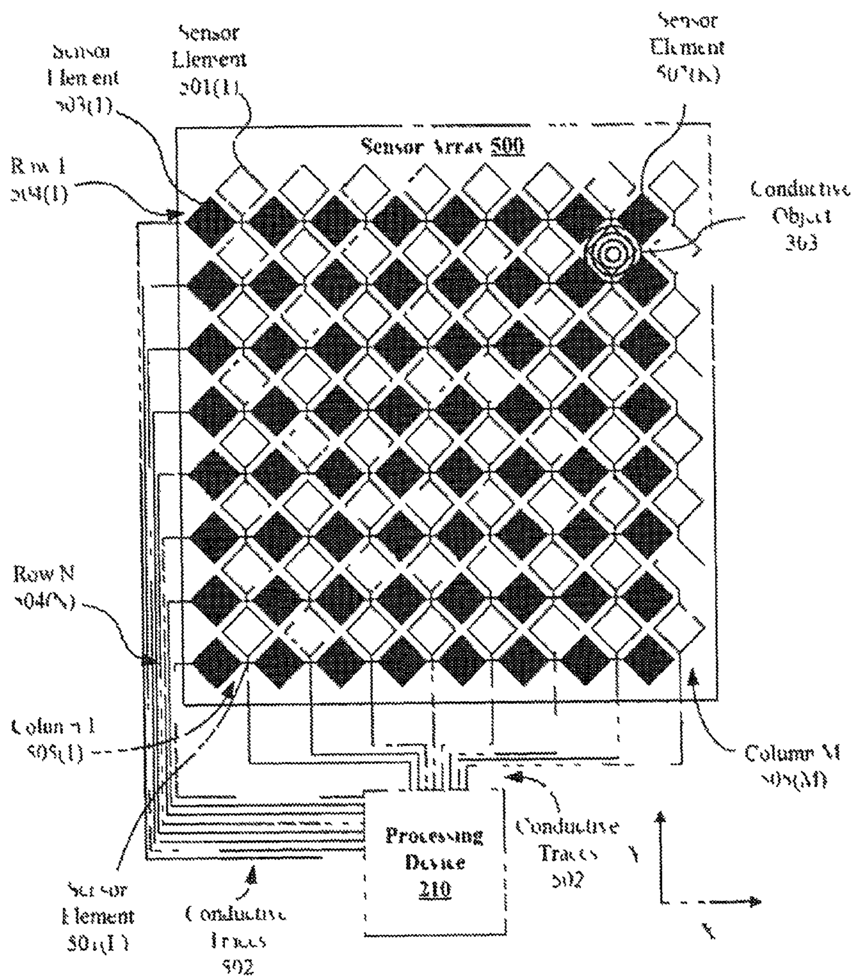


FIG 5A

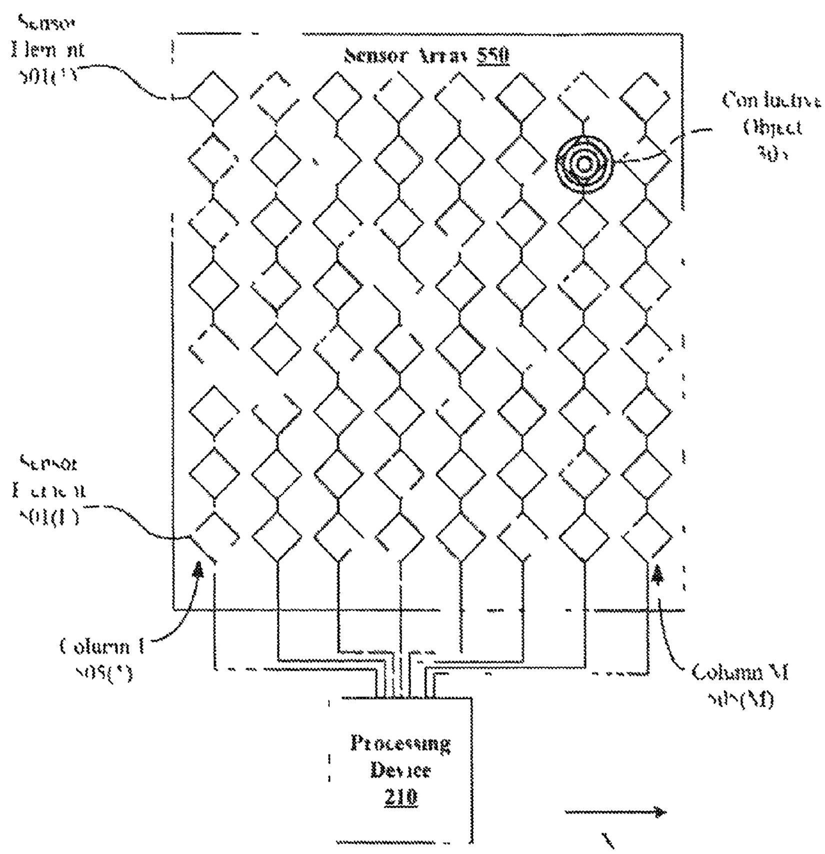

Sensor Element 501(1)
Sensor Array 550
Conductive Object
Sensor Element 501(L)
Column 1
Column M
Processing Device 210

FIG. 5B

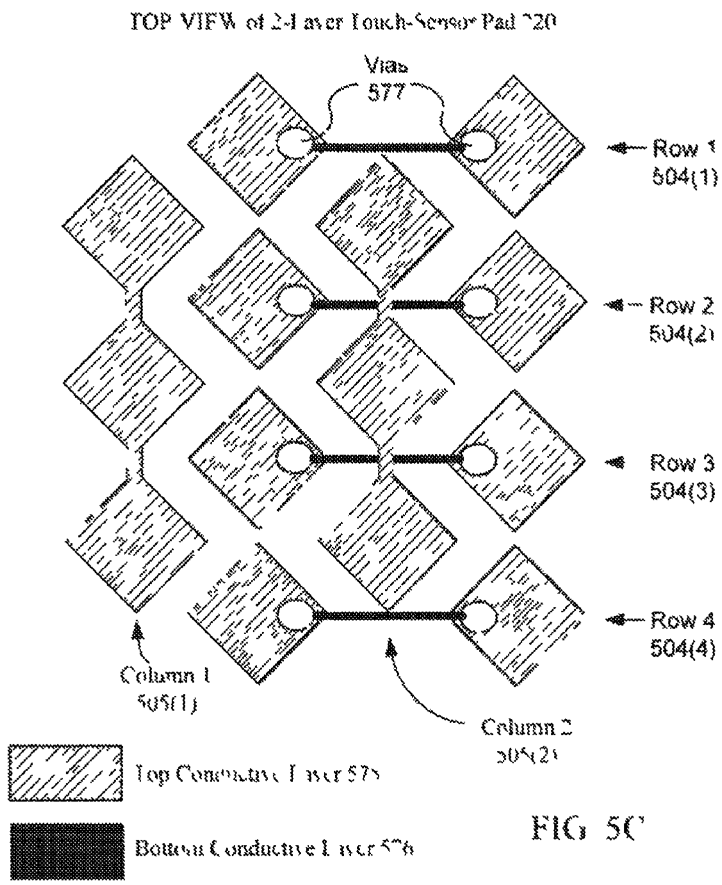

TOP VIEW of 2-Layer Touch-Sensor Pad 220
Vias
577
Row 1
504(1)
Row 2
504(2)
Row 3
504(3)
Row 4
504(4)
Column 1
505(1)
Column 2
505(2)
Top Conductive Layer 575
Bottom Conductive Layer 576

FIG 5C

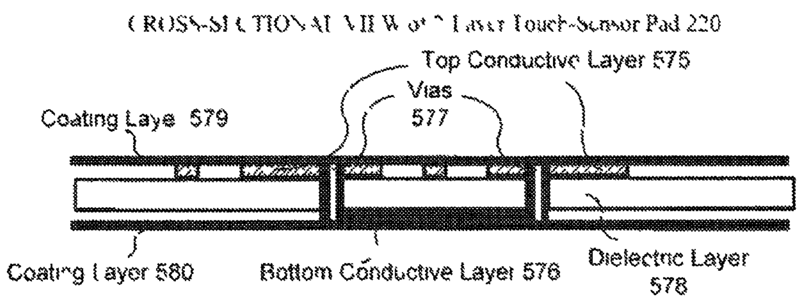

CROSS-SECTIONAL VIEW of 2-Layer Touch-Sensor Pad 220
Top Conductive Layer 575
Vias
577
Coating Laye 579
Coating Layer 580
Bottom Conductive Layer 576
Dielectric Layer
578

FIG 5D

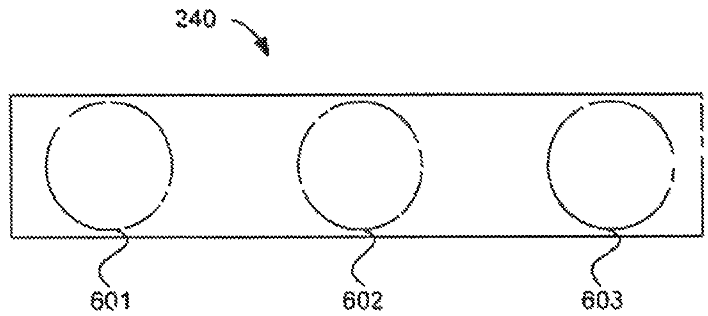

240
601
602
603

FIG 6A

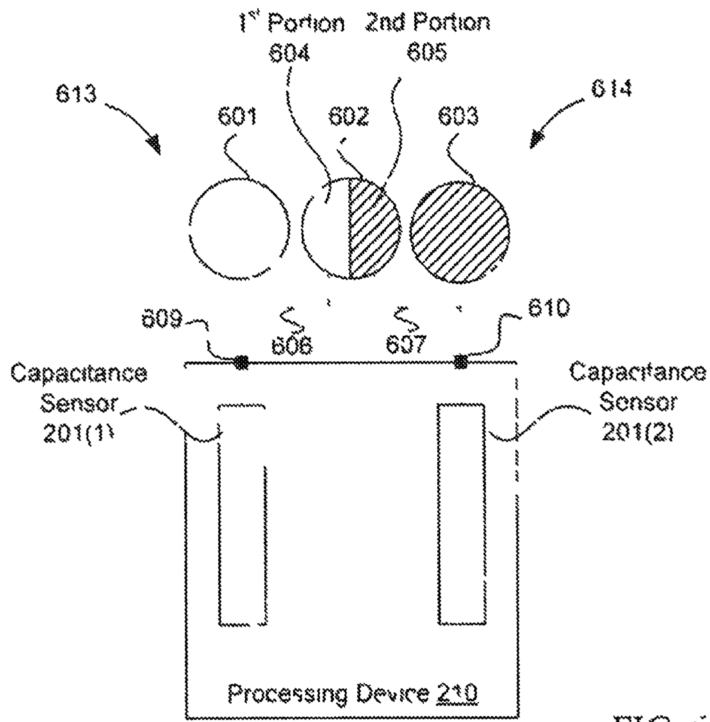

1st Portion 604
2nd Portion 605
613
614
601
602
603
609
606
607
610
Capacitance Sensor 201(1)
Capacitance Sensor 201(2)
Processing Device 210

FIG 6B

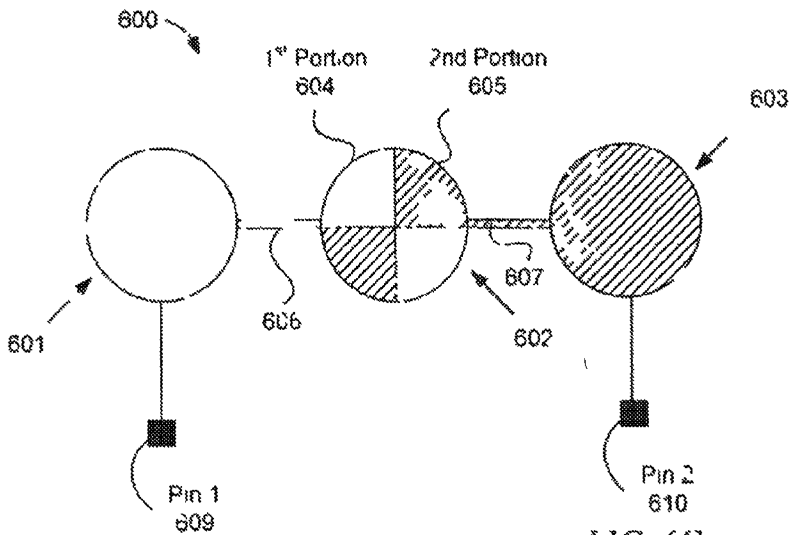

600
1st Portion
604
2nd Portion
605
603
601
606
607
602
Pin 1
609
Pin 2
610

FIG 6C

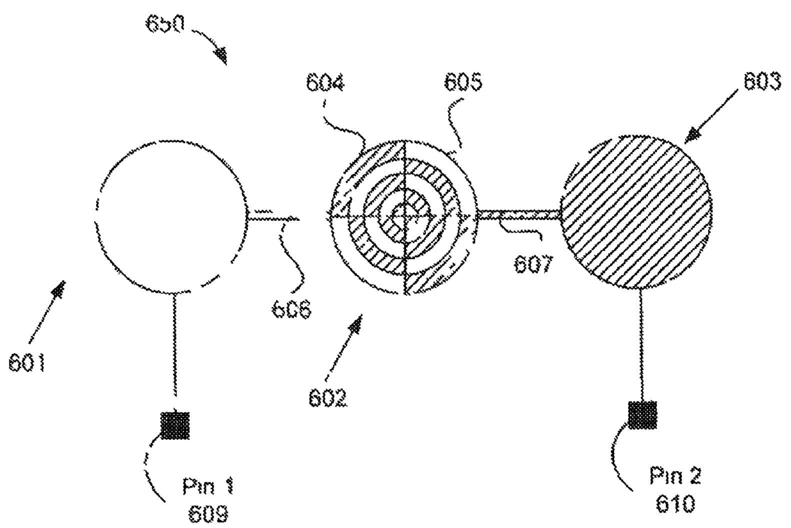
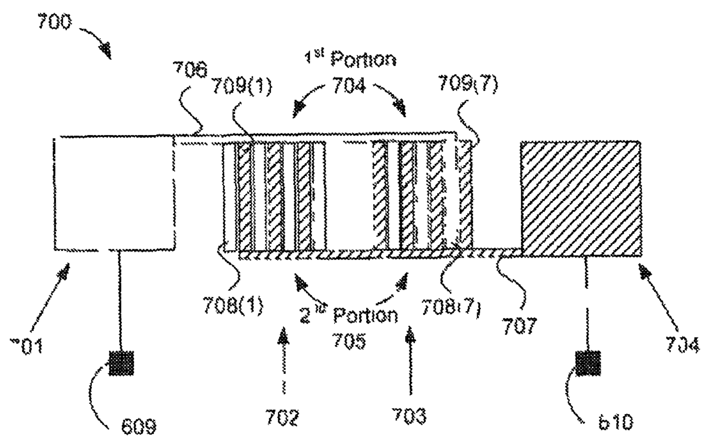
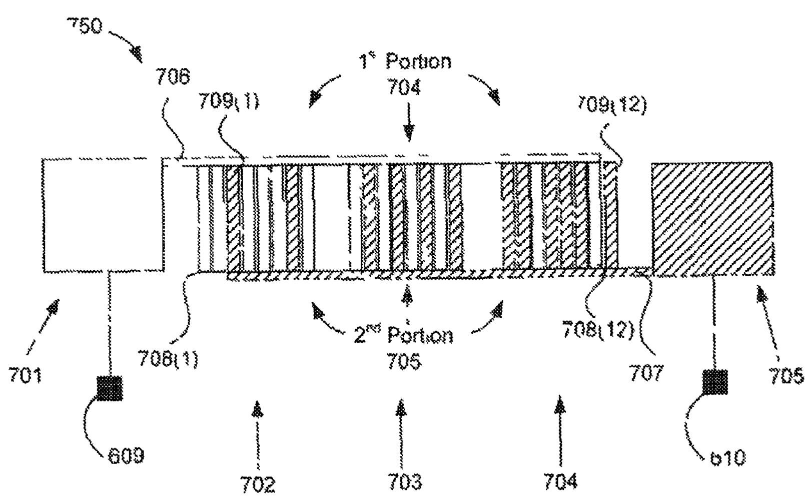

650
604
605
603
601
606
607
602
Pin 1
609
Pin 2
610

FIG 6D



700
706
709(1)
1st Portion
704
709(7)
708(1)
2nd Portion
705
708(7)
707
701
704
609
702
703
610

FIG 7A



750
706
709(1)
1st Portion
704
709(12)
708(1)
2nd Portion
705
708(12)
707
701
705
609
702
703
704
610

FIG 7B

APPARATUS AND METHODS FOR DETECTING A CONDUCTIVE OBJECT AT A LOCATION

RELATED APPLICATIONS

This application is a continuation of U S patent application Ser No 13/204 543 filed Aug 5 2011 now U S Pat No 8 174 507 issued May 8 2012 which is a continuation of U S patent application Ser No 11/437 517 filed May 18 2006 now U S Pat No 8 004 497 issued Aug 23 2011

TECHNICAL FIELD

This invention relates to the field of user interface devices and in particular to touch sensing devices

BACKGROUND

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 user interface device that is common is a touch sensor button A basis touch sensor button emulates the function of a mechanical button Touch sensor buttons may be embedded into different types of operational panels of electronic devices For example touch sensor buttons may be used on operational or control panels of household appliances consumer electronics mechanical devices and the like Touch sensor buttons may also be used in conjunction with or in place of other user input devices such as keyboards mice trackballs or the like

FIG 1A illustrates a conventional sensing device having three touch sensor buttons Conventional sensing device **100** includes button **101** button **102** and button **103** These buttons are conventional touch sensor buttons These three buttons may be used for user input using a conductive object such as a finger

FIG 1B illustrates a conventional sensing device of three touch sensor buttons **101 103** coupled to a processing device **110** Processing device **110** is used to detect whether a conductive object is present on either or none of the touch sensor buttons **101 103** To detect the presence of the conductive object the processing device **110** may include capacitance sensors **104 106** which are coupled to buttons **101 103** respectively The capacitance sensors of the processing device are coupled to the touch sensor buttons in a one to one configuration Accordingly the processing device **110** scans the touch sensor buttons **101 103** using the capacitance sensors **104 106** and measures the capacitance on the touch sensor buttons **101 103**

Each of the conventional touch sensor buttons **101 103** may be made of a sensor element of conductive material such as copper clad The conductive material may be form shaped in a circular shape (illustrated in FIG 1A) or even in a rectangular shape (illustrated in FIG 1B) The touch sensor buttons may be capacitance sensor buttons which may be used as non contact switches These switches when protected by an insulating layer offer resistance to severe environments

It should be noted that the conventional configuration of FIG 1B includes a one to one configuration of touch sensor buttons to capacitance sensors There are other conventional configurations that may use less capacitance sensors to measure the capacitance on the three touch sensor buttons These conventional configurations however still require a one to one configuration of pins to touch sensor buttons Accordingly by adding more buttons the processing device needs to have more pins to correspond to the one to one configuration of pins to touch sensor buttons Similarly by increasing the pin count the scan time to scan the sensor elements increases In addition the memory of the processing device which may be used to store program data and/or temporary data (e g raw measurement data differential counts baseline measurement data and the like) increases by increasing the pin count

BRIEF DESCRIPTION OF THE DRAWINGS

The present invention is illustrated by way of example and not by way of limitation in the figures of the accompanying drawings

FIG 1A illustrates a conventional sensing device having three touch sensor buttons

FIG 1B illustrates a conventional sensing device of three touch sensor buttons coupled to a processing device

FIG **2** illustrates a block diagram of one embodiment of an electronic system having a processing device for detecting a presence of a conductive object

FIG 3A illustrates a varying switch capacitance

FIG 3B illustrates one embodiment of a relaxation oscillator

FIG **4** illustrates a block diagram of one embodiment of a capacitance sensor including a relaxation oscillator and digital counter

FIG **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

FIG **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

FIG **5C** illustrates a top side view of one embodiment of a two layer touch sensor pad

FIG **5D** illustrates a side view of one embodiment of the two layer touch sensor pad of FIG **5C**

FIG **6A** illustrates one embodiment of a sensing device having three touch sensor buttons

FIG **6B** illustrates one embodiment of the sensing device of FIG **6A** coupled to a processing device

FIG **6C** illustrates another embodiment of a sensing device having three touch sensor buttons

FIG **6D** illustrates another embodiment of a sensing device having three touch sensor buttons

FIG **7A** illustrates another embodiment of a sensing device having four touch sensor buttons

FIG **7B** illustrates another embodiment of a sensing device having five touch sensor buttons

DETAILED DESCRIPTION

Described herein is an apparatus and method for detecting a presence of a conductive object on a sensing device and recognizing three or more button operations performed by the conductive object using two sensing areas of the sensing device 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

Embodiments of a method and apparatus are described to recognize three or more button operations performed by the conductive object on three or more sensor elements that are coupled to two pins of a processing device In one embodiment the apparatus may include a sensing device (e g touch sensor button) that has first second and third sensor elements The third sensor element has a first portion coupled to the first sensor element and a second portion coupled to the second sensor element These portions of the third sensor element are electrically isolated from one another

The embodiments describe herein permit the expansion of additional buttons (e g three or more total buttons) to the sensing device while using only two pins on the processing device Conversely since the conventional configuration has implemented a one to one configuration of sensor elements to pins of the processing device each button added requires an additional pin on the processing device Using only two pins the scan time does not increase by adding additional buttons to implement three or more buttons on the sensing device By maintaining two pins for three or more buttons the scan time to scan the sensor elements is not increased In other words more buttons may be implemented without increasing the total scan time of the sensing device Similarly the memory of the processing device is not increased to accommodate additional program data and/or temporary data (e g raw measurement data differential counts baseline measurement data and the like) for the additional buttons

The sensing device may use two capacitive switch relaxation oscillator (CSR) pins of a processing device to realize more than two buttons on the sensing device For example the three or more buttons may be realized by using two sensing areas Each sensing area may include a bar of conductive material and several interconnected sub bars The sub bars of the two sensing areas are interleaved and are electrically isolated In other words one set of interconnected sub bars are connected to one pin while the other set is coupled to the other pin The two sensing areas make up three or more sensor elements that are used to form the touch sensor buttons The different buttons contain different percentages of surface area of the sensing areas Alternatively each sensing area may include two or more bars of conductive material with or without several interconnected sub bars

For example a three button scheme using two pins includes one sensor element that has 100% of the first sensing area the second sensor element has 50% of the first sensing area and 50% of the second sensing area and the third sensor element has 100% of the second sensing area Accordingly by scanning and measuring the capacitance (e g capacitance variation of the capacitance minus the baseline as described below) on the two pins to detect the presence of the conductive object the processing device can distinguish between the presence of the conductive object on the first second and third sensor elements For example if the capacitance variation δ_1 measured on the first pin is greater than zero and the capacitance variation δ_2 measured on the second pin is equal to approximately zero then the first button has been pressed Similarly if the capacitance variation δ_1 measured on the first pin is equal to the capacitance variation δ_2 measured on the second pin then the second button has been pressed If the capacitance variation δ_1 measured on the first pin is equal to approximately zero and the capacitance variation δ_2 measured on the second pin is greater than zero then the third button has been pressed

The embodiments herein may be beneficial to help reduce the pin count of the processing device This may decrease the complexity of the processing device or allow the processing device to support additional functionality such as cursor positioning and selecting functionality keyboard functionality slider functionality or the like Furthermore the embodiments may be beneficial to help reduce the scan time of the sensing device Using two pins of the processing device to measure the capacitance on two sensing areas to realize three or more buttons is faster than measuring the capacitance on three or more touch sensor buttons of the conventional configuration (e g one to one configuration) In addition using two pins reduces the RAM/FLASH space needed in the sensing device as compared to the conventional configuration

The embodiments described herein may be used in different types of operational panels of electronic devices For example touch sensor buttons may be used on operational or control panels of household appliances consumer electronics mechanical devices and the like Touch sensor buttons may also be used in conjunction with or in place of other user input devices such as keyboards mice trackballs or the like

FIG 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 non volatile 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**

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**

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

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 key pad operation

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

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

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**

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

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

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**

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

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

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 Calif 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)

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**

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

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

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

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

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 Cp 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

FIG 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 FIG 3B 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) 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

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

FIG 3B 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.

$$CdV=I_C dt \tag{1}$$

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**.

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**.

$$\Delta C \propto \Delta f \text{, where} \tag{2}$$

$$\Delta f = f_{RO} - f_{REF} \tag{3}$$

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.

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.

FIG. **4** illustrates a block diagram of one embodiment of a capacitance sensor including a relaxation oscillator and digital counter. Capacitance sensor **201** of FIG. **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 FIG. **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**).

Relaxation oscillator **350** of FIG. **4** includes all the components described with respect to FIG. **3B**, 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**.

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.

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.

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

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

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

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

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

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

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

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

$$\frac{\Delta n}{n} = \frac{Cf}{Cp} \tag{4}$$

The value of Δn should be large enough for reasonable resolution and clear indication of switch actuation This drives switch construction decisions

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

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

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

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

$$n = \Delta n \cdot \frac{Cf}{Cp} = 2000 \tag{5}$$

Adding some margin to yield 2500 counts and running the frequency measurement method at 1 0 MHz the detection time for the switch is approximately 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

$$\Delta n = \frac{i \qquad i}{V_{TH}} \frac{Cf}{Cp^2} \tag{6}$$

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)

In the period measurement method the count difference between a switch with and without actuation (i e CP+CF vs CP) is approximately

$$\Delta n = N_{P \quad ods} \frac{Cf \quad V_{TH}}{i_C} f_{Sy \; Clk} \tag{7}$$

The charge currents are typically lower and the period is longer to increase sensitivity or the number of periods for which $f_{Sy,\ Clk}$ 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

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

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

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

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

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 FIG 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

$$C = \varepsilon_0 \ \varepsilon_R \ \frac{A}{d} = \varepsilon_R \ 8\ 85 \ \frac{A}{d} pF/m \tag{8}$$

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

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

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

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

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

$$\text{Centroid} = \frac{n_{\ 1} \ (i-1) + n\, i + n_{\ 1} \ (i+1)}{n_{\ 1} + n\, i + n_{\ 1}} \tag{9}$$

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

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

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

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

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

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

FIG 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×M sensor matrix The N×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

FIG 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×M sensor matrix The 1×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**

Alternating columns in FIG 5A correspond to x and y axis elements The y axis sensor elements **503(1) 503**(K) are illustrated as black diamonds in FIG 5A and the x axis sensor elements **501(1) 501**(L) are illustrated as white diamonds in FIG 5A and FIG 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

FIGS 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 FIGS 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**

As illustrated in FIG 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 sensor 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**

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

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

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

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

FIG **6**A illustrates one embodiment of a sensing device having three touch sensor buttons Sensing device **240** of FIG **6**A includes buttons **601 602** and **603** These three buttons may be used for user input using a conductive object such as a finger

FIG **6**B illustrates one embodiment of the sensing device of FIG **6**A coupled to a processing device **210** Processing device **210** is used to detect whether a conductive object is present on either or none of the touch sensor buttons **601 603** To detect the presence of the conductive object the processing device **210** may include capacitance sensors **201(1)** and **201(2)** which are coupled to buttons **601 603** In particular button **601** is coupled to capacitance sensor **201(1)** button **603** is coupled to capacitance sensor **201(2)** and button **602** is coupled to both capacitance sensor **201(1)** and **201(2)**

Each of the conventional touch sensor buttons **601 603** may be made of a sensor element of conductive material such as copper clad The conductive material may be formed in a circular shape (illustrated in FIGS **6**A **6**D) in a rectangular shape or in a square shape (illustrated in FIGS **7**A and **7**B) The touch sensor buttons may be capacitance sensor buttons which may be used as non contact switches These switches when protected by an insulating layer offer resistance to severe environments

The sensing device of FIG **6**B includes two sensing areas **613** and **614** of conductive material that are electrically isolated The sensing areas of conductive area are used to make up the three buttons **601 603** In particular button **601** includes a sensor element having a surface area of one conductive material (illustrated as white surface area of button **601**) Similarly button **603** includes a sensor element having a surface area of another conductive material (illustrated as hashed surface area of button **603**) The conductive materials may be similar or dissimilar materials but more importantly are electrically isolated from one another For example button **601** is coupled to a first pin **609** and button **603** is coupled to a second pin **610** of processing device **210** Button **602** however includes a sensor element having a surface area of two conductive materials (illustrated as white and hashed surface areas of button **603**) that are electrically isolated A portion first portion **604** of the sensor element of button **602** is coupled to the conductive material of button **601** and another portion second portion **605** is coupled to the conductive material of button **603**

In one embodiment first portion **604** is coupled to the sensor element of button **601** using a conductive line **606** and second portion **605** is coupled to the sensor element button **603** using a conductive line **607** The conductive lines **606** and **607** may be conductive traces printed on the surface of the PCB Alternatively conductive lines may be conductive paths of conductive material that coupled the conductive material of the sensor elements and to the pins of the processing device **210**

The processing device **210** scans the touch sensor buttons **601 603** using the capacitance sensors **201(1)** and **201(2)** and measures the capacitance on the two sensing areas of conductive material that realize the touch sensor buttons **601 603** The processing device is operable to recognize a first button operation on the first sensor element a second button operation on the second sensor element and third button operation on the first and second portions of the third sensor element Accordingly the capacitance sensors of the processing device are not coupled to the touch sensor buttons in a one to one configuration like that of the conventional sensing device

In another embodiment the processing device **210** may include only one capacitance sensor **201** that is coupled to a selection circuit The selection circuit operates to select one conductive path to scan and measure The processing device **210** includes two pins to couple to the two sensing areas of conductive material that make up the three or more buttons In another embodiment the processing device **210** may include only one pin and be coupled to a selection circuit that is external to the processing device that selects between the two sensing areas of conductive material

In one embodiment the processing device that is coupled to the sensing device of three or more touch sensor buttons includes one more capacitance sensors coupled to the first and second sensor elements The one or more capacitance sensors are operable to measure capacitance on the three or more sensor elements For example if the capacitance variation δ_1 measured on the first pin **609** is greater than zero and the capacitance variation δ_2 measured on the second pin **610** is equal to approximately zero then the first button **601** has been pressed Similarly if the capacitance variation δ_1 measured on the first pin **609** is equal to the capacitance variation δ_2 measured on the second pin **610** then the second button **602** has been pressed If the capacitance variation δ_1 measured on the first pin **609** is equal to approximately zero and the capacitance variation δ_2 measured on the second pin **610** is greater than zero then the third button **603** has been pressed

In one embodiment the one or more capacitance sensors (e g **201(1)** and **201(2)**) may include a relaxation oscillator The relaxation oscillator may be similar to the relaxation oscillator described above which includes a current source a selection circuit a comparator and a reset switch The relaxation oscillator may be coupled to a digital counter that is operable to count at least one of a frequency or a period of a relaxation oscillator output received from the relaxation oscillator

In one embodiment the method may be performed by detecting a presence of a conductive object on a sensing device and recognizing three or more button operations performed by the conductive object using two sensing areas of the sensing device In one embodiment the operation of recognizing the three or more button operations may include recognizing a first button operation when the presence of the conductive object is detected on a first sensing area **613** of the two sensing areas of the sensing device recognizing a second button operation when the presence of the conductive object is detected on a second sensing area 614 of the two sensing areas of the sensing device and recognizing one or more button operations when the presence of the conductive object is detected on the first and second sensing areas 613 and 614

The method may include the operation of determining a capacitance on each of the two sensing areas and determining the three or more button operations based on the determined capacitance The sensing areas 613 and 614 may be scanned sequentially or alternatively may be scanned simultaneously by one or more capacitance sensors of the processing device 210

In one embodiment the two sensing areas may be used to realize three buttons as illustrated in FIGS 6A 6D Alternatively the two sensing areas may be used to realize more than three button areas In one embodiment the sensor elements of the touch sensor buttons may be circular shaped as illustrated in FIGS 6A 6D Alternatively the sensor elements may have other shapes such as rectangles squares ovals hexagon octagons or the like

In one embodiment portions 613 and 614 are substantially equal in surface area of the sensor element of button 602 Alternatively portions 613 and 614 are not equal in surface area In one embodiment the portions of sensor element of button 602 are semi circularly shaped Alternatively the portions of the sensor element may have other shapes

FIG 6C illustrates another embodiment of a sensing device having three touch sensor buttons Sensing device 600 includes three touch sensor buttons that are similar to the touch sensor buttons 601 603 of FIG 6B except the portions of the second sensor element of the second button 602 are dissimilarly shaped than the portions of FIG 6B First portion 604 of FIG 6C has a shape of two pie shapes Similarly second portion 605 of FIG 6C has a shape of two pie shapes The four pie shapes form a substantially circular shape for the sensor element In one embodiment the two pie shapes of each portion are coupled together in a single layer while the other two pie shapes are coupled together in a second conductive layer using vias as described with respect to FIGS 5C & 5D Alternatively the conductive material of one portion is coupled together using other methods known by those of ordinary skill in the art

In the embodiment of FIG 6C conductive lines 606 and 607 are conductive traces that couple the first and second portions 604 and 605 to the first and third sensor elements of button 601 and 603 respectively The conductive lines 607 and 608 may be comprised of similar or dissimilar materials as the conductive material of the sensor elements It should be noted that first portion 604 sensor element of button 601 and conductive line 606 are electrically isolated from second portion 605 sensor element of button 603 and conductive line 607 Accordingly the two sensing areas (e g 613 and 614) are comprised of these electrically isolated conductive materials

In one embodiment the first and second portions 604 and 605 each have a surface area that is substantially equal Alternatively the portions may have surface areas in other proportions

FIG 6D illustrates another embodiment of a sensing device having three touch sensor buttons Sensing device 650 includes three touch sensor buttons that are similar to the touch sensor buttons 601 603 of FIG 6B except the portions of the second sensor element of the second button 602 are dissimilarly shaped than the portions of FIG 6B First portion 604 of FIG 6C has multiple arc shapes of conductive material that are electrically isolated from multiple arc shapes of another conductive material of second portion 605 The multiple arc shapes of both the first and second portions 604 and 605 form a substantially circular shape for the sensor element In one embodiment the multiple arc shapes of each portion are coupled together in a single layer while the other two pie shapes are coupled together in a second conductive layer using vias as described with respect to FIGS 5C & 5D Alternatively the conductive material of one portion is coupled together using other methods known by those of ordinary skill in the art

In the embodiment of FIG 6D conductive lines 606 and 607 are conductive traces that couple the first and second portions 604 and 605 to the first and third sensor elements of button 601 and 603 respectively The conductive lines 607 and 608 may be comprised of similar or dissimilar materials as the conductive material of the sensor elements It should be noted that first portion 604 sensor element of button 601 and conductive line 606 are electrically isolated from second portion 605 sensor element of button 603 and conductive line 607 Accordingly the two sensing areas (e g 613 and 614) are comprised of these electrically isolated conductive materials

In one embodiment the first and second portions 604 and 605 each have a surface area that is substantially equal Alternatively the portions may have surface areas in other proportions

The shapes of the sensor elements and the portions of the sensor elements are not limited to the shapes illustrated and described herein but may include other shapes For example FIGS 7A and 7B include embodiments of rectangular and square shapes for the sensor elements and the portions of the sensor elements In addition the number of sensor elements in the sensing device is not limited to three but may be greater than three For example FIGS 7A and 7B illustrate embodiments of four and five touch sensor buttons however more sensor elements than five may also be used

FIG 7A illustrates another embodiment of a sensing device having four touch sensor buttons Sensing device 700 includes four touch sensor buttons 701 704 Each of the conventional touch sensor buttons 701 704 may be made of a sensor element of conductive material such as copper clad The sensor elements in this embodiment are square shaped The touch sensor buttons may be capacitance sensor buttons which may be used as non contact switches

The sensing device 700 of FIG 7A includes two sensing areas of conductive material that are electrically isolated The sensing areas of conductive area are used to make up the four buttons 701 704 In particular button 701 includes a sensor element having a surface area of one conductive material (illustrated as white surface area of button 701) Similarly button 704 includes a sensor element having a surface area of another conductive material (illustrated as hashed surface area of button 704) The conductive materials may be similar or dissimilar materials but more importantly are electrically isolated from one another For example button 701 is coupled to a first pin 609 and button 704 is coupled to a second pin 610 of processing device 210 Buttons 702 and 703 however include a sensor element having a surface area of two conductive materials (illustrated as white and hashed surface areas of buttons 702 and 703) that are electrically isolated A portion first portion 710 of the sensor elements of buttons 702 and 703 is coupled to the conductive material of button 701 and another portion second portion 711 is coupled to the conductive material of button 704

In one embodiment first portion 710 is coupled to the sensor element of button 701 using a conductive line 706 and second portion 711 is coupled to the sensor element button 704 using a conductive line 707 The conductive lines 706 and 707 may be conductive traces printed on the surface of the

PCB Alternatively conductive lines **706** and **707** may be conductive paths of conductive material that coupled the conductive material of the sensor elements and to the pins of the processing device **210**

In one embodiment each sensor element of buttons **702** and **703** comprises two surface areas one surface area being the first portion **710** and the other surface area being the second portion **711** The surface areas may be one solid shape or alternatively the surface areas may be interleaved sub traces For example the first conductive line **706** is a first conductive trace and the first conductive trace has one or more sub traces (e g **708(1)** **708(7)**) and the second conductive line **707** is a second conductive trace that has one or more sub traces (e g **709(1)** **709(7)**) In one embodiment at least one sub trace of the first conductive trace **706** is interleaved with at least one sub trace of the second conductive trace **707** Alternatively the sub traces of the first and second conductive traces are not interleaved

The sensor elements of buttons **702** and **703** each have a surface area ratio between the surface area of the first portion **710** and the second portion **711** In one embodiment the surface area ratio of button **702** is approximately 25% of the first portion **710** to approximately 75% of the second portion **711** (25/75) The surface area ratio of button **703** is approximately 75% of the first portion **710** to approximately 25% of the second portion **711** (75/25) Alternatively the surface area ratios of buttons **702** and **703** may be switched in surface area ratios e g 75/25 for button **702** and 25/75 for button **703** In another embodiment button **702** and button **703** may have other surface area ratios ranging from 99/1 to 49/51 and vice versa

In the embodiment of FIG 7A buttons **702** and **703** each include seven sub traces sub traces **708(1)** **708(7)** and sub traces **709(1)** **709(7)** In particular button **702** includes four sub traces **708(1)** **708(4)** of the first portion **710** and three sub traces **709(1)** **709(3)** of the second portion **711** Button **703** includes three sub traces **708(5)** **708(7)** of the first portion **710** and four sub traces **709(4)** **709(7)** of the second portion **711** Accordingly the surface area ratio of button **702** is 4/7 of the first portion **710** to 3/7 of the second portion **711** and the surface area ratio of button **703** is 3/7 of the first portion **710** to 4/7 of the second portion **711** Alternatively other total number of sub traces and other combinations of sub traces may be used to form the different surface area ratios

FIG 7B illustrates another embodiment of a sensing device having five touch sensor buttons Sensing device **750** includes five touch sensor buttons **701** **705** The touch sensor buttons of sensing device **750** are similar to those of sensing device **700** expect there is one additional sensor element and there are eight sub traces per sensor element for buttons **702** **704** which consequently changes the surface area ratios

The sensing device **750** of FIG 7B includes two sensing areas (illustrates a white and hashed surface areas) of conductive material that are electrically isolated The sensing areas of conductive area are used to make up the five buttons **701** **705**

In one embodiment each sensor element of buttons **702** **703** and **704** comprises two surface areas one surface area being the first portion **710** and the other surface area being the second portion **711** The surface areas may be one solid shape or alternatively the surface areas may be interleaved sub traces For example the first conductive line **706** is a first conductive trace and the first conductive trace has twelve sub traces **708(1)** **708(12)** and the second conductive line **707** is a second conductive trace that has twelve sub traces **709(1)** **709(12)** At least two sub traces of both the first and second conductive traces are interleaved in each sensor element

In this embodiment the surface area ratio of button **702** is approximately 6/8 of the first portion **710** to approximately 2/8 of the second portion **711** The surface area ratio of button **703** is approximately 4/8 (25%) of the first portion **710** to approximately 4/8 (50%) of the second portion **711** The surface area ratio of button **704** is approximately 2/8 of the first portion **710** to approximately 6/8 of the second portion **711**

In another embodiment the surface area ratio of button **702** is approximately 25% of the first portion **710** to approximately 75% of the second portion **711** The surface area ratio of button **703** is approximately 50% of the first portion **710** to approximately 50% of the second portion **711** The surface area ratio of button **704** is approximately 75% of the first portion **710** to approximately 25% of the second portion **711**

In another embodiment the surface area ratio of button **702** is approximately 33% of the first portion **710** to approximately 67% of the second portion **711** The surface area ratio of button **703** is approximately 50% of the first portion **710** to approximately 50% of the second portion **711** The surface area ratio of button **704** is approximately 67% of the first portion **710** to approximately 33% of the second portion **711**

Alternatively other surface area ratios total number of sub traces and other combinations of sub traces may be used to form the sensor elements that include the two conductive materials

As described with respect to the embodiments above the processing device **210** can scan the touch sensor buttons **701** **704** of FIG 7A (or the touch sensor buttons **701** **705** of FIG 7B) using one or more capacitance sensors and measure the capacitance on the two sensing areas of conductive material that realize the touch sensor buttons **701** **704** (or **701** **705**) Accordingly the processing device is operable to recognize a first button operation on the first sensor element a second button operation on the second sensor element and third and fourth button operations (or third fourth and fifth button operations) on the first and second portions of the third and fourth sensor elements (or third fourth and fifth sensor elements)

It should be noted that although the sensor elements that include the two portions are illustrated and described as being inside or in between the two sensor elements that are coupled to the pins the sensor elements that include the two portions may be disposed in other positions with respect to the other two sensor elements

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

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

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

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

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

What is claimed is

1 A method comprising

determining capacitance variations of a first number of two or more sense elements of a touch screen device using a processing device to detect a presence of a conductive object on any one of a second number of three or more button areas of the touch screen device wherein the first number of sense elements is less than the second number of button areas and

recognizing an activation of one of the three or more button areas using the determined capacitance variations of the first number of two or more sense elements

2 The method of claim **1** wherein the first number is two and the second number is three and wherein the recognizing comprises

detecting the presence of the conductive object at a first button area when the capacitance variation of a first sense element is greater than a reference value and the capacitance variation of a second sense element is not greater than the reference value

detecting the presence of the conductive object at a second button area when the capacitance variation of the first sense element is not greater than the reference value and the capacitance variation of the second sense element is greater than the reference value and

detecting the presence of the conductive object at a third button area when the capacitance variation of the first sense element and the capacitance variation of the second sense element are both greater than the reference value

3 The method of claim **2** wherein the determining the capacitance variations comprises measuring a first capacitance of the first sense element and a second capacitance of the second sense element

4 The method of claim **2** wherein the determining the capacitance variations comprises

measuring a first capacitance of the first sense element on a first pin of the processing device and

measuring a second capacitance of the second sense element on a second pin of the processing device

5 The method of claim **1** wherein the recognizing comprises

determining a combination of the capacitance variations of the first number of two or more sense elements and

recognizing the activation using the determined combination

6 The method of claim **1** wherein the second number is nine and wherein the recognizing comprises recognizing the activation of one of the nine button areas using the determined capacitance variations of the first number of two or more sense elements

7 An apparatus comprising

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

8 The apparatus of claim **7** wherein the first number is two and the second number is three and wherein the processing device is configured to

detect the presence of the conductive object at a first button area when the capacitance variation of a first sense element is greater than a reference value and the capacitance variation of a second sense element is not greater than the reference value

detect the presence of the conductive object at a second button area when the capacitance variation of the first sense element is not greater than the reference value and the capacitance variation of the second sense element is greater than the reference value and

detect the presence of the conductive object at a third button area when the capacitance variation of the first sense element and the capacitance variation of the second sense element are both greater than the reference value

9 The apparatus of claim **7** wherein the processing device comprises

a capacitance sensing circuit and

a selection circuit coupled to the capacitance sensing circuit and the first number of two or more sense elements

10 The apparatus of claim **7** wherein the processing device comprises

a first capacitance sensing circuit

a second capacitance sensing circuit and

a selection circuit coupled to the first number of two or more sense elements the first capacitance sensing circuit and a second capacitance sensing circuit wherein the selection circuit is configured to selectively couple the capacitance sensing circuit to one of the first number of two or more sense elements and to selectively couple the second capacitance sensing circuit to another one of the first number of two or more sense elements

11 The apparatus of claim 7 wherein the first number is two and the second number is three and wherein the processing device is configured to

detect a conductive object proximate to a first button area based on a first change in capacitance of a first sense element

detect the conductive object proximate to a second button area based on a first change in capacitance of a second sense element and

detect the conductive object proximate to a second button area based on a second change in capacitance of the first sense element and a second change in capacitance of the second sense element

12 The apparatus of claim 7 wherein the processing device comprises one or more capacitance sensing circuits configured to measure capacitance of the first number of two or more sense elements

13 The apparatus of claim 12 wherein the one or more capacitance sensing circuits comprises a relaxation oscillator configured to measure the capacitance of the first number of two or more sense elements

14 The apparatus of claim 12 wherein the processing device comprises

a first pin coupled to the one or more capacitance sensing circuits and

a second pint coupled to the one or more capacitance sensing circuits

15 The apparatus of claim 7 wherein the processing device is configured to determine a combination of the capacitance variations of the first number of two or more sense elements and to recognize the activation using the determined combination

16 The apparatus of claim 7 wherein the second number is nine and wherein the processing device is configured to recognize the activation of one of the nine button areas using the determined capacitance variations of the first number of two or more sense elements

17 A system comprising

a touch screen device comprising a first number of two or more sense elements and a second number of three or more button areas wherein the first number of sense elements is less than the second number of button areas and

a processing device coupled to the touch screen device wherein the processing device is configured to determine capacitance variations of the two or more sense elements of the touch screen device and to recognize an activation of one of the three or more buttons areas using the capacitance variations of the two or more sense elements

18 The system of claim 17 wherein the first number is two and the second number is three and wherein the processing device is configured to

detect the presence of the conductive object at a first button area when the capacitance variation of a first sense element is greater than a reference value and the capacitance variation of a second sense element is not greater than the reference value

detect the presence of the conductive object at a second button area when the capacitance variation of the first sense element is not greater than the reference value and the capacitance variation of the second sense element is greater than the reference value and

detect the presence of the conductive object at a third button area when the capacitance variation of the first sense element and the capacitance variation of the second sense element are both greater than the reference value

19 The system of claim 17 wherein the processing device is configured to

determine a combination of the capacitance variations of the two or more sense elements and

recognize the activation using the determined combination

20 The system of claim 17 wherein the second number is nine and wherein the processing device is configured to recognize the activation of one of the nine button areas using the determined capacitance variations of the two or more sense elements

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APPLICANTS
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** **CONTINUING DATA** *************************
This application is a CON of 13/204 543 08/05/2011 PAT 8174507
which is a CON of 11/437 517 05/18/2006 PAT 8004497

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

** **IF REQUIRED, FOREIGN FILING LICENSE GRANTED** **
04/20/2012

Foreign Priority claimed ☐ Yes ☑ No 35 USC 119(a d) conditions met ☐ Yes ☑ No Verified and Acknowledged /BENYAM KETEMA/ Examiners Signature	☐ Met after Allowance Initials	STATE OR COUNTRY	SHEETS DRAWINGS	TOTAL CLAIMS	INDEPENDENT CLAIMS
		CHINA	10	20	3

ADDRESS

CYPRESS SEMICONDUCTOR CORPORATION
198 CHAMPION COURT
SAN JOSE CA 95134 1709
UNITED STATES

TITLE

APPARATUS AND METHODS FOR DETECTING A CONDUCTIVE OBJECT AT A LOCATION

FILING FEE RECEIVED		
1380	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

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BIB DATA SHEET

CONFIRMATION NO 6333

SERIAL NUMBER	FILING or 371(c) DATE	CLASS	GROUP ART UNIT	ATTORNEY DOCKET NO
13/442 716	04/09/2012 RULE	345	2696	CD06039C2

APPLICANTS
Jiang XIAOPING Shanghai CHINA

** **CONTINUING DATA** *************************
This application is a CON of 11/437 517 05/18/2006 PAT 8 004 497
and is a CON of 13/204 543 08/05/2011 PAT 8 174 507
( )Data provided by applicant is not consistent with PTO records

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

** **IF REQUIRED, FOREIGN FILING LICENSE GRANTED** **
04/20/2012

Foreign Priority claimed ☐ Yes ☑ No 35 USC 119(a d) conditions met ☐ Yes ☑ No Verified and Acknowledged /BENYAM KETEMA/ Examiner's Signature	☐ Met after Allowance Initials	STATE OR COUNTRY	SHEETS DRAWINGS	TOTAL CLAIMS	INDEPENDENT CLAIMS
		CHINA	10	20	3

ADDRESS

CYPRESS SEMICONDUCTOR CORPORATION
198 CHAMPION COURT
SAN JOSE CA 95134 1709
UNITED STATES

TITLE

APPARATUS AND METHODS FOR DETECTING A CONDUCTIVE OBJECT AT A LOCATION

FILING FEE RECEIVED	FEES	
1380	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

BIB (Rev 05/07)

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United States Patent and Trademark Office
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Al and a, V g m 22313 1450
www pt g

BIB DATA SHEET

CONFIRMATION NO 6333

SERIAL NUMBER	FILING or 371(c) DATE	CLASS	GROUP ART UNIT	ATTORNEY DOCKET NO
13/442 716	04/09/2012 **RULE**	345	2629	CD06039C2

APPLICANTS
Jiang XIAOPING Shanghai CHINA

** **CONTINUING DATA** *************************
This application is a CON of 11/437 517 05/18/2006 PAT 8 004 497
and is a CON of 13/204 543 08/05/2011 PAT 8 174 507 *
(*)Data provided by applicant is not consistent with PTO records

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

** **IF REQUIRED, FOREIGN FILING LICENSE GRANTED** **
04/20/2012

Foreign Priority claimed / 35 USC 119(a d) conditions met / Verified and Acknowledged	Met after Allowance	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 /BENYAM KETEMA/ Examiner's Signature	☐ Met after Allowance Initials	CHINA	10	20	3

ADDRESS

CYPRESS SEMICONDUCTOR CORPORATION
198 CHAMPION COURT
SAN JOSE CA 95134 1709
UNITED STATES

TITLE

APPARATUS AND METHODS FOR DETECTING A CONDUCTIVE OBJECT AT A LOCATION

FILING FEE RECEIVED	FEES	
1380	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

Electronic Acknowledgement Receipt

EFS ID	12502370
Application Number	13442716
International Application Number	
Confirmation Number	6333
Title of Invention	APPARATUS AND METHODS FOR DETECTING A CONDUCTIVE OBJECT AT A LOCATION
First Named Inventor/Applicant Name	Jiang XiaoPing
Customer Number	60909
Filer	Larry Joel Johnson/YING JIANG
Filer Authorized By	Larry Joel Johnson
Attorney Docket Number	CD06039C2
Receipt Date	09 APR 2012
Filing Date	
Time Stamp	19 21 05
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	Application Data Sheet	CD06039C2ADS04092012 pdf	1089384 d74ca4e4130 99b231d7d0bf3 25a40ef b9b97	no	4

Warnings

Information

2	Drawings only black and white line drawings	CD06039C2_FIGS_04092012 pdf	614076 f65 8903d2ff7e4 14f 7555070873988d6bf 69f	no	10
Warnings					
Information					
3		CD06039C2_SpecClaimAbs_04092012 pdf	2020852 78 b 494d 992b68 509609f 06 1 3c5 1 9d88	yes	55

	Multipart Description/PDF files in zip description		
	Document Description	**Start**	**End**
	Specification	1	49
	Claims	50	54
	Abstract	55	55

Warnings					
Information					
4	Preliminary Amendment	CD06039C2_PreliminaryAmendment_04092012 pdf	20172 196791d6092940a3 616f7 508 16a f3963 f462	no	3
Warnings					
Information					
			Total Files Size (in bytes):	3744484	

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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

PTO/SB/14 (11 08)
Approved for use through 01/31/2014 OMB 0651 0032
U S Patent and Trademark Office U S DEPARTMENT OF COMMERCE

Application Data Sheet 37 CFR 1 76	Attorney Docket Number	CD06039C2
	Application Number	

Title of Invention	APPARATUS AND METHODS FOR DETECTING A CONDUCTIVE OBJECT AT A LOCATION

The application data sheet is part of the provisional or nonprovisional application for which it is being submitted The following form contains the bibliographic data arranged in a format specified by the United States Patent and Trademark Office as outlined in 37 CFR 1 76
This document may be completed electronically and submitted to the Office in electronic format using the Electronic Filing System (EFS) or the document may be printed and included in a paper filed application

Secrecy Order 37 CFR 5 2

☐ Portions or all of the application associated with this Application Data Sheet may fall under a Secrecy Order pursuant to 37 CFR 5 2 (Paper filers only Applications that fall under Secrecy Order may not be filed electronically)

Applicant Information

Applicant 1 Remove

Applicant Authority	◉Inventor	○Legal Representative under 35 U S C 117	○Party of Interest under 35 U S C 118

Prefix	**Given Name**	**Middle Name**	**Family Name**	**Suffix**
	JIANG		XIAOPING	

Residence Information (Select One) ○ US Residency ◉ Non US Residency ○ Active US Military Service

City	Shanghai	**Country Of Residence**	CN
Citizenship under 37 CFR 1 41(b)	CN		

Mailing Address of Applicant

Address 1	Room 06 07 26F 1Gateway Plaza No 1 HongQiao Rd		
Address 2			
City	Shanghai	**State/Province**	
Postal Code	200030	**Country**	CN

All Inventors Must Be Listed - Additional Inventor Information blocks may be generated within this form by selecting the **Add** button Add

Correspondence Information

Enter either Customer Number or complete the Correspondence Information section below
For further information see 37 CFR 1 33(a)

☐ **An Address is being provided for the correspondence Information of this application**

Customer Number	60909	
Email Address	LARZ@CYPRESS COM	Add Email Remove Email

Application Information

Title of the Invention	APPARATUS AND METHODS FOR DETECTING A CONDUCTIVE OBJECT AT A LOCATION		
Attorney Docket Number	CD06039C2	**Small Entity Status Claimed**	☐
Application Type	Nonprovisional		
Subject Matter	Utility		
Suggested Class (if any)		**Sub Class (if any)**	
Suggested Technology Center (if any)			
Total Number of Drawing Sheets (if any)	10	**Suggested Figure for Publication (if any)**	

PTO/SB/14 (11 08)
Approved for use through 01/31/2014 OMB 0651-0032
U S Patent and Trademark Office U S DEPARTMENT OF COMMERCE

Application Data Sheet 37 CFR 1 76	Attorney Docket Number	CD06039C2
	Application Number	
Title of Invention	APPARATUS AND METHODS FOR DETECTING A CONDUCTIVE OBJECT AT A LOCATION	

Publication Information

☐ Request Early Publication (Fee required at time of Request 37 CFR 1 219)

☒ **Request Not to Publish** I hereby request that the attached application not be published under 35 U S C 122(b) and certify that the invention disclosed in the attached application **has not and will not** be the subject of an application filed in another country or under a multilateral international agreement that requires publication at eighteen months after filing

Representative Information

Representative information should be provided for all practitioners having a power of attorney in the application Providing this information in the Application Data Sheet does not constitute a power of attorney in the application (see 37 CFR 1 32)
Enter either Customer Number or complete the Representative Name section below If both sections are completed the Customer Number will be used for the Representative Information during processing

Please Select One	◉ Customer Number	○ US Patent Practitioner	○ Limited Recognition (37 CFR 11 9)
Customer Number	60909		

Domestic Benefit/National Stage Information

This section allows for the applicant to either claim benefit under 35 U S C 119(e) 120 121 or 365(c) or indicate National Stage entry from a PCT application Providing this information in the application data sheet constitutes the specific reference required by 35 U S C 119(e) or 120 and 37 CFR 1 78(a)(2) or CFR 1 78(a)(4) and need not otherwise be made part of the specification

Prior Application Status	Patented				Remove
Application Number	Continuity Type	Prior Application Number	Filing Date (YYYY MM DD)	Patent Number	Issue Date (YYYY MM DD)
	Continuation of	11437517	2006 05 18	8004497	2011 08 23

Prior Application Status	Pending		Remove
Application Number	Continuity Type	Prior Application Number	Filing Date (YYYY MM DD)
	Continuation of	13204543	2011 08 05

Additional Domestic Benefit/National Stage Data may be generated within this form by selecting the **Add** button — Add

Foreign Priority Information

This section allows for the applicant to claim benefit of foreign priority and to identify any prior foreign application for which priority is not claimed Providing this information in the application data sheet constitutes the claim for priority as required by 35 U S C 119(b) and 37 CFR 1 55(a)

Application Number	Country i	Parent Filing Date (YYYY MM DD)	Priority Claimed
			○ Yes ◉ No

Remove

Additional Foreign Priority Data may be generated within this form by selecting the **Add** button — Add

Application Data Sheet 37 CFR 1 76	Attorney Docket Number	CD06039C2
	Application Number	
Title of Invention	APPARATUS AND METHODS FOR DETECTING A CONDUCTIVE OBJECT AT A LOCATION	

Assignee Information

Providing this information in the application data sheet does not substitute for compliance with any requirement of part 3 of Title 37 of the CFR to have an assignment recorded in the Office

Assignee 1 Remove

If the Assignee is an Organization check here	☒		
Organization Name	CYPRESS SEMICONDUCTOR CORPORATION		
Mailing Address Information			
Address 1	198 CHAMPION CT		
Address 2			
City	SAN JOSE	**State/Province**	CA
Country	US	Postal Code	95134
Phone Number	(408)545 7194	Fax Number	(408)545-6911
Email Address	LARZ@CYPRESS COM		

Additional Assignee Data may be generated within this form by selecting the **Add** button Add

Signature

A signature of the applicant or representative is required in accordance with 37 CFR 1 33 and 10 18 Please see 37 CFR 1 4(d) for the form of the signature

Signature	/LARRY JOHNSON/			Date (YYYY MM DD)	2012 04 09
First Name	LARRY	Last Name	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

Title Apparatus and Methods for Detecting a Conductive Object at a Location
Inventor Jiang XiaoPing
Cypress Ref No CD06039C1

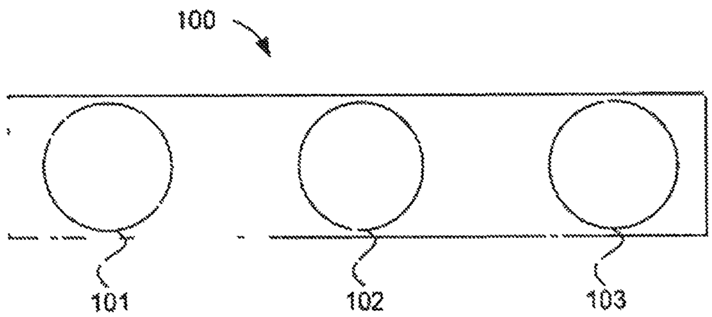

FIG 1A

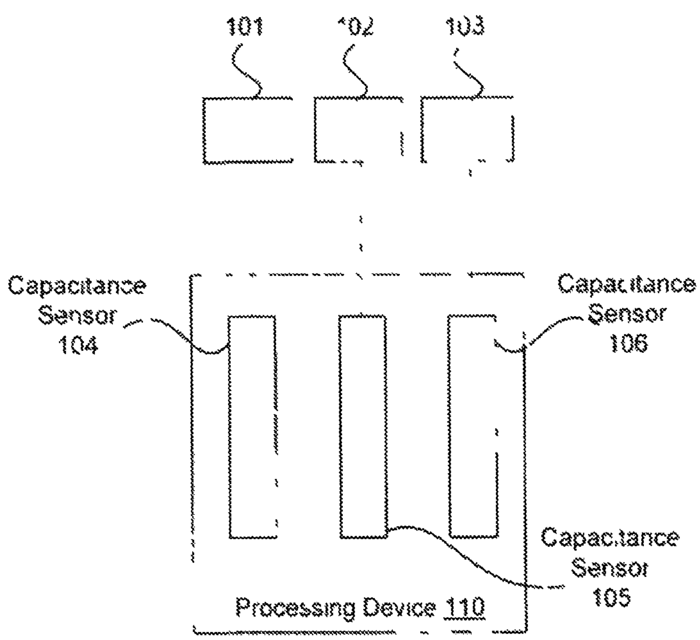

FIG 1B

Title Apparatus and Methods for Detecting a Conductive Object at a Location
Inventor Jiang XiaoPing
Cypress Ref No CD06039C1

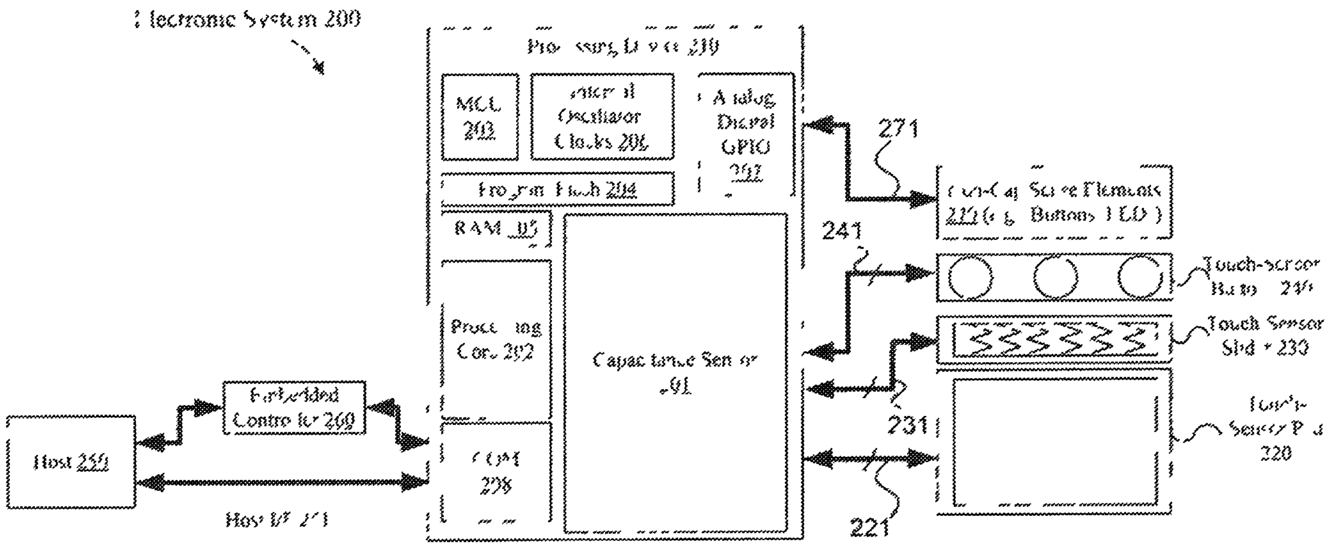

FIG 2

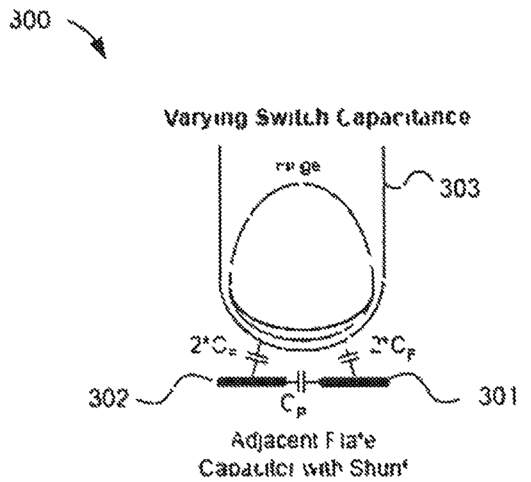
300
Varying Switch Capacitance
303
2*C_F
2*C_F
302
C_P
301
Adjacent Plate
Capacitor with Shunt

FIG 3A

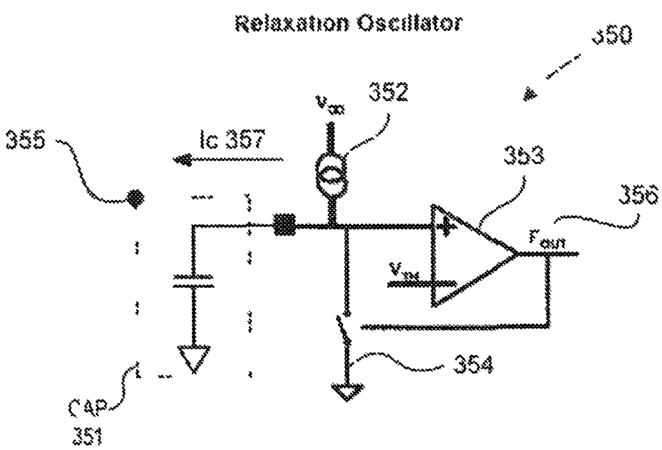
Relaxation Oscillator
350
352
355
Ic 357
353
356
F_out
354
CAP
351

FIG 3B

Title Apparatus and Methods for Detecting a Conductive Object at a Location
Inventor Jiang XiaoPing
Cypress Ref No CD06039C1

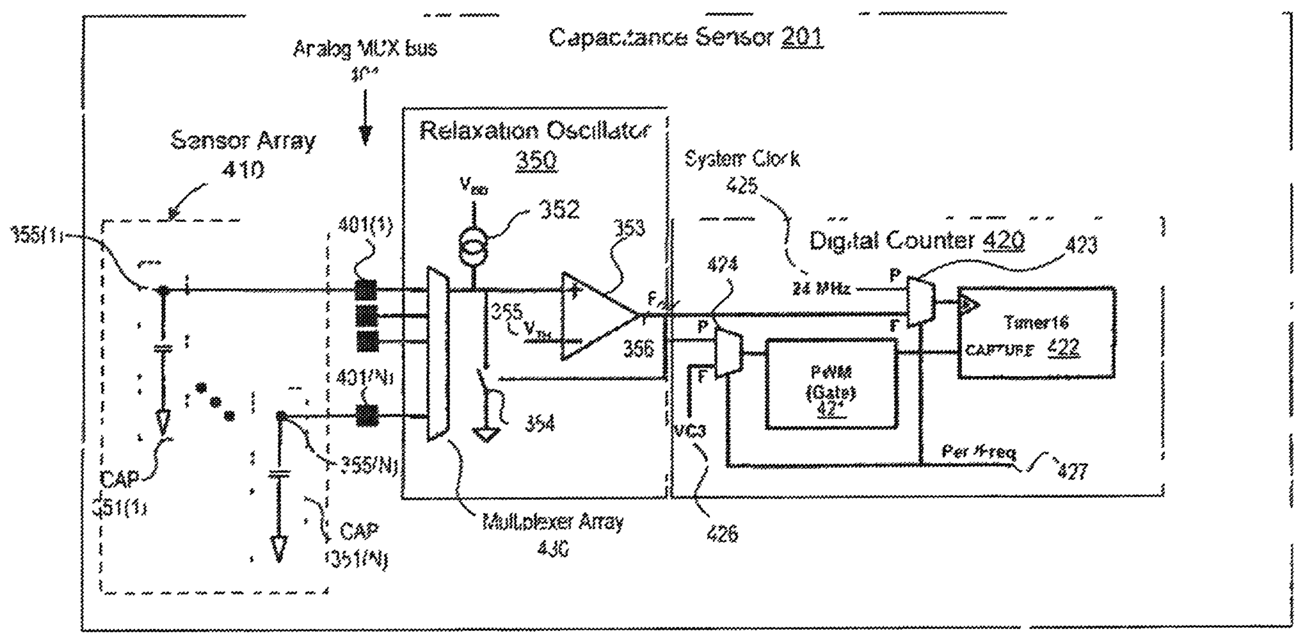

FIG 4

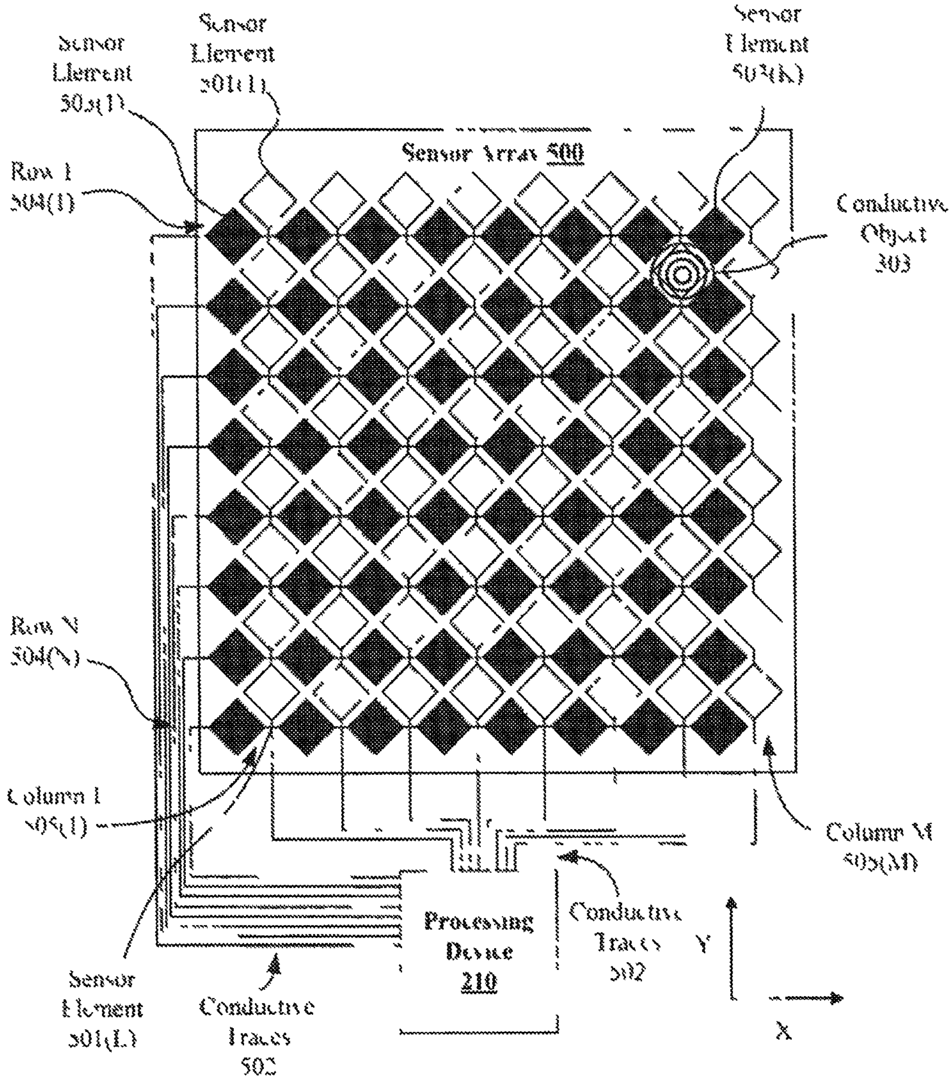
Sensor Element 503(1)
Sensor Element 501(1)
Sensor Element 503(K)
Sensor Array 500
Row 1 504(1)
Conductive Object 303
Row N 504(N)
Column 1 505(1)
Column M 505(M)
Processing Device 210
Conductive Traces 502
Y
X
Sensor Element 501(L)
Conductive Traces 502

FIG 5A

Title Apparatus and Methods for Detecting a Conductive Object at a Location
Inventor Jiang XiaoPing
Express Ref No CD06039C1

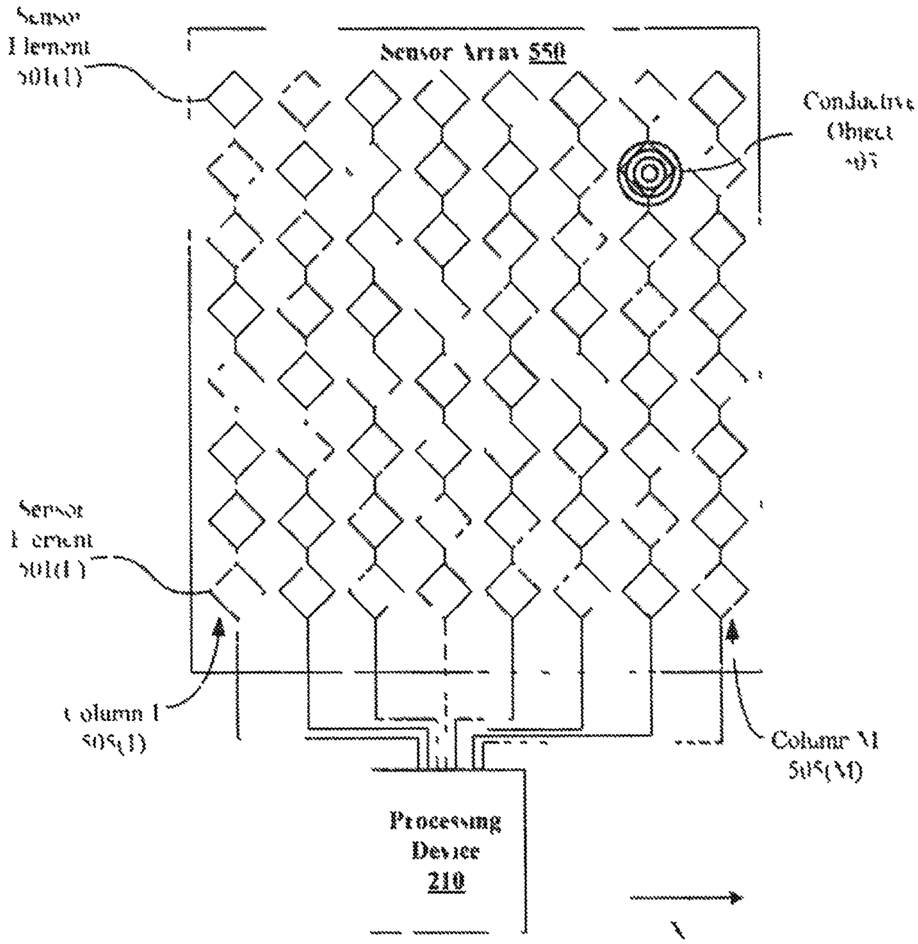

FIG 5B

TOP VIEW of 2-Layer Touch-Sensor Pad 220

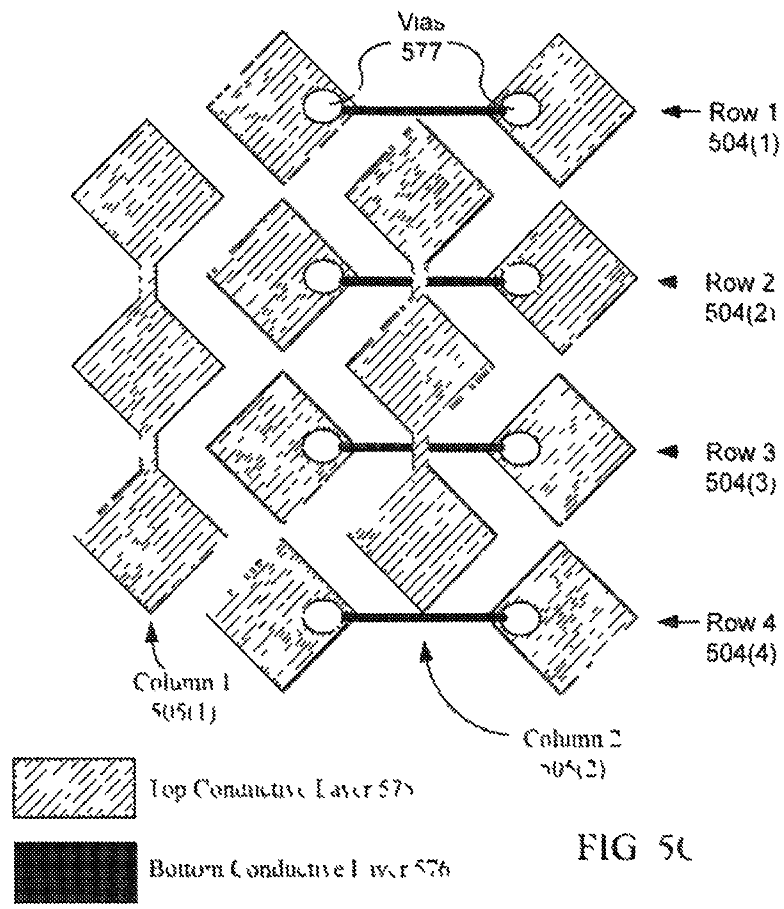

FIG 5C

CROSS-SECTIONAL VIEW of 2-Layer Touch-Sensor Pad 220

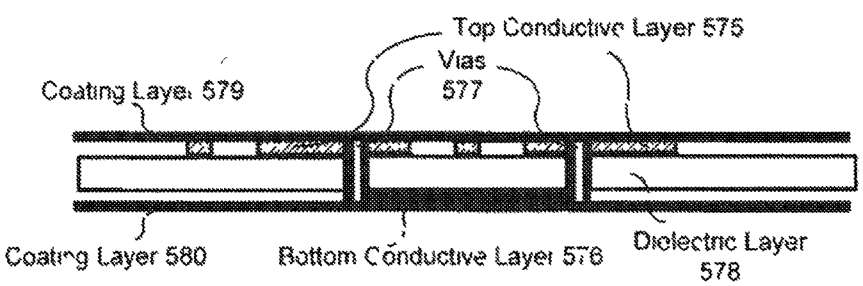

FIG 5D

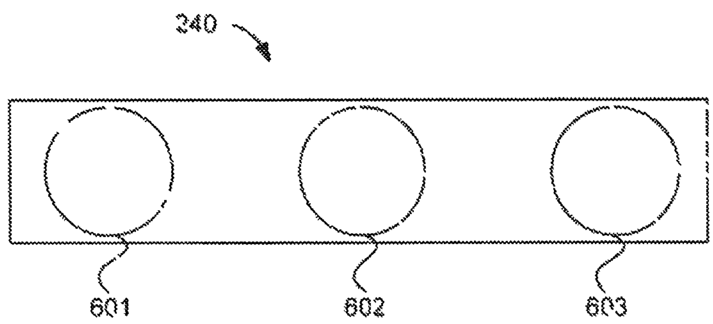
240
601
602
603

FIG 6A

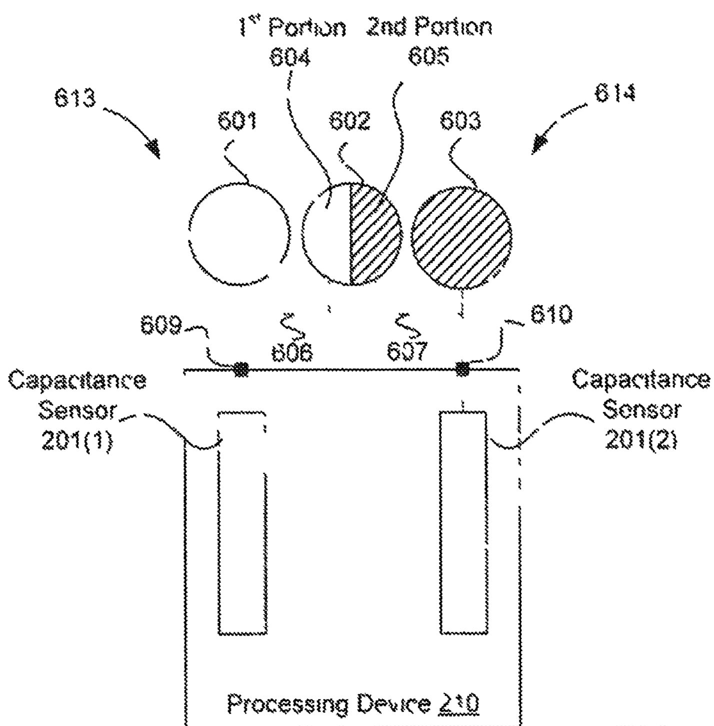
1st Portion 604
2nd Portion 605
613
614
601
602
603
609
606
607
610
Capacitance Sensor 201(1)
Capacitance Sensor 201(2)
Processing Device 210

FIG 6B

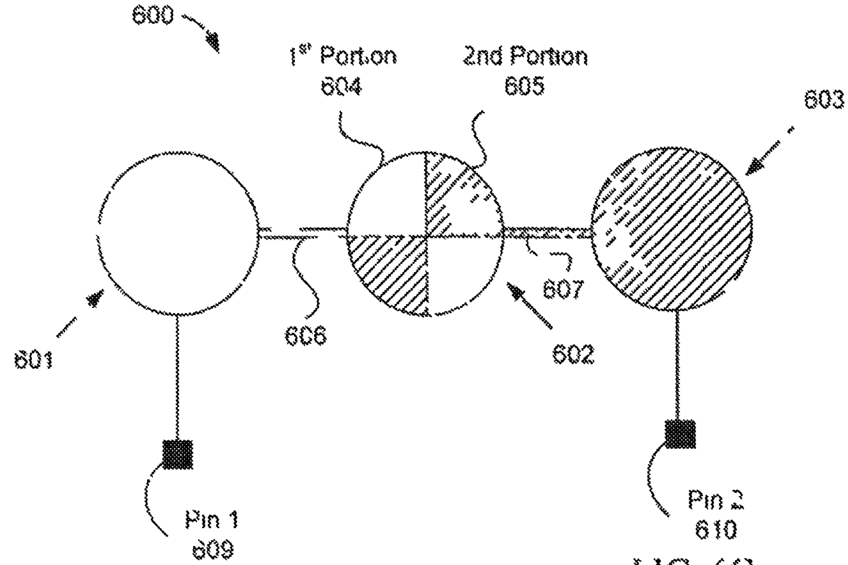
600
1st Portion
604
2nd Portion
605
603
607
606
601
602
Pin 1
609
Pin 2
610

FIG 6C

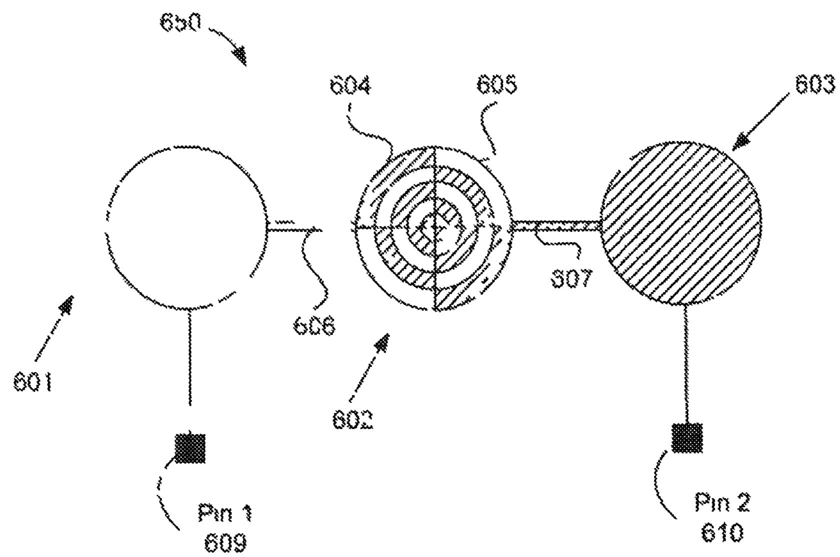
650
604
605
603
607
606
601
602
Pin 1
609
Pin 2
610

FIG 6D

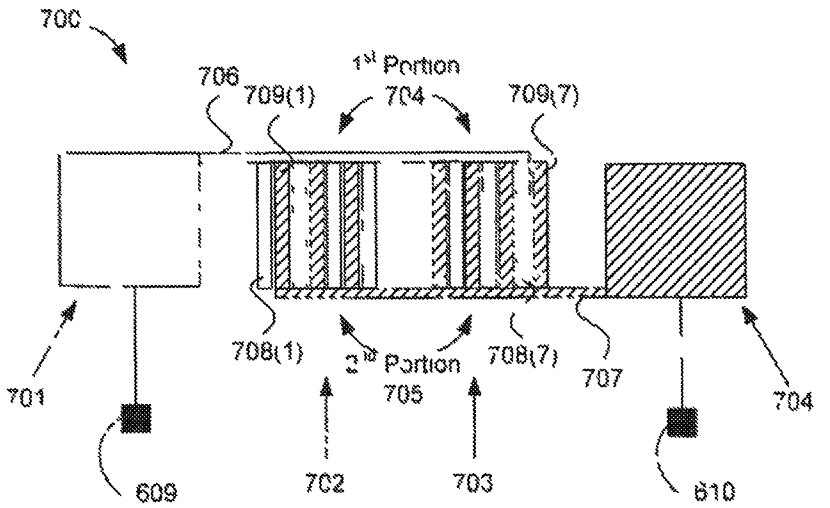
700
706
709(1)
1st Portion
704
709(7)
708(1)
2nd Portion
705
708(7)
707
701
702
703
704
609
610

FIG 7A

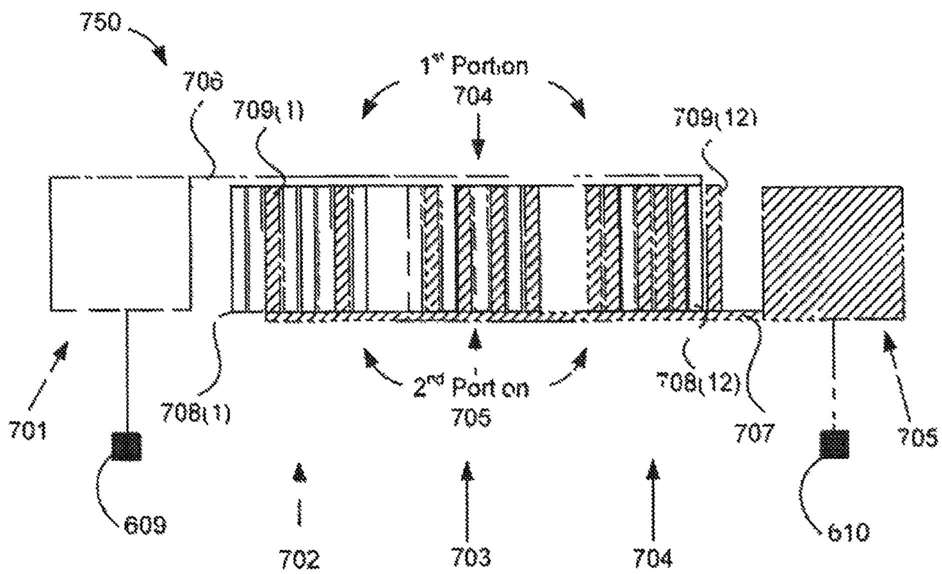
750
706
709(1)
1st Portion
704
709(12)
708(1)
2nd Portion
705
708(12)
707
701
705
702
703
704
609
610

FIG 7B

UNITED STATES PATENT APPLICATION

For

APPARATUS AND METHODS FOR DETECTING A CONDUCTIVE OBJECT AT A LOCATION

Inventor

Jiang XiaoPing

Cypress Ref No CD06039C1

APPARATUS AND METHODS FOR DETECTING A CONDUCTIVE OBJECT AT A LOCATION

RELATED MATTERS

[0001] This application is a continuation of U S Patent Application No 11/437 517, filed May 18 2006 which is incorporated herein by reference in its entirety

TECHNICAL FIELD

[0002] This invention relates to the field of user interface devices and in particular, to touch-sensing devices

BACKGROUND

[0003] 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 user interface device that is common is a touch-sensor button A basis touch-sensor button emulates the function of a mechanical button Touch-sensor buttons may be embedded into different types of operational panels of electronic devices For example touch sensor buttons may be used on operational or control panels of household appliances consumer electronics mechanical devices and the like Touch-sensor buttons may also be used in conjunction with, or in place of other user input devices, such as keyboards mice trackballs or the like

[0004] Figure 1A illustrates a conventional sensing device having three touch sensor buttons Conventional sensing device 100 includes button 101, button 102, and button 103 These buttons are conventional touch sensor buttons These three buttons may be used for user input using a conductive object such as a finger

[0005] Figure 1B illustrates a conventional sensing device of three touch-sensor buttons 101 103 coupled to a processing device 110 Processing device 110 is used to detect whether a conductive object is present on either or none, of the touch sensor buttons 101-103 To detect the presence of the conductive object, the processing device 110 may include capacitance sensors 104-106 which are coupled to buttons 101-103, respectively The capacitance sensors of the processing device are coupled to the touch sensor buttons in a one-to-one configuration Accordingly the processing device 110 scans the touch sensor buttons 101 103 using the capacitance sensors 104-106, and measures the capacitance on the touch-sensor buttons 101-103

[0006] Each of the conventional touch sensor buttons 101 103 may be made of a sensor element of conductive material such as copper clad The conductive material may be form shaped in a circular shape (illustrated in Figure 1A), or even in a rectangular shape (illustrated in Figure 1B) The touch sensor buttons may be capacitance sensor buttons which may be used as non-contact switches These switches when protected by an insulating layer offer resistance to severe environments

[0007] It should be noted that the conventional configuration of Figure 1B includes a one to-one configuration of touch sensor buttons to capacitance sensors There are other conventional configurations that may use less capacitance sensors to measure the capacitance on the three touch sensor buttons These conventional configurations, however, still require a one-to-one configuration of pins to touch-sensor buttons Accordingly, by adding more buttons, the processing device needs to have more pins to correspond to the one-to-one configuration of pins to touch sensor buttons Similarly by increasing the pin count the scan time to scan the sensor elements ıncreases In addıtıon the memory of the processıng devıce whıch may be used to store program data and/or temporary data (e g , raw measurement data, dıfferentıal counts, baselıne measurement data, and the lıke), ıncreases by ıncreasıng the pın count

BRIEF DESCRIPTION OF THE DRAWINGS

[0008] The present invention is illustrated by way of example, and not by way of limitation, in the figures of the accompanying drawings

[0009] Figure 1A illustrates a conventional sensing device having three touch sensor buttons

[0010] Figure 1B illustrates a conventional sensing device of three touch-sensor buttons coupled to a processing device

[0011] 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

[0012] Figure 3A illustrates a varying switch capacitance

[0013] Figure 3B illustrates one embodiment of a relaxation oscillator

[0014] Figure 4 illustrates a block diagram of one embodiment of a capacitance sensor including a relaxation oscillator and digital counter

[0015] 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

[0016] 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

[0017] Figure 5C illustrates a top-side view of one embodiment of a two-layer touch sensor pad

[0018] Figure 5D illustrates a side view of one embodiment of the two layer touch sensor pad of Figure 5C

[0019] Figure 6A illustrates one embodiment of a sensing device having three touch-sensor buttons

[0020] Figure 6B illustrates one embodiment of the sensing device of Figure 6A coupled to a processing device

[0021] Figure 6C illustrates another embodiment of a sensing device having three touch-sensor buttons

[0022] Figure 6D illustrates another embodiment of a sensing device having three touch-sensor buttons

[0023] Figure 7A illustrates another embodiment of a sensing device having four touch-sensor buttons

[0024] Figure 7B illustrates another embodiment of a sensing device having five touch sensor buttons

DETAILED DESCRIPTION

[0025] Described herein is an apparatus and method for detecting a presence of a conductive object on a sensing device, and recognizing three or more button operations performed by the conductive object using two sensing areas of the sensing device 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

[0026] Embodiments of a method and apparatus are described to recognize three or more button operations performed by the conductive object on three or more sensor elements that are coupled to two pins of a processing device In one embodiment the apparatus may include a sensing device (e g , touch sensor button) that has first, second and third sensor elements The third sensor element has a first portion coupled to the first sensor element and a second portion coupled to the second sensor element These portions of the third sensor element are electrically isolated from one another

[0027] The embodiments describe herein permit the expansion of additional buttons (e g three or more total buttons) to the sensing device while using only two pins on the processing device Conversely since the conventional configuration has implemented a one-to-one configuration of sensor elements to pins of the processing device, each button added requires an additional pin on the processing device Using only two pins, the scan time does not increase by adding additional buttons to implement three or more buttons on the sensing device By maintaining two pins for three or more buttons the scan time to scan the sensor elements is not increased In other words, more buttons may be implemented without increasing the total scan time of the sensing device Similarly, the memory of the processing device is not increased to accommodate additional program data and/or temporary data (e g , raw measurement data differential counts, baseline measurement data and the like) for the additional buttons

[0028] The sensing device may use two capacitive switch relaxation oscillator (CSR) pins of a processing device to realize more than two buttons on the sensing device For example the three or more buttons may be realized by using two sensing areas Each sensing area may include a bar of conductive material and several interconnected sub-bars The sub-bars of the two sensing areas are interleaved and are electrically isolated In other words one set of interconnected sub bars are connected to one pin, while the other set is coupled to the other pin The two sensing areas make up three or more sensor elements that are used to form the touch sensor buttons The different buttons contain different percentages of surface area of the sensing areas Alternatively, each sensing area may include two or more bars of conductive material with or without several interconnected sub bars

[0029] For example a three-button scheme using two pins includes one sensor element that has 100% of the first sensing area, the second sensor element has 50% of the first sensing area and 50% of the second sensing area and the third sensor element has

100% of the second sensing area Accordingly, by scanning and measuring the capacitance (e g , capacitance variation of the capacitance minus the baseline, as described below) on the two pins to detect the presence of the conductive object the processing device can distinguish between the presence of the conductive object on the first second, and third sensor elements For example if the capacitance variation δ_1 measured on the first pin is greater than zero, and the capacitance variation δ_2 measured on the second pin is equal to approximately zero, then the first button has been pressed Similarly if the capacitance variation δ_1, measured on the first pin, is equal to the capacitance variation δ_2, measured on the second pin, then the second button has been pressed If the capacitance variation δ_1 measured on the first pin is equal to approximately zero, and the capacitance variation δ_2, measured on the second pin is greater than zero then the third button has been pressed

[0030] The embodiments herein may be beneficial to help reduce the pin count of the processing device This may decrease the complexity of the processing device or allow the processing device to support additional functionality, such as cursor positioning and selecting functionality, keyboard functionality, slider functionality or the like Furthermore, the embodiments may be beneficial to help reduce the scan time of the sensing device Using two pins of the processing device to measure the capacitance on two sensing areas to realize three or more buttons is faster than measuring the capacitance on three or more touch-sensor buttons of the conventional configuration (e g , one to one configuration) In addition using two pins reduces the RAM/FLASH space needed in the sensing device as compared to the conventional configuration

[0031] The embodiments described herein may be used in different types of operational panels of electronic devices For example touch-sensor buttons may be used on operational or control panels of household appliances, consumer electronics, mechanical devices and the like Touch sensor buttons may also be used in conjunction with or in place of, other user input devices such as keyboards, mice trackballs, or the like

[0032] 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 progiam flash 204 RAM 205 may be static RAM (SRAM) and program flash 204 may be a non-volatile 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 ınclude a memory controller unıt (MCU) 203 coupled to memory and the processıng core 202

[0033] The processıng devıce 210 may also ınclude an analog block array (not ıllustrated) The analog block aıray ıs also coupled to the system bus Analog block array also may be confıgured to ımplement a varıety of analog cırcuıts (e g , ADC analog filters etc) usıng ın one embodıment, configurable UMs The analog block array may also be coupled to the GPIO 207

[0034] As ıllustrated capacıtance sensor 201 may be ıntegrated ınto processıng devıce 210 Capacıtance sensor 201 may ınclude analog I/O for couplıng to an external component such as touch-sensor pad 220, touch sensor slıder 230 touch sensor buttons 240 and/or other devıces Capacıtance sensor 201 and processıng devıce 202 are descrıbed ın more detaıl below

[0035] It should be noted that the embodıments descrıbed hereın are not lımıted to touch sensor pads for notebook ımplementatıons but can be used ın other capacıtıve sensıng ımplementatıons, for example, the sensıng devıce may be a touch sensor slıder 230, oı a touch sensor button 240 (e g , capacıtance sensıng button) Sımılarly the operatıons descrıbed hereın are not lımıted to notebook cursor operatıons, but can ınclude other operatıons, such as lıghtıng control (dımmer) volume control graphıc equalızer control, speed control, or other control operatıons requırıng gradual adjustments It should also be noted that these embodıments of capacıtıve sensıng ımplementatıons may be used ın conjunctıon wıth non capacıtıve sensıng elements, ıncludıng but not lımıted to pıck buttons slıders (ex dısplay brıghtness and contrast), scroll-wheels multı-medıa control (ex volume, track advance, etc) handwnting recognition and numeric keypad operation

[0036] 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

[0037] 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

[0038] 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

[0039] 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

[0040] 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

[0041] 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

[0042] 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

[0043] 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

[0044] 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)

[0045] 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

[0046] 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

[0047] 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

[0048] 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

[0049] 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

[0050] 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

[0051] 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 3B 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) 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

[0052] 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

[0053] Figure 3B 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

$$CdV = I_C dt \qquad (1)$$

[0054] 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

[0055] 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 capacitoi 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 Accoidingly, equations (2) and (3) below describe that a change ın frequency between F_{OUT} 356 and REF CLK ıs proportıonal to a change ın capacıtance of the capacıtor 351

$$\Delta C \propto \Delta f \quad \text{where} \tag{2}$$

$$\Delta f = f_{RO} - f_{REF} \tag{3}$$

[0056] In one embodıment, a frequency comparator may be coupled to receıve relaxatıon oscıllator clock sıgnal (F_{OUT} 356) and REF CLK, compare theır frequencıes f_{RO} and f_{REF}, respectıvely, and output a sıgnal ındıcatıve of the dıfference Δf between these frequencıes By monıtorıng Δf one can determıne whether the capacıtance of the capacıtor 351 has changed

[0057] In one exemplary embodıment, the relaxatıon oscıllatoı 350 may be buılt usıng a programmable tımer (e g 555 tımer) to ımplement the comparator 353 and reset swıtch 354 Alternatıvely the relaxatıon oscıllator 350 may be buılt usıng other cırcuıtıng Relaxatıon oscıllators are known ın by those of ordınary skıll ın the art, and accordıngly, addıtıonal detaıls regardıng theır operatıon have not been ıncluded so as to not obscure the present embodıments

[0058] Fıgure 4 ıllustrates a block dıagram of one embodıment of a capacıtance sensor ıncludıng a relaxatıon oscıllator and dıgıtal counter Capacıtance sensor 201 of Fıgure 4 ıncludes a sensor array 410 (also known as a swıtch array), relaxatıon oscıllator 350 and a dıgıtal counter 420 Sensor array 410 ıncludes a pluralıty of sensor elements 355(1) 355(N), where N ıs a posıtıve ınteger value that represents the number of rows (or alternatıvely columns) of the sensor array 410 Each sensor element ıs represented as a capacıtor, as prevıously descrıbed wıth respect to Fıgure 3B The sensor array 410 ıs coupled to relaxatıon oscıllator 350 vıa an analog bus 401 havıng a pluralıty of pıns

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)

[0059] Relaxation oscillator 350 of Figure 4 includes all the components described with respect to Figure 3B 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

[0060] 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

[0061] 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

[0062] 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

[0063] 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

[0064] 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

[0065] 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

[0066] 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

[0067] 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

[0068] 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

[0069] 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

$$\frac{\Delta n}{n} = \frac{Cf}{Cp} \qquad (4)$$

[0070] The value of Δn should be large enough for reasonable resolution and clear indication of switch actuation This drives switch construction decisions

[0071] 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

[0072] 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

[0073] 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

[0074] 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

$$n = \Delta n \frac{\mathrm{Cf}}{\mathrm{Cp}} = 2000 \qquad (5)$$

[0075] Adding some margin to yield 2500 counts and running the frequency measurement method at 1 0 MHz, the detection time for the switch is approximately 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

$$\Delta n = \frac{t_{count}\ i_c}{V_{TH}} \frac{\mathrm{Cf}}{\mathrm{Cp}^2} \qquad (6)$$

[0076] 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)

[0077] In the period measurement method the count difference between a switch with and without actuation (i e , CP+CF vs CP) is approximately

$$\Delta n = N_{Periods} \frac{Cf\ V_{TH}}{i_C} f_{SysClk} \qquad (7)$$

[0078] 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

[0079] 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

[0080] 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

[0081] 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

[0082] 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

[0083] 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

$$C = \varepsilon_0 \ \varepsilon_R \ \frac{A}{d} = \varepsilon_R \ 8\ 85 \ \frac{A}{d} pF/m \quad (8)$$

[0084] 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

[0085] 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 gridded 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

[0086] 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

[0087] 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

[0088] 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

$$Centroid = \frac{n_{i-1} \quad (i-1) + n_i i + n_{i+1} \quad (i+1)}{n_{i-1} + n_i i + n_{i+1}} \qquad (9)$$

[0089] 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

[0090] 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

[0091] 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

[0092] 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

[0093] 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

[0094] 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 greatei 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

[0095] Figure 5A illustrates a top side view of one embodiment of a sensoi 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

[0096] 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

[0097] 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

[0098] 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

[0099] 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

[00100] 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

[00101] 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

[00102] 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

[00103] 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

[00104] Figure 6A illustrates one embodiment of a sensing device having three touch sensor buttons Sensing device 240 of Figure 6A includes buttons 601 602 and 603 These three buttons may be used for user input using a conductive object such as a finger

[00105] Figure 6B illustrates one embodiment of the sensing device of Figure 6A coupled to a processing device 210 Processing device 210 is used to detect whether a conductive object is present on either or none of the touch-sensor buttons 601-603 To detect the presence of the conductive object the processing device 210 may include capacitance sensors 201(1) and 201(2), which are coupled to buttons 601-603 In particular, button 601 is coupled to capacitance sensor 201(1), button 603 is coupled to capacitance sensor 201(2) and button 602 is coupled to both capacitance sensor 201(1) and 201(2)

[00106] Each of the conventional touch-sensor buttons 601-603 may be made of a sensor element of conductive material such as copper clad The conductive material may be formed in a circular shape (illustrated in Figures 6A 6D), in a rectangular shape or in a square shape (illustrated in Figures 7A and 7B) The touch-sensor buttons may be capacitance sensor buttons which may be used as non contact switches These switches when protected by an insulating layer offer resistance to severe environments

[00107] The sensing device of Figure 6B includes two sensing areas 613 and 614 of conductive material that are electrically isolated The sensing areas of conductive area are used to make up the three buttons 601 603 In particular, button 601 includes a sensor element having a surface area of one conductive material (illustrated as white surface area of button 601) Similarly button 603 includes a sensor element having a surface area of another conductive material (illustrated as hashed surface area of button 603) The conductive materials may be similar or dissimilar materials, but more importantly are electrically isolated from one another For example, button 601 is coupled to a first pin 609 and button 603 is coupled to a second pin 610 of processing device 210 Button 602 however includes a sensor element having a surface area of two conductive materials (illustrated as white and hashed surface areas of button 603) that are electrically isolated A portion first portion 604 of the sensor element of button 602 is coupled to the conductive material of button 601, and another portion second portion 605 is coupled to the conductive material of button 603

[00108] In one embodiment, first portion 604 is coupled to the sensor element of button 601 using a conductive line 606 and second portion 605 is coupled to the sensor element button 603 using a conductive line 607 The conductive lines 606 and 607 may be conductive traces printed on the surface of the PCB Alternatively conductive lines may be conductive paths of conductive material that coupled the conductive material of the sensor elements and to the pins of the processing device 210

[00109] The processing device 210 scans the touch sensor buttons 601 603 using the capacitance sensors 201(1) and 201(2) and measures the capacitance on the two sensing areas of conductive material that realize the touch-sensor buttons 601 603 The processing device is operable to recognize a first button operation on the first sensor element a second button operation on the second sensor element and third button operation on the first and second portions of the third sensor element Accordingly the capacitance sensors of the processing device are not coupled to the touch-sensor buttons in a one-to one configuration like that of the conventional sensing device

[00110] In another embodiment the processing device 210 may include only one capacitance sensor 201 that is coupled to a selection circuit The selection circuit operates to select one conductive path to scan and measure The processing device 210 includes two pins to couple to the two sensing areas of conductive material that make up the three or more buttons In another embodiment, the processing device 210 may include only one pin and be coupled to a selection circuit that is external to the processing device that selects between the two sensing areas of conductive material

[00111] In one embodiment the processing device that is coupled to the sensing device of three or more touch sensor buttons includes one more capacitance sensors coupled to the first and second sensor elements The one or more capacitance sensors are operable to measure capacitance on the three or more sensor elements For example if the capacitance variation δ_1, measured on the first pin 609, is greater than zero and the capacitance variation δ_2, measured on the second pin 610 is equal to approximately zero then the first button 601 has been pressed Similarly, if the capacitance variation δ_1 measured on the first pin 609, is equal to the capacitance variation δ_2, measured on the second pin 610, then the second button 602 has been pressed If the capacitance variation δ_1 measured on the first pin 609, is equal to approximately zero and the capacitance variation δ_2, measured on the second pin 610 is greater than zero then the third button 603 has been pressed

[00112] In one embodiment the one or more capacitance sensors (e g , 201(1) and 201(2)) may include a relaxation oscillator The relaxation oscillator may be similar to the relaxation oscillator described above which includes a current source a selection circuit, a comparator, and a reset switch The relaxation oscillator may be coupled to a digital counter that is operable to count at least one of a frequency or a period of a relaxation oscillator output received from the relaxation oscillator

[00113] In one embodiment the method may be performed by detecting a presence of a conductive object on a sensing device and recognizing three or more button operations performed by the conductive object using two sensing areas of the sensing device In one embodiment the operation of recognizing the three or more button operatıons may ınclude recognızıng a first button operatıon when the presence of the conductıve object ıs detected on a first sensıng area 613 of the two sensıng areas of the sensıng devıce recognızıng a second button operatıon when the presence of the conductıve object ıs detected on a second sensıng area 614 of the two sensıng areas of the sensıng devıce and recognızıng one or more button operatıons when the presence of the conductıve object ıs detected on the first and second sensıng areas 613 and 614

[00114] The method may ınclude the operatıon of determınıng a capacıtance on each of the two sensıng areas, and determınıng the three or more button operatıons based on the determıned capacıtance The sensıng areas 613 and 614 may be scanned sequentıally, or alternatıvely may be scanned sımultaneously by one or more capacıtance sensors of the processıng devıce 210

[00115] In one embodıment the two sensıng areas may be used to realıze three buttons as ıllustrated ın Fıgures 6A 6D Alternatıvely the two sensıng areas may be used to realıze more than three button areas In one embodıment the sensor elements of the touch sensor buttons may be cırcular shaped as ıllustrated ın Fıgures 6A-6D Alternatıvely, the sensor elements may have other shapes such as rectangles squares, ovals hexagon octagons or the lıke

[00116] In one embodıment portıons 613 and 614 are substantıally equal ın surface area of the sensor element of button 602 Alternatıvely, portıons 613 and 614 are not equal ın surface area In one embodıment the portıons of sensor element of button 602 are semı cırcularly shaped Alternatıvely the portıons of the sensor element may have other shapes

[00117] Figure 6C illustrates another embodiment of a sensing device having three touch sensor buttons Sensing device 600 includes three touch-sensor buttons that are similar to the touch-sensor buttons 601-603 of Figure 6B except the portions of the second sensor element of the second button 602 are dissimilarly shaped than the portions of Figure 6B First portion 604 of Figure 6C has a shape of two pie shapes Similarly, second portion 605 of Figure 6C has a shape of two pie shapes The four pie shapes form a substantially circular shape for the sensor element In one embodiment the two pie shapes of each portion are coupled together in a single layer while the other two pie shapes are coupled together in a second conductive layer using vias as described with respect to Figures 5C & 5D Alternatively the conductive material of one portion is coupled together using other methods known by those of ordinary skill in the art

[00118] In the embodiment of Figure 6C conductive lines 606 and 607 are conductive traces that couple the first and second portions 604 and 605 to the first and third sensor elements of button 601 and 603 respectively The conductive lines 607 and 608 may be comprised of similar or dissimilar materials as the conductive material of the sensor elements It should be noted that first portion 604 sensor element of button 601, and conductive line 606 are electrically isolated from second portion 605 sensor element of button 603 and conductive line 607 Accordingly the two sensing areas (e g , 613 and 614) are comprised of these electrically isolated conductive materials

[00119] In one embodiment the first and second portions 604 and 605 each have a surface area that is substantially equal Alternatively the portions may have surface areas in other proportions

[00120] Figure 6D illustrates another embodiment of a sensing device having three touch-sensor buttons Sensing device 650 includes three touch-sensor buttons that are similar to the touch-sensor buttons 601-603 of Figure 6B, except the portions of the second sensor element of the second button 602 are dissimilarly shaped than the portions of Figure 6B First portion 604 of Figure 6C has multiple arc shapes of conductive material that are electrically isolated from multiple arc shapes of another conductive material of second portion 605 The multiple arc shapes of both the first and second portions 604 and 605 form a substantially circular shape for the sensor element In one embodiment, the multiple arc shapes of each portion are coupled together in a single layer, while the other two pie shapes are coupled together in a second conductive layer using vias as described with respect to Figures 5C & 5D Alternatively the conductive material of one portion is coupled together using other methods known by those of ordinary skill in the art

[00121] In the embodiment of Figure 6D, conductive lines 606 and 607 are conductive traces that couple the first and second portions 604 and 605 to the first and third sensor elements of button 601 and 603 respectively The conductive lines 607 and 608 may be comprised of similar or dissimilar materials as the conductive material of the sensor elements It should be noted that first portion 604, sensor element of button 601 and conductive line 606 are electrically isolated from second portion 605, sensor element of button 603 and conductive line 607 Accordingly the two sensing areas (e g , 613 and 614) are comprised of these electrically isolated conductive materials

[00122] In one embodiment the first and second portions 604 and 605 each have a surface area that is substantially equal Alternatively the portions may have surface areas in other proportions

[00123] The shapes of the sensor elements and the portions of the sensor elements are not limited to the shapes illustrated and described herein but may include other shapes For example Figures 7A and 7B include embodiments of rectangular and square shapes for the sensor elements and the portions of the sensor elements In addition, the number of sensor elements in the sensing device is not limited to three but may be greater than three For example, Figures 7A and 7B illustrate embodiments of four and five touch sensor buttons however, more sensor elements than five may also be used

[00124] Figure 7A illustrates another embodiment of a sensing device having four touch sensor buttons Sensing device 700 includes four touch sensor buttons 701-704 Each of the conventional touch-sensor buttons 701-704 may be made of a sensor element of conductive material such as copper-clad The sensor elements, in this embodiment are square shaped The touch sensor buttons may be capacitance sensor buttons which may be used as non contact switches

[00125] The sensing device 700 of Figure 7A includes two sensing areas of conductive material that are electrically isolated The sensing areas of conductive area are used to make up the four buttons 701 704 In particular, button 701 includes a sensor element having a surface area of one conductive material (illustrated as white surface area of button 701) Similarly, button 704 includes a sensor element having a surface area of another conductive material (illustrated as hashed surface area of button 704) The conductive materials may be similar or dissimilar materials but more importantly are

electrically isolated from one another For example button 701 is coupled to a first pin 609 and button 704 is coupled to a second pin 610 of processing device 210 Buttons 702 and 703 however, include a sensor element having a surface area of two conductive materials (illustrated as white and hashed surface areas of buttons 702 and 703) that are electrically isolated A portion, first portion 710 of the sensor elements of buttons 702 and 703 is coupled to the conductive material of button 701 and another portion, second portion 711, is coupled to the conductive material of button 704

[00126] In one embodiment, first portion 710 is coupled to the sensor element of button 701 using a conductive line 706 and second portion 711 is coupled to the sensor element button 704 using a conductive line 707 The conductive lines 706 and 707 may be conductive traces printed on the surface of the PCB Alternatively, conductive lines 706 and 707 may be conductive paths of conductive material that coupled the conductive material of the sensor elements and to the pins of the processing device 210

[00127] In one embodiment each sensor element of buttons 702 and 703 comprises two surface areas one surface area being the first portion 710 and the other surface area being the second portion 711 The surface areas may be one solid shape, or alternatively the surface areas may be interleaved sub-traces For example, the first conductive line 706 is a first conductive trace, and the first conductive trace has one or more sub traces (e g 708(1) 708(7)) and the second conductive line 707 is a second conductive trace that has one or more sub-traces (e g 709(1)-709(7)) In one embodiment, at least one sub trace of the first conductive trace 706 is interleaved with at least one sub trace of the second conductive trace 707 Alternatively the sub traces of the first and second conductive traces are not interleaved

[00128] The sensor elements of buttons 702 and 703 each have a surface area ratio between the surface area of the first portion 710 and the second portion 711 In one embodiment the surface area ratio of button 702 is approximately 25% of the first portion 710 to approximately 75% of the second portion 711 (25/75) The surface area ratio of button 703 is approximately 75% of the first portion 710 to approximately 25% of the second portion 711 (75/25) Alternatively the surface area ratios of buttons 702 and 703 may be switched in surface area ratios, e g , 75/25 for button 702 and 25/75 for button 703 In another embodiment, button 702 and button 703 may have other surface area ratios, ranging from 99/1 to 49/51, and vice versa

[00129] In the embodiment of Figure 7A, buttons 702 and 703 each include seven sub traces, sub-traces 708(1)-708(7) and sub traces 709(1)-709(7) In particular button 702 includes four sub traces 708(1) 708(4) of the first portion 710, and three sub traces 709(1)-709(3) of the second portion 711 Button 703 includes three sub-traces 708(5)-708(7) of the first portion 710 and four sub traces 709(4)-709(7) of the second portion 711 Accordingly, the surface area ratio of button 702 is 4/7 of the first portion 710 to 3/7 of the second portion 711 and the surface area ratio of button 703 is 3/7 of the first portion 710 to 4/7 of the second portion 711 Alternatively other total number of sub-traces and other combinations of sub traces, may be used to form the different surface area ratios

[00130] Figure 7B illustrates another embodiment of a sensing device having five touch-sensor buttons Sensing device 750 includes five touch sensor buttons 701-705 The touch-sensor buttons of sensing device 750 are similar to those of sensing device

700, expect there is one additional sensor element and there are eight sub traces per sensor element for buttons 702 704, which consequently changes the surface area ratios

[00131] The sensing device 750 of Figure 7B includes two sensing areas (illustrates a white and hashed surface areas) of conductive material that are electrically isolated The sensing areas of conductive area are used to make up the five buttons 701-705

[00132] In one embodiment, each sensor element of buttons 702, 703 and 704 comprises two surface areas one surface area being the first portion 710, and the other surface area being the second portion 711 The surface areas may be one solid shape or alternatively, the surface areas may be interleaved sub-traces For example, the first conductive line 706 is a first conductive trace, and the first conductive trace has twelve sub-traces 708(1)-708(12), and the second conductive line 707 is a second conductive trace that has twelve sub-traces 709(1) 709(12) At least two sub-traces of both the first and second conductive traces are interleaved in each sensor element

[00133] In this embodiment, the surface area ratio of button 702 is approximately 6/8 of the first portion 710 to approximately 2/8 of the second portion 711 The surface area ratio of button 703 is approximately 4/8 (25%) of the first portion 710 to approximately 4/8 (50%) of the second portion 711 The surface area ratio of button 704 is approximately 2/8 of the first portion 710 to approximately 6/8 of the second portion 711

[00134] In another embodiment the surface area ratio of button 702 is approximately 25% of the first portion 710 to approximately 75% of the second portion 711 The surface area ratio of button 703 is approximately 50% of the first portion 710 to approximately 50% of the second portion 711 The surface area ratio of button 704 is approximately 75% of the first portion 710 to approximately 25% of the second portion 711

[00135] In another embodiment, the surface area ratio of button 702 is approximately 33% of the first portion 710 to approximately 67% of the second portion 711 The surface area ratio of button 703 is approximately 50% of the first portion 710 to approximately 50% of the second portion 711 The surface area ratio of button 704 is approximately 67% of the first portion 710 to approximately 33% of the second portion 711

[00136] Alternatively other surface area ratios, total number of sub-traces and other combinations of sub traces may be used to form the sensor elements that include the two conductive materials

[00137] As described with respect to the embodiments above, the processing device 210 can scan the touch sensor buttons 701 704 of Figure 7A (or the touch sensor buttons 701-705 of Figure 7B) using one or more capacitance sensors, and measure the capacitance on the two sensing areas of conductive material that realize the touch-sensor buttons 701 704 (or 701-705) Accordingly the processing device is operable to recognize a first button operation on the first sensor element, a second button operation on the second sensor element and third and fourth button operations (or third, fourth and fifth button operations) on the first and second portions of the third and fourth sensor elements (or third fourth and fifth sensor elements)

[00138] It should be noted that although the sensor elements that include the two portions are illustrated and described as being inside or in between the two sensor elements that are coupled to the pins, the sensor elements that include the two portions may be disposed in other positions with respect to the other two sensor elements

[00139] 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

[00140] 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

[00141] 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

[00142] 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

[00143] 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

determining a capacitance variation of a first sensor element and a capacitance variation of a second sensor element

detecting a touch at a first location if the capacitance variation of the first sensor element is greater than a reference value and the capacitance variation of the second sensor element is not greater than the reference value

detecting the touch at a second location if the capacitance variation of the first sensor element is not greater than the reference value and the capacitance variation of the second sensor element is greater than the reference value and

detecting the touch at a third location if the capacitance variation of the first sensor element and the capacitance variation of the second sensor element are both greater than the reference value

2 The method of claim 1 wherein the determining of the capacitance variation of the first sensor element and the capacitance variation of the second sensor element includes sequentially measuring a capacitance of the first sensor element and a capacitance of the second sensor element

3 The method of claim 2 wherein sequentially measuring the capacitance of the first sensor element and the capacitance of the second sensor element includes using a selection circuit to select a first conductive path coupled to the first sensor element and to select a second conductive path coupled to the second sensor element wherein the capacitance of the first sensor

element is measured through the first conductive path and the capacitance of the second sensor element is measured through the second conductive path

4 The method of claim 2 wherein sequentially measuring the capacitance of the first sensor element and the capacitance of the second sensor element includes using a selection circuit to select the first sensor element to measure over a conductive path and to select the second sensor element to measure over the conductive path

5 The method of claim 1 wherein the determining of the capacitance variation of the first sensor element and the capacitance variation of the second sensor element includes using a single capacitance sensor to measure a capacitance of the first sensor element and to measure a capacitance of the second sensor element

6 The method of claim 5 wherein the single capacitance sensor includes a relaxation oscillator

7 The method of claim 1 wherein the first location the second location and the third location reside on a common axis

8 An apparatus comprising

a first sensor element

a second sensor element that is electrically isolated from the first sensor element and

a processing device coupled with the first sensor element and the second sensor element wherein the processing device is configured to

detect a presence at a first location based on a first change in capacitance of the first sensor element detect the presence at a second location based on a first change in capacitance of the second sensor element and

detect the presence at a third location based on a second change in capacitance of the first sensor element and a second change in capacitance of the second sensor element

9 The apparatus of claim 8 wherein the processing device comprises one or more capacitance sensors configured to measure capacitance of the first sensor element and the second sensor element

10 The apparatus of claim 9 wherein each of the one or more capacitance sensors comprise a relaxation oscillator configured to measure capacitance

11 The apparatus of claim 9 wherein the processing device comprises a first pin coupled to the first sensor element and a second pin coupled to the second sensor element wherein the processing device is configured to measure a capacitance of the first sensor element through the first pin and measure a capacitance of the second sensor element through the second pin

12 The apparatus of claim 9 wherein the processing device comprises a pin coupled to the first sensor element and coupled to the second sensor element wherein the processing device is configured to measure a capacitance of the first sensor element through the pin and measure a capacitance of the second sensor element through the pin

13 The apparatus of claim 12 wherein the processing device is configured to use a selection circuit to sequentially select the first sensor element and the second sensor element for measurement through the pin

14 A system comprising

a user interface comprising a multi dimensional sensor array the multi dimensional sensor array including a plurality of sensor elements and

a processing device coupled to the user interface the processing device configured to

determine a capacitance variation of a first sensor element and a capacitance variation of a second sensor element the first sensor element and the second sensor element of the plurality of sensor elements

detect a touch at a first location of the multi dimensional sensor array responsive to the capacitance variation of the first sensor element being greater than a reference value and the capacitance variation of the second sensor element not being greater than the reference value

detect the touch at a second location of the multi dimensional sensor array responsive to the capacitance variation of the first sensor element not being greater than the reference value and the capacitance variation of the second sensor element being greater than the reference value and

detect the touch at a third location of the multi dimensional sensor array responsive to the capacitance variation of the first sensor element and the capacitance variation of the second sensor element both being greater than the reference value

15 The system of claim 14 wherein the processing device is configured to sequentially measure a capacitance of the first sensor element and a capacitance of the second sensor element as part

of the determination of the capacitance variation of the first sensor element and the capacitance variation of the second sensor element

16 The system of claim 15 wherein the processing device is configured to use a selection circuit to select a first conductive path coupled to the first sensor element and to select a second conductive path coupled to the second sensor element wherein the processing device is configured to measure the capacitance of the first sensor element through the first conductive path and measure the capacitance of the second sensor element through the second conductive path

17 The system of claim 15 wherein the processing device is configured to use a selection circuit to select the first sensor element to measure over a conductive path and to select the second sensor element to measure over the conductive path

18 The system of claim 14 wherein the processing device includes a capacitance sensor to measure a capacitance of the first sensor element and to measure a capacitance of the second sensor element

19 The system of claim 18 wherein the capacitance sensor includes a relaxation oscillator

20 The system of claim 14 wherein the first location, the second location, and the third location reside on a common axis of the multi-dimensional sensor array

ABSTRACT

A method and apparatus to detect a conductive object at a location determines a capacitance variation of a first sensor element and a capacitance variation of a second sensor element The method and apparatus detects a touch at a first location if the capacitance variation of the first sensor element is greater than a reference value and the capacitance variation of the second sensor element is not greater than the reference value The method and apparatus detects the touch at a second location if the capacitance variation of the first sensor element is not greater than the reference value and the capacitance variation of the second sensor element is greater than the reference value The method and apparatus detects the touch at a third location if the capacitance variation of the first sensor element and the capacitance variation of the second sensor element are both greater than the reference value

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Applicant(s) Jiang XiaoPing	Group Art Unit **Herewith**
Serial No Herewith	Examiner Unknown
Filed Herewith	Confirmation # Herewith
Title APPARATUS AND METHODS FOR DETECTING A CONDUCTIVE OBJECT AT A LOCATION	Assignee Cypress Semiconductor Corp
Attorney Docket No **CD06039C2**	

PRELIMINARY AMENDMENT

Commissioner for Patents
P O Box 1450
Alexandria VA 22313 1450

I Introductory Comments

Please enter these amendments before prosecution on the merits

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

II Amendments to the Specification

Please replace paragraph **[0001]** with the following

RELATED APPLICATIONS

[0001] This application is a continuation application of US Patent Application Number 11/437,517 filed May 18, 2006, now US Patent Number 8,004,497, issued August 23, 2011, which claims the benefit of and priority to US Application Number 13/204,543 filed August 05, 2011, both of which are incorporated by reference herein

~~[0001] This application is a continuation of U S Patent Application No 11/437,517 filed May 18, 2006, which is incorporated herein by reference in its entirety~~

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

III <u>Remarks</u>

No new mattei has been added ın thıs amendment

Should the Patent Office have any questıons regardıng thıs submıssıon or the applıcatıon ın general the Patent Offıce ıs urged to contact the Applıcant's attorney, Larry Johnson by telephone at (408) 545-7194 All correspondence should contınue to be dırected to the address gıven below

Respectfully submıtted
For Jıang XıaoPıng
by hıs representatıve,

/Larry J Johnson/_______________
Larry J Johnson
Reg No 56,861
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198 Champıon Court
San Jose, CA 95134
Customer No 60909

CY00002057

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APPLICATION NUMBER	FILING or 371(c) DATE	GRP ART UNIT	FIL FEE REC D	ATTY DOCKET NO	TOT CLAIMS	IND CLAIMS
13/442 716	04/09/2012	2629	0 00	CD06039C2	20	3

CONFIRMATION NO 6333

60909
CYPRESS SEMICONDUCTOR CORPORATION
198 CHAMPION COURT
SAN JOSE CA 95134 1709

FILING RECEIPT

OC000000053898755

Date Mailed 04/26/2012

Receipt is acknowledged of this non provisional patent application The application will be taken up for examination in due course Applicant will be notified as to the results of the examination Any correspondence concerning the application must include the following identification information the U S APPLICATION NUMBER FILING DATE NAME OF APPLICANT and TITLE OF INVENTION Fees transmitted by check or draft are subject to collection Please verify the accuracy of the data presented on this receipt **If an error is noted on this Filing Receipt, please submit a written request for a Filing Receipt Correction Please provide a copy of this Filing Receipt with the changes noted thereon If you received a Notice to File Missing Parts for this application, please submit any corrections to this Filing Receipt with your reply to the Notice When the USPTO processes the reply to the Notice, the USPTO will generate another Filing Receipt incorporating the requested corrections**

Applicant(s)
Jiang XIAOPING Shanghai CHINA

Assignment For Published Patent Application
CYPRESS SEMICONDUCTOR CORPORATION San Jose CA

Power of Attorney None

Domestic Priority data as claimed by applicant
This application is a CON of 11/437 517 05/18/2006 PAT 8004497
and is a CON of 13/204 543 08/05/2011 PAT 8174507
(*)Data provided by applicant is not consistent with PTO records

Foreign Applications (You may be eligible to benefit from the **Patent Prosecution Highway** program at the USPTO Please see http //www uspto gov for more information)

If Required, Foreign Filing License Granted 04/20/2012

The country code and number of your priority application to be used for filing abroad under the Paris Convention is **US 13/442,716**

Projected Publication Date Request for Non Publication Acknowledged

Non Publication Request Yes

Early Publication Request No

Title

APPARATUS AND METHODS FOR DETECTING A CONDUCTIVE OBJECT AT A LOCATION

Preliminary Class

345

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Almost every country has its own patent law and a person desiring a patent in a particular country must make an application for patent in that country in accordance with its particular laws Since the laws of many countries differ in various respects from the patent law of the United States applicants are advised to seek guidance from specific foreign countries to ensure that patent rights are not lost prematurely

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APPLICATION NUMBER	FILING OR 371(C) DATE	FIRST NAMED APPLICANT	ATTY DOCKET NO /TITLE
13/442 716	04/09/2012	Jiang XIAOPING	CD06039C2

CONFIRMATION NO 6333

60909
CYPRESS SEMICONDUCTOR CORPORATION
198 CHAMPION COURT
SAN JOSE CA 95134 1709

FORMALITIES LETTER

OC000000053898756

Date Mailed 04/26/2012

NOTICE TO FILE MISSING PARTS OF NONPROVISIONAL APPLICATION

FILED UNDER 37 CFR 1 53(b)

Filing Date Granted

Items Required To Avoid Abandonment

An application number and filing date have been accorded to this application The item(s) indicated below however are missing Applicant is given **TWO MONTHS** from the date of this Notice within which to file all required items below to avoid abandonment 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 statutory basic filing fee is missing
Applicant must submit ***$380*** *to complete the basic filing fee for a non small entity If appropriate applicant may make a written assertion of entitlement to small entity status and pay the small entity filing fee (37 CFR 1 27)*
The oath or declaration is missing
A properly signed oath or declaration in compliance with 37 CFR 1 63 identifying the application by the above Application Number and Filing Date is required
Note If a petition under 37 CFR 1 47 is being filed an oath or declaration in compliance with 37 CFR 1 63 signed by all available joint inventors or if no inventor is available by a party with sufficient proprietary interest is required

The applicant needs to satisfy supplemental fees problems indicated below

The required item(s) identified below must be timely submitted to avoid abandonment

A surcharge (for late submission of filing fee search fee examination fee or oath or declaration) as set forth in 37 CFR 1 16(f) of **$130** for a non small entity must be submitted

SUMMARY OF FEES DUE

Total fee(s) required within **TWO MONTHS** from the date of this Notice is **$1380** for a non small entity
$380 Statutory basic filing fee
$130 Surcharge
The application search fee has not been paid Applicant must submit **$620** to complete the search fee
The application examination fee has not been paid Applicant must submit **$250** to complete the examination fee for a non small entity

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EFS ID	12900191
Application Number	13442716
International Application Number	
Confirmation Number	6333
Title of Invention	APPARATUS AND METHODS FOR DETECTING A CONDUCTIVE OBJECT AT A LOCATION
First Named Inventor/Applicant Name	Jiang XIAOPING
Customer Number	60909
Filer	Kevin Grange
Filer Authorized By	
Attorney Docket Number	CD06039C2
Receipt Date	31 MAY 2012
Filing Date	09 APR 2012
Time Stamp	12 15 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		01682 982 P456C2_Preliminary Amendment_05 31 2012 pdf	47609 676e57 b7e677b 05d150 13b484efd 5fd b4 2b	yes	8

	Multipart Description/PDF files in zip description		
	Document Description	**Start**	**End**
	Preliminary Amendment	1	1
	Abstract	2	2
	Claims	3	7
	Applicant Arguments/Remarks Made in an Amendment	8	8
Warnings			
Information			
	Total Files Size (in bytes):	47609	

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<u>National Stage of an International Application under 35 U S C 371</u>
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<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

Attorney Docket No CD06039C2 PATENT

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In Re Patent Application of

Jiang XiaoPing

Application No 13/442 716

Filing Date April 9 2012

Art unit 2838

Examiner Not Yet Assigned

For APPARATUS AND METHODS FOR DETECTING A CONDUCTIVE OBJECT AT A LOCATION

Confirmation No 6333

CERTIFICATE OF TRANSMISSION
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/Kitty Yuen/	May 31, 2012
Name	*Date*

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PRELIMINARY AMENDMENT

Sir/Madam

Prior to an examination of the above identified application, Applicants respectfully request the Examiner to enter the following preliminary amendments and to consider the following remarks

Amendments to the Abstract being 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 7 of this paper

IN THE SPECIFICATION

Please replace the abstract with the following abstract

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

IN THE CLAIMS

The claims are amended as follows

1-20 (Canceled)

21 (New) A method comprising

determining capacitance variations of a first number of two or more sense elements of a touch screen device using a processing device to detect a presence of a conductive object on any one of a second number of three or more button areas of the touch screen device wherein the first number of sense elements is less than the second number of button areas and

recognizing an activation of one of the three or more button areas using the determined capacitance variations of the first number of two or more sense elements

22 (New) The method of claim 21, wherein the first number is two and the second number is three and wherein the recognizing comprises

detecting the presence of the conductive object at a first button area when the capacitance variation of a first sense element is greater than a reference value and the capacitance variation of a second sense element is not greater than the reference value

detecting the presence of the conductive object at a second button area when the capacitance variation of the first sense element is not greater than the reference value and the capacitance variation of the second sense element is greater than the reference value and

detecting the presence of the conductive object at a third button area when the capacitance variation of the first sense element and the capacitance variation of the second sense element are both greater than the reference value

23 (New) The method of claim 22, wherein the determining the capacitance variations comprises measuring a first capacitance of the first sense element and a second capacitance of the second sense element

24 (New) The method of claim 22, wherein the determining the capacitance variations comprises

measuring a first capacitance of the first sense element on a first pin of the processing device and

measuring a second capacitance of the second sense element on a second pin of the processing device

25 (New) The method of claim 21, wherein the recognizing comprises

determining a combination of the capacitance variations of the first number of two or more sense elements and

recognizing the activation using the determined combination

26 (New) The method of claim 21, wherein the second number is nine, and wherein the recognizing comprises recognizing the activation of one of the nine button areas using the determined capacitance variations of the first number of two or more sense elements

27 (New) An apparatus comprising

a processing device coupled to a first number of two or more sense elements of a touch screen device wherein the processing device is configured to determine capacitance variations of the first number of two or more sense elements to detect a presence of a conductive object on any one of a second number of three or more buttons areas of the touch screen device wherein the first number of sense elements is less than the second number of button areas, and wherein the processing device is configured to recognize an activation of one of the three or more button areas using the determined capacitance variations of the first number of two or more sense elements

28 (New) The apparatus of claim 27 wherein the first number is two and the second number is three and wherein the processing device is configured to

detect the presence of the conductive object at a first button area when the capacitance variation of a first sense element is greater than a reference value and the capacitance variation of a second sense element is not greater than the reference value

detect the presence of the conductive object at a second button area when the capacitance variation of the first sense element is not greater than the reference value and the capacitance variation of the second sense element is greater than the reference value, and

detect the presence of the conductive object at a third button area when the capacitance variation of the first sense element and the capacitance variation of the second sense element are both greater than the reference value

29 (New) The apparatus of claim 27, wherein the processing device comprises

a capacitance sensing circuit and

a selection circuit coupled to the capacitance sensing circuit and the first number of two or more sense elements

30 (New) The apparatus of claim 27 wherein the processing device comprises

a first capacitance sensing circuit

a second capacitance sensing circuit and

a selection circuit coupled to the first number of two or more sense elements the first capacitance sensing circuit, and a second capacitance sensing circuit, wherein the selection circuit is configured to selectively couple the capacitance sensing circuit to one of the first number of two or more sense elements and to selectively couple the second capacitance sensing circuit to another one of the first number of two or more sense elements

31 (New) The apparatus of claim 27, wherein the first number is two and the second number is three and wherein the processing device is configured to

detect a conductive object proximate to a first button area based on a first change in capacitance of a first sense element

detect the conductive object proximate to a second button area based on a first change in capacitance of a second sense element, and

detect the conductive object proximate to a second button area based on a second change in capacitance of the first sense element and a second change in capacitance of the second sense element

32 (New) The apparatus of claim 27, wherein the processing device comprises one or more capacitance sensing circuits configured to measure capacitance of the first number of two or more sense elements

33 (New) The apparatus of claim 32, wherein the one or more capacitance sensing circuits comprises a relaxation oscillator configured to measure the capacitance of the first number of two or more sense elements

34 (New) The apparatus of claim 32, wherein the processing device comprises
a first pin coupled to the one or more capacitance sensing circuits and
a second pint coupled to the one or more capacitance sensing circuits

35 (New) The apparatus of claim 27, wherein the processing device is configured to determine a combination of the capacitance variations of the first number of two or more sense elements and to recognize the activation using the determined combination

36 (New) The apparatus of claim 27, wherein the second number is nine, and wherein the processing device is configured to recognize the activation of one of the nine button areas using the determined capacitance variations of the first number of two or more sense elements

37 (New) A system comprising
a touch screen device comprising a first number of two or more sense elements and a second number of three or more button areas wherein the first number of sense elements is less than the second number of button areas, and
a processing device coupled to the touch screen device, wherein the processing device is configured to determine capacitance variations of the two or more sense elements of the touch screen device, and to recognize an activation of one of the three or more buttons areas using the capacitance variations of the two or more sense elements

38 (New) The system of claim 37 wherein the first number is two and the second number is three and wherein the processing device is configured to

detect the presence of the conductive object at a first button area when the capacitance variation of a first sense element is greater than a reference value and the capacitance variation of a second sense element is not greater than the reference value

detect the presence of the conductive object at a second button area when the capacitance variation of the first sense element is not greater than the reference value and the capacitance variation of the second sense element is greater than the reference value, and

detect the presence of the conductive object at a third button area when the capacitance variation of the first sense element and the capacitance variation of the second sense element are both greater than the reference value

39 (New) The system of claim 37, wherein the processing device is configured to

determine a combination of the capacitance variations of the two or more sense elements, and

recognize the activation using the determined combination

40 (New) The system of claim 37 wherein the second number is nine and wherein the processing device is configured to recognize the activation of one of the nine button areas using the determined capacitance variations of the two or more sense elements

REMARKS

The Applicants respectfully request the Examiner to enter the presented amendments prior to the examination of the application Claims 1-20 have been canceled Claims 21 40 have been added No new matter has been added

If the Examiner believes a telephone interview would expedite the prosecution of this application the Examiner is invited to contact Larry Johnson by telephone at (408) 545-7194

Please charge any additional 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, or apply any credits to our PTO deposit account number 50-1358

Respectfully submitted,

LOWENSTEIN SANDLER LLP

Date May 31, 2012

/Kevin O Grange/
Kevin O Grange
Reg No 60 793

Customer No 60909
390 Lytton Avenue
Palo Alto CA 94301

Electronic Acknowledgement Receipt	
EFS ID	13043997
Application Number	13442716
International Application Number	
Confirmation Number	6333
Title of Invention	APPARATUS AND METHODS FOR DETECTING A CONDUCTIVE OBJECT AT A LOCATION
First Named Inventor/Applicant Name	Jiang XIAOPING
Customer Number	60909
Filer	Larry Joel Johnson/YING JIANG
Filer Authorized By	Larry Joel Johnson
Attorney Docket Number	CD06039C2
Receipt Date	18 JUN 2012
Filing Date	09 APR 2012
Time Stamp	18 35 05
Application Type	Utility under 35 USC 111(a)

Payment information

Submitted with Payment	yes
Payment Type	Deposit Account
Payment was successfully received in RAM	$1380
RAM confirmation Number	5852
Deposit Account	503781
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File Listing

Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part / zip	Pages (if appl)
1	Oath or Declaration filed	CD06039C2_Oath_06182012 pdf	110932 b4c28c4d7d1 5270 7892 7d 22d1ec6 8fc50	no	3
Warnings					
Information					
2	Transmittal Letter	CD06039C2_MissingPartsLetter _06182012 pdf	17450 5f79d d6 8c4 a4e12 2f589685cf3df2dda b	no	2
Warnings					
Information					
3	Fee Worksheet (SB06)	fee info pdf	37038 7025d49094ef5 2d 2181b34f06d340d8b5 5564	no	2
Warnings					
Information					
		Total Files Size (in bytes):	165420		

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

Attorney Docket No 16820P456 **Patent**

First Named Inventor Jiang XiaoPing

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

TWO-PIN BUTTONS

(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 Jiang XiaoPing
(Given Name (First and Middle [if any]) Family Name (or Surname) and Suffix [if any])

Inventor's Signature Jiang XiaoPing Date May 18, 2006

Residence Shanghai, P.R China *(City State Country)* Citizenship China *(Country)*

Mailing Address Room 06 07, 26F, 1 Gateway Plaza, No. 1 Hong Qiao Road
Shanghai, P.R. China 200030

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Applıcatıon of Jıang XIAOPING	)	Examıner Unknown
Applıcatıon No 13/442 716	)	Gıoup Art Unıt 2629
Fıled Aprıl 09, 2012	)	Confirmatıon No 6333
For APPARATUS AND METHODS FOR DETECTING A CONDUCTIVE OBJECT AT A LOCATION	)	

<u>RESPONSE TO MISSING PARTS and INCOMPELTE REPLY</u>

Commıssıoner for Patents
P O Box 1450
Alexandrıa VA 22313 1450

Sır

Applıcant hereby responds to the NOTICE TO FILE MISSING PARTS OF NONPROVISIONAL APPLICATION FILED UNDER 37 C F R § 1 53(b) – FILING DATE GRANTED maıled Aprıl 26 2012, and the NOTICE OF INCOMPELTE REPLY (NONPROVISINAL) maıled June 8 2012 enclosed please fınd the Declaratıon and surcharge fee

The Commıssıoner ıs hereby authorızed to charge any approprıate fees under 37 C F R §§ 1 16 1 17, 1 18 1 20 and 1 21 that may be requıred to maıntaın pendency of the present applıcatıon, and to credıt any overpayments to Deposıt Account No 50 3781

/

/

/

Customer No 60909

Should the Patent Office have any questions regarding this response 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 06/18/2012

By /Larry J. Johnson/
Larry J 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

UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
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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
13/442 716	04/09/2012	Jiang XIAOPING	CD06039C2

CONFIRMATION NO 6333

60909
CYPRESS SEMICONDUCTOR CORPORATION
198 CHAMPION COURT
SAN JOSE CA 95134 1709

FORMALITIES LETTER

OC000000054728825

Date Mailed 06/08/2012

NOTICE OF INCOMPLETE REPLY (NONPROVISIONAL)

Filing Date Granted

The U S Patent and Trademark Office has received your reply on 05/31/2012 to the Notice to File Missing Parts (Notice) mailed 04/26/2012 and it has been entered into the nonprovisional application The reply however does not include the following items required in the Notice A complete reply must be timely filed to prevent ABANDONMENT of the above identified application Replies should be mailed to Mail Stop Missing Parts Commissioner for Patents P O Box 1450 Alexandria VA 22313 1450

Applicant is given **TWO MONTHS** from the date of the Notice to File Missing Parts (Notice) mailed 04/26/2012 within which to file all required items and pay any fees required below to avoid abandonment 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 statutory basic filing fee is missing
*Applicant must submit **$380** to complete the basic filing fee for a non small entity If appropriate applicant may make a written assertion of entitlement to small entity status and pay the small entity filing fee (37 CFR 1 27)*
The oath or declaration is missing
A properly signed oath or declaration in compliance with 37 CFR 1 63 identifying the application by the above Application Number and Filing Date is required
Note If a petition under 37 CFR 1 47 is being filed an oath or declaration in compliance with 37 CFR 1 63 signed by all available joint inventors or if no inventor is available by a party with sufficient proprietary interest is required
Surcharge (for late submission of filing fee search fee examination fee or oath or declaration) as set forth in 37 CFR 1 16(f) of $130 was not received

The applicant needs to satisfy supplemental fees problems indicated below

The required item(s) identified below must be timely submitted to avoid abandonment

SUMMARY OF FEES DUE

Total fee(s) required within **TWO MONTHS** from the date of the Notice is **$1380** for a non small entity
$380 Statutory basic filing fee
$130 Surcharge
The application search fee has not been paid Applicant must submit **$620** to complete the search fee
The application examination fee has not been paid Applicant must submit **$250** to complete the examination fee for a non small entity

Replies should be mailed to

Mail Stop Missing Parts
Commissioner for Patents
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Alexandria VA 22313 1450

Registered users of EFS Web may alternatively submit their reply to this notice via EFS Web
https //sportal uspto gov/authenticate/AuthenticateUserLocalEPF html

For more information about EFS Web please call the USPTO Electronic Business Center at **1 866 217 9197** or visit our website at http //www uspto gov/ebc

If you are not using EFS-Web to submit your reply you must include a copy of this notice

/kgebremichael/

Office of Data Management Application Assistance Unit (571) 272 4000 or (571) 272 4200 or 1 888 786 0101

Electronic Patent Application Fee Transmittal	
Application Number	13442716
Filing Date	09 Apr 2012
Title of Invention	APPARATUS AND METHODS FOR DETECTING A CONDUCTIVE OBJECT AT A LOCATION
First Named Inventor/Applicant Name	Jiang XIAOPING
Filer	Larry Joel Johnson/YING JIANG
Attorney Docket Number	CD06039C2
Filed as Large Entity	

Utility under 35 USC 111(a) Filing Fees

Description	Fee Code	Quantity	Amount	Sub Total in USD($)
Basic Filing				
Utility application filing	1011	1	380	380
Utility Search Fee	1111	1	620	620
Utility Examination Fee	1311	1	250	250
Pages				
Claims				
Miscellaneous Filing				
Late filing fee for oath or declaration	1051	1	130	130
Petition				

Description	Fee Code	Quantity	Amount	Sub Total in USD($)
Patent Appeals and Interference				
Post Allowance and Post Issuance				
Extension of Time				
Miscellaneous				
		Total in USD ($)		**1380**

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APPLICATION NUMBER	FILING or 371(c) DATE	GRP ART UNIT	FIL FEE REC D	ATTY DOCKET NO	TOT CLAIMS	IND CLAIMS
13/442 716	04/09/2012	2629	1380	CD06039C2	20	3

CONFIRMATION NO 6333

60909
CYPRESS SEMICONDUCTOR CORPORATION
198 CHAMPION COURT
SAN JOSE CA 95134 1709

UPDATED FILING RECEIPT

OC000000054985517

Date Mailed 06/22/2012

Receipt is acknowledged of this non provisional patent application The application will be taken up for examination in due course Applicant will be notified as to the results of the examination Any correspondence concerning the application must include the following identification information the U S APPLICATION NUMBER FILING DATE NAME OF APPLICANT and TITLE OF INVENTION Fees transmitted by check or draft are subject to collection Please verify the accuracy of the data presented on this receipt **If an error is noted on this Filing Receipt, please submit a written request for a Filing Receipt Correction Please provide a copy of this Filing Receipt with the changes noted thereon If you received a Notice to File Missing Parts for this application, please submit any corrections to this Filing Receipt with your reply to the Notice When the USPTO processes the reply to the Notice, the USPTO will generate another Filing Receipt incorporating the requested corrections**

Applicant(s)

Jiang XIAOPING Shanghai CHINA

Assignment For Published Patent Application

CYPRESS SEMICONDUCTOR CORPORATION San Jose CA

Power of Attorney The patent practitioners associated with Customer Number 08791

Domestic Priority data as claimed by applicant

This application is a CON of 11/437 517 05/18/2006 PAT 8004497
and is a CON of 13/204 543 08/05/2011 PAT 8174507
(*)Data provided by applicant is not consistent with PTO records

Foreign Applications (You may be eligible to benefit from the **Patent Prosecution Highway** program at the USPTO Please see http //www uspto gov for more information)

If Required, Foreign Filing License Granted 04/20/2012

The country code and number of your priority application to be used for filing abroad under the Paris Convention is **US 13/442,716**

Projected Publication Date Request for Non Publication Acknowledged

Non Publication Request Yes

Early Publication Request No

Title

APPARATUS AND METHODS FOR DETECTING A CONDUCTIVE OBJECT AT A LOCATION

Preliminary Class

345

PROTECTING YOUR INVENTION OUTSIDE THE UNITED STATES

Since the rights granted by a U S patent extend only throughout the territory of the United States and have no effect in a foreign country an inventor who wishes patent protection in another country must apply for a patent in a specific country or in regional patent offices Applicants may wish to consider the filing of an international application under the Patent Cooperation Treaty (PCT) An international (PCT) application generally has the same effect as a regular national patent application in each PCT member country The PCT process **simplifies** the filing of patent applications on the same invention in member countries but **does not result** in a grant of an international patent and does not eliminate the need of applicants to file additional documents and fees in countries where patent protection is desired

Almost every country has its own patent law and a person desiring a patent in a particular country must make an application for patent in that country in accordance with its particular laws Since the laws of many countries differ in various respects from the patent law of the United States applicants are advised to seek guidance from specific foreign countries to ensure that patent rights are not lost prematurely

Applicants also are advised that in the case of inventions made in the United States the Director of the USPTO must issue a license before applicants can apply for a patent in a foreign country The filing of a U S patent application serves as a request for a foreign filing license The application s filing receipt contains further information and guidance as to the status of applicant s license for foreign filing

Applicants may wish to consult the USPTO booklet General Information Concerning Patents (specifically the section entitled Treaties and Foreign Patents) for more information on timeframes and deadlines for filing foreign patent applications The guide is available either by contacting the USPTO Contact Center at 800 786 9199 or it can be viewed on the USPTO website at http //www uspto gov/web/offices/pac/doc/general/index html

For information on preventing theft of your intellectual property (patents trademarks and copyrights) you may wish to consult the U S Government website http //www stopfakes gov Part of a Department of Commerce initiative this website includes self help toolkits giving innovators guidance on how to protect intellectual property in specific countries such as China Korea and Mexico For questions regarding patent enforcement issues applicants may call the U S Government hotline at 1 866 999 HALT (1 866 999 4158)

LICENSE FOR FOREIGN FILING UNDER

Title 35, United States Code, Section 184

Title 37, Code of Federal Regulations, 5 11 & 5 15

GRANTED

The applicant has been granted a license under 35 U S C 184 if the phrase IF REQUIRED FOREIGN FILING LICENSE GRANTED followed by a date appears on this form Such licenses are issued in all applications where the conditions for issuance of a license have been met regardless of whether or not a license may be required as

set forth in 37 CFR 5 15 The scope and limitations of this license are set forth in 37 CFR 5 15(a) unless an earlier license has been issued under 37 CFR 5 15(b) The license is subject to revocation upon written notification The date indicated is the effective date of the license unless an earlier license of similar scope has been granted under 37 CFR 5 13 or 5 14

This license is to be retained by the licensee and may be used at any time on or after the effective date thereof unless it is revoked This license is automatically transferred to any related applications(s) filed under 37 CFR 1 53(d) This license is not retroactive

The grant of a license does not in any way lessen the responsibility of a licensee for the security of the subject matter as imposed by any Government contract or the provisions of existing laws relating to espionage and the national security or the export of technical data Licensees should apprise themselves of current regulations especially with respect to certain countries of other agencies particularly the Office of Defense Trade Controls Department of State (with respect to Arms Munitions and Implements of War (22 CFR 121 128)) the Bureau of Industry and Security Department of Commerce (15 CFR parts 730 774) the Office of Foreign AssetsControl Department of Treasury (31 CFR Parts 500+) and the Department of Energy

NOT GRANTED

No license under 35 U S C 184 has been granted at this time if the phrase IF REQUIRED FOREIGN FILING LICENSE GRANTED DOES NOT appear on this form Applicant may still petition for a license under 37 CFR 5 12 if a license is desired before the expiration of 6 months from the filing date of the application If 6 months has lapsed from the filing date of this application and the licensee has not received any indication of a secrecy order under 35 U S C 181 the licensee may foreign file the application pursuant to 37 CFR 5 15(b)

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APPLICATION NO	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO	CONFIRMATION NO
13/442 716	04/09/2012	Jiang XIAOPING	CD06039C2	6333

60909 7590 09/19/2012
CYPRESS SEMICONDUCTOR CORPORATION
198 CHAMPION COURT
SAN JOSE CA 95134 1709

EXAMINER	
KETEMA BENYAM	
ART UNIT	**PAPER NUMBER**
2629	
MAIL DATE	**DELIVERY MODE**
09/19/2012	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)
	13/442 716	XIAOPING JIANG
	Examiner	Art Unit
	BENYAM KETEMA	2629

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 *31 May 2012*

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

3)☐ 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

4)☐ 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

5)☒ Claim(s) *21 40* is/are pending in the application

5a) Of the above claim(s) _____ is/are withdrawn from consideration

6)☐ Claim(s) _____ is/are allowed

7)☒ Claim(s) *21 40* is/are rejected

8)☐ Claim(s) _____ is/are objected to

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

Application Papers

10)☐ The specification is objected to by the Examiner

11)☒ The drawing(s) filed on *04/09/2012* 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)

12)☐ 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

13)☐ 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

1 Claims 21- 40 are presented for examination

Specification

2 The disclosure is objected to because of the following informalities

Paragraph (0001) under the heading of related Applications need to be corrected in order to show current application as being continuation of US Application Number 13/204,543 filed August 05, 2011 which in turn is continuation of US Patent Application Number 11/437,517 filed May 18, 2006, now US Patent Number 8,004 497, issued August 23, 2011 Appropriate correction is required

Double Patenting

3 The nonstatutory double patenting rejection is based on a judicially created doctrine grounded in public policy (a policy reflected in the statute) so as to prevent the unjustified or improper timewise extension of the right to exclude' granted by a patent and to prevent possible harassment by multiple assignees A nonstatutory obviousness-type double patenting rejection is appropriate where the conflicting claims are not identical, but at least one examined application claim is not patentably distinct from the reference claim(s) because the examined application claim is either anticipated by, or would have been obvious over, the reference claim(s) See, e g , *In re Berg, 140* F 3d 1428,46 USPQ2d 1226 (Fed Cir 1998), *In re Goodman,* 11 F 3d 1046,29 USPQ2d 2010 (Fed Cir 1993), *In re Longi,* 759 F 2d 887, 225 USPQ 645 (Fed Cir *1985), In* re *Van Ornum,* 686 F 2d 937, 214 USPQ 761 (CCPA 1982) *In re Vogel, 422*

F 2d 438,164 USPQ 619 (CCPA 1970), and In re Thorington, 418 F 2d 528,163 USPQ 644 (CCPA 1969)

A timely filed terminal disclaimer in compliance with 37 CFR 1 321 (c) or 1 321 (d) may be used to overcome an actual or provisional rejection based on a nonstatutory double patenting ground provided the conflicting application or patent either is shown to be commonly owned with this application or claims an invention made as a result of activities undertaken within the scope of a joint research agreement

Effective January 1, 1994, a registered attorney or agent of record may sign a terminal disclaimer A terminal disclaimer signed by the assignee must fully comply with 37 CFR 3 73(b)

3 Claims 21-25, and 27-39 are rejected on the ground of nonstatutory double patenting over claims1 5,11, and 15-18 of U S Patent No 8,004,487 since the claims, if allowed, would improperly extend the "right to exclude" already granted in the patent

The subject matter claimed in the instant application is fully disclosed in the patent and is covered by the patent since the patent and the application are claiming common subject matter, as follows both the instant application and the patent document are related to detecting a presence of conductive object on anyone of three or more button areas using two or more sense elements wherein the number of sense elements is less than the number of button areas Although the patent document contains more limitations in the claim language of its respective allowed claims the instant application's claims come within the subset and scope of the previously allowed claims

4 Although the conflicting claims are not identical, they are not patentably distinct from each other because the subject matter recited in the application is anticipated and obvious referred to the same invention as to the references Patent

For instance, with regard to independent claim 2, The reference Patent # 8,004,497 recites all the limitations of claim 2 with the exception of "reference value" However it is well known in the touch input art that in order to detect the presence of conductive object on a sensing (detecting) area of the capacitive input unit the measured capacitance had to be compared to a reference value in order to distingue the difference between an input and no input by the user

Current Application (13/442716)	**US Patent No 8004497**
21 A method comprising determining capacitance variations of a first number of two or more sense elements of a touch screen device using a processing device to detect a presence of a conductive object on anyone of a second number of three or more button areas of the touch screen device wherein the first number of sense elements is less than the second number of button areas, and recognizing an activation of one of the three or more button areas using the determined capacitance variations of the first number of two or more sense elements	1 A method comprising, detecting a presence of a conductive object on a capacitance sensing device, the sensing device comprising at least two sensing areas each coupled to a capacitance measurement input, and recognizing activation of at least three button performed by the detected presence of the conductive object, wherein the number of buttons is equal to at least the number of sensing areas plus one and wherein a combination of the at least two sensing areas is used to recognize
22 The method of claim 21, wherein the first number is two and the second number is three, and wherein the recognizing comprises detecting the presence of the conductive object at a first button area when the capacitance variation	2 The method of claim 1, wherein recognizing the plurality of button activations comprises recognizing a first activated button when the presence of the conductive object is detected on a first sensing area of the at least two

of a first sense element is greater than a reference value and the capacitance variation of a second sense element is not greater than the reference value, detecting the presence of the conductive object at a second button area when the capacitance variation of the first sense element is not greater than the reference value and the capacitance variation of the second sense element is greater than the reference value, and detecting the presence of the conductive object at a third button area when the capacitance variation of the first sense element and the capacitance variation of the second sense element are both greater than the reference value	sensing areas of the sensing device, recognizing a second activated button when the presence of the conductive object is detected on a second sensing area of the at least two sensing areas of the sensing device, and recognizing a third activated button when the presence of the conductive object is detected on the first and second sensing areas
23 The method of claim 22, wherein the determining the capacitance variations comprises measuring a first capacitance of the first sense element and a second capacitance of the second sense element	3 The method of claim 1, further comprising measuring a capacitance of the conductive object on the sensing device over time, wherein measuring the capacitance further comprises measuring a capacitance of the at least two sensing areas of the sensing device, and wherein recognizing the activated buttons is based on the measured capacitance of the at least two sensing areas
24 The method of claim 22, wherein the determining the capacitance variations comprises measuring a first capacitance of the first sense element on a first pin of the processing device, and measuring a second capacitance of the second sense element on a second pin of the processing device	15 The apparatus of claim 14, wherein the processing device comprises a first pin and a second pin, wherein the first pin is coupled to the first sensor element, and wherein the second pin is coupled to the second sensor element 16 The apparatus of claim 15, wherein the processing device is operable to recognize a first button operation on the first sensor element, a second button operation on the second sensor element and a third button operation on the first and second portions of the third sensor element

25 The method of claim 21, wherein the recognizing comprises determining a combination of the capacitance variations of the first number of two or more sense elements and recognizing using the determined combination	3 The method of claim 1 further comprising measuring a capacitance of the conductive object on the sensing device over time, wherein measuring the capacitance further comprises measuring a capacitance of the at least two sensing areas of the sensing device, and wherein recognizing the activated buttons is based on the measured capacitance of the at least two sensing areas

Furthermore, there is no apparent reason why applicant was prevented from presenting claims corresponding to those of the instant application during prosecution of the application which matured into a patent See In re Schneller, 397 F 2d 350, 158 USPQ 210 (CCPA 1968) See also MPEP § 804

5 Any inquiry concerning this communication or earlier communications from the examiner should be directed to BENYAM KETEMA whose telephone number is (571)270-7224 The examiner can normally be reached on Monday- Friday 8 00AM - 5 00PM

If attempts to reach the examiner by telephone are unsuccessful, the examiner s supervisor, SHALWALA BIPIN H can be reached on 571-272-7681 The fax phone number for the organization where this application or proceeding is assigned is 571-273 8300 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 Should you have questions on access to the Private PAIR system contact the Electronic Business Center (EBC) at 866-

217-9197 (toll-free) If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571 272-1000

/B K/
Examiner Art Unit 2629

/Bipin Shalwala/
Supervisory Patent Examiner, Art Unit 2629
09/05/2012

Notice of References Cited	Application/Control No 13/442 716	Applicant(s)/Patent Under Reexamination XIAOPING JIANG	
	Examiner BENYAM KETEMA	Art Unit 2629	Page 1 of 1

U S PATENT DOCUMENTS

*		Document Number Country Code Number Kind Code	Date MM YYYY	Name	Classification
*	A	US 2004/0239616	12 2004	Collins Ryan V	345/156
*	B	US 7 158 125	01 2007	Sinclair et al	345/173
*	C	US 7 253 643	08 2007	Seguine Ryan D	324/686
	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	
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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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TO EXAMINER KETEMA, BENYAM	FROM ANDREW J BATEMAN, REG NO 45,573
FAX NUMBER 571 273 8300	DATE 11/08/2012
COMPANY U S PATENT AND TRADEMARK OFFICE	TOTAL NO OF PAGES INCLUDING COVER 3
PHONE NUMBER (571)270-7224	SENDER'S REFERENCE NUMBER CD06039C2
RE REVOCATION AND NEW POWER OF ATTORNEY	USPTO APPLICATION NUMBER. 13/442,716

☐ URGENT ☐ FOR REVIEW ☐ PLEASE COMMENT ☐ PLEASE REPLY ☐ PLEASE RECYCLE

NOTES/COMMENTS

Application No 13/442,716
Filing Date 04-09-2012
First Named Inventor Jiang XIAOPING
Art Unit 2696
Confirmation No 6333
Examiner Name KETEMA, BENYAM
Attorney Docket No CD06039C2

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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POWER OF ATTORNEY OR REVOCATION OF POWER OF ATTORNEY WITH A NEW POWER OF ATTORNEY AND CHANGE OF CORRESPONDENCE ADDRESS

Application Number	13/442 716
Filing Date	04-09 2012
First Named Inventor	Jiang XIAOPING
Title	APPARATUS AND METHODS
Art Unit	2696
Examiner Name	KETEMA, BENYAM
Attorney Docket Number	CD06039C2

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 Practitioner(s) associated with the following Customer Number as my/our attorney(s) or agent(s) to prosecute the application identified above and to transact all business in the United States Patent and Trademark Office connected therewith — 60909

OR

☐ I hereby appoint Practitioner(s) named below as my/our attorney(s) or agent(s) to prosecute the application identified above and to transact all business in the United States Patent and Trademark Office connected therewith

Practitioner(s) Name	Registration Number

Please recognize or change the correspondence address for the above identified application to

☐ The address associated with the above-mentioned Customer Number

OR

☒ The address associated with Customer Number 60909

OR

☐ Firm or Individual Name					
Address					
City		State		Zip	
Country					
Telephone		Email			

I am the

☐ Applicant/Inventor

OR

☒ Assignee of record of the entire interest. See 37 CFR 3 71
Statement under 37 CFR 3 73(b) (Form PTO/SB/96) submitted herewith or filed on ______

SIGNATURE of Applicant or Assignee of Record

Signature	[signature]	Date	11/08/2012
Name	Victoria Tidwell	Telephone	408-943 2979
Title and Company	Vice President of Legal Affairs & General Counsel, Cypress Semiconductor Corporation		

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

RECEIVED

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PTO/SB/96 (01-08)
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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

STATEMENT UNDER 37 CFR 3.73(b)

Applicant/Patent Owner Jiang XIAOPING, et al

Application No /Patent No 13/442,716 Filed/Issue Date 04-09 2012

Entitled APPARATUS AND METHODS FOR DETECTING A CONDUCTIVE OBJECT AT A LOCATION

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 028479, Frame 0418, 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

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☐ 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
11/08/2012 — Date

Andrew J. Bateman, Reg. No. 45,573 — Printed or Typed Name
408-943-6878 — Telephone Number

Attorney of Record — Title

Electronic Acknowledgement Receipt	
EFS ID	14247888
Application Number	13442716
International Application Number	
Confirmation Number	6333
Title of Invention	APPARATUS AND METHODS FOR DETECTING A CONDUCTIVE OBJECT AT A LOCATION
First Named Inventor/Applicant Name	Jiang XIAOPING
Customer Number	60909
Filer	Kevin Grange/Kitty Yuen
Filer Authorized By	Kevin Grange
Attorney Docket Number	CD06039C2
Receipt Date	16 NOV 2012
Filing Date	09 APR 2012
Time Stamp	13 58 57
Application Type	Utility under 35 USC 111(a)

Payment information

Submitted with Payment	yes
Payment Type	Deposit Account
Payment was successfully received in RAM	$160
RAM confirmation Number	270
Deposit Account	501358
Authorized User	

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

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File Listing

Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part / zip	Pages (if appl)
1		01682 982 P456C2_Response to OA_11 16 2012 pdf	57649 055b18b101f663620805b4407 682bd20e 7079d	yes	10

	Multipart Description/PDF files in zip description		
	Document Description	**Start**	**End**
	Amendment/Req Reconsideration After Non Final Reject	1	1
	Specification	2	2
	Claims	3	7
	Abstract	8	10

Warnings

Information

Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part / zip	Pages (if appl)
2	Terminal Disclaimer Filed	01682 982 P456C2_Terminal Disclaimer_11 16 2012 pdf	374629 27fc09d9dc814 00c29450 a47654 2925d 36b71	no	2

Warnings

Information

Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part / zip	Pages (if appl)
3	Fee Worksheet (SB06)	fee info pdf	30479 27149811cb5c83 81ff10ff8d1b225fcbd39 848	no	2

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Total Files Size (in bytes):	462757

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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

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

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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

Attorney Docket No CD06039C2 PATENT

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In Re Patent Application of

Jiang XiaoPing

Application No 13/442 716

Filing Date April 9 2012

Art unit 2838

Examiner Ketema Benyam

For APPARATUS AND METHODS FOR DETECTING A CONDUCTIVE OBJECT AT A LOCATION

Confirmation No 6333

CERTIFICATE OF TRANSMISSION
I hereby certify that this correspondence is being submitted electronically via EFS Web on the date shown below

/Kitty Yuen/ November 16, 2012
Name *Date*

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

AMENDMENT AND RESPONSE TO OFFICE ACTION

Sir/Madam

In response to the Office Action mailed on September 19, 2012, Applicants respectfully requests that the Examination enter the following amendments and consider the following remarks

Amendments to the Specification being 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 8 of this paper

AMENDMENTS

Amendments to the Specification

Please replace the paragraph beginning at line [0001] as follows

[0001] This application is a continuation of U S Patent Application number 13/204,543, filed August 5 2011 now U S Patent No 8,174,507 issued May 8 2012 which is a continuation of U S Patent Application number 11/437 517 filed May 8, 2006, now U S Patent No 8,004 497 issued August 23 2011

Amendments to the Claims

This listing of claims will replace all prior versions, and listings of the claims in the application

1-20 (Canceled)

21 (Previously presented) A method comprising

determining capacitance variations of a first number of two or more sense elements of a touch screen device using a processing device to detect a presence of a conductive object on any one of a second number of three or more button areas of the touch screen device wherein the first number of sense elements is less than the second number of button areas and

recognizing an activation of one of the three or more button areas using the determined capacitance variations of the first number of two or more sense elements

22 (Previously presented) The method of claim 21 wherein the first number is two and the second number is three, and wherein the recognizing comprises

detecting the presence of the conductive object at a first button area when the capacitance variation of a first sense element is greater than a reference value and the capacitance variation of a second sense element is not greater than the reference value

detecting the presence of the conductive object at a second button area when the capacitance variation of the first sense element is not greater than the reference value and the capacitance variation of the second sense element is greater than the reference value and

detecting the presence of the conductive object at a third button area when the capacitance variation of the first sense element and the capacitance variation of the second sense element are both greater than the reference value

23 (Previously presented) The method of claim 22, wherein the determining the capacitance variations comprises measuring a first capacitance of the first sense element and a second capacitance of the second sense element

24 (Previously presented) The method of claim 22 wherein the determining the capacitance variations comprises

measuring a first capacitance of the first sense element on a first pin of the processing device and

measuring a second capacitance of the second sense element on a second pin of the processing device

25 (Previously presented) The method of claim 21, wherein the recognizing comprises

determining a combination of the capacitance variations of the first number of two or more sense elements, and

recognizing the activation using the determined combination

26 (Previously presented) The method of claim 21 wherein the second number is nine and wherein the recognizing comprises recognizing the activation of one of the nine button areas using the determined capacitance variations of the first number of two or more sense elements

27 (Previously presented) An apparatus comprising

a processing device coupled to a first number of two or more sense elements of a touch screen device, wherein the processing device is configured to determine capacitance variations of the first number of two or more sense elements to detect a presence of a conductive object on any one of a second number of three or more buttons areas of the touch screen device, wherein the first number of sense elements is less than the second number of button areas, and wherein the processing device is configured to recognize an activation of one of the three or more button areas using the determined capacitance variations of the first number of two or more sense elements

28 (Previously presented) The apparatus of claim 27, wherein the first number is two and the second number is three, and wherein the processing device is configured to

detect the presence of the conductive object at a first button area when the capacitance variation of a first sense element is greater than a reference value and the capacitance variation of a second sense element is not greater than the reference value,

detect the presence of the conductive object at a second button area when the capacitance variation of the first sense element is not greater than the reference value and the capacitance variation of the second sense element is greater than the reference value, and

detect the presence of the conductive object at a third button area when the capacitance variation of the first sense element and the capacitance variation of the second sense element are both greater than the reference value

29 (Previously presented) The apparatus of claim 27 wherein the processing device comprises

a capacitance sensing circuit, and

a selection circuit coupled to the capacitance sensing circuit and the first number of two or more sense elements

30 (Previously presented) The apparatus of claim 27 wherein the processing device comprises

a first capacitance sensing circuit,

a second capacitance sensing circuit and

a selection circuit coupled to the first number of two or more sense elements, the first capacitance sensing circuit and a second capacitance sensing circuit wherein the selection circuit is configured to selectively couple the capacitance sensing circuit to one of the first number of two or more sense elements and to selectively couple the second capacitance sensing circuit to another one of the first number of two or more sense elements

31 (Previously presented) The apparatus of claim 27, wherein the first number is two and the second number is three, and wherein the processing device is configured to

detect a conductive object proximate to a first button area based on a first change in capacitance of a first sense element,

detect the conductive object proximate to a second button area based on a first change in capacitance of a second sense element and detect the conductive object proximate to a second button area based on a second change in capacitance of the first sense element and a second change in capacitance of the second sense element

32 (Previously presented) The apparatus of claim 27, wherein the processing device comprises one or more capacitance sensing circuits configured to measure capacitance of the first number of two or more sense elements

33 (Previously presented) The apparatus of claim 32, wherein the one or more capacitance sensing circuits comprises a relaxation oscillator configured to measure the capacitance of the first number of two or more sense elements

34 (Previously presented) The apparatus of claim 32, wherein the processing device comprises

a first pin coupled to the one or more capacitance sensing circuits and

a second pint coupled to the one or more capacitance sensing circuits

35 (Previously presented) The apparatus of claim 27, wherein the processing device is configured to determine a combination of the capacitance variations of the first number of two or more sense elements and to recognize the activation using the determined combination

36 (Previously presented) The apparatus of claim 27, wherein the second number is nine, and wherein the processing device is configured to recognize the activation of one of the nine button areas using the determined capacitance variations of the first number of two or more sense elements

37 (Previously presented) A system comprising

a touch screen device comprising a first number of two or more sense elements and a second number of three or more button areas, wherein the first number of sense elements is less than the second number of button areas and

a processing device coupled to the touch screen device, wherein the processing device is configured to determine capacitance variations of the two or more sense elements of the touch screen device and to recognize an activation of one of the three or more buttons areas using the capacitance variations of the two or more sense elements

38 (Previously presented) The system of claim 37, wherein the first number is two and the second number is three, and wherein the processing device is configured to

detect the presence of the conductive object at a first button area when the capacitance variation of a first sense element is greater than a reference value and the capacitance variation of a second sense element is not greater than the reference value

detect the presence of the conductive object at a second button area when the capacitance variation of the first sense element is not greater than the reference value and the capacitance variation of the second sense element is greater than the reference value, and

detect the presence of the conductive object at a third button area when the capacitance variation of the first sense element and the capacitance variation of the second sense element are both greater than the reference value

39 (Previously presented) The system of claim 37 wherein the processing device is configured to

determine a combination of the capacitance variations of the two or more sense elements and

recognize the activation using the determined combination

40 (Previously presented) The system of claim 37 wherein the second number is nine and wherein the processing device is configured to recognize the activation of one of the nine button areas using the determined capacitance variations of the two or more sense elements

REMARKS

Applicants request reconsideration of this application in view of the following remarks For the Examiner's convenience and reference, Applicants' remarks are presented in substantially the same order in which the corresponding issues were raised in the Office Action

Summary of the Office Action

The specification is objected to for informalities

Claims 21-25 and 27 39 stand rejected on the ground of nonstatutory obviousness type double patenting as being unpatentable over claims 1 5 11 and 15 18 of U S Patent No 8,004,497

Response to Objection

Applicant respectfully submits that paragraph 001 has been amended as suggested by the examiner Applicant appreciates the examiner's suggestion and requests that the objection be withdrawn based on the amendment to the specification presented herein

Response to Double Patenting Rejection

Claims 21-25 and 27 39 stand rejected on the ground of nonstatutory obviousness-type double patenting as being unpatentable over claims 1 5, 11, and 15-18 of U S Patent No 8 004,497 Without admitting the validity of the obviousness-type double patenting rejection, Applicant is submitting herewith the appropriate terminal disclaimer in compliance with 37 C F R § 1 1321 to overcome the rejection of claims 21-25 and 27-39 Please note that the Applicant submitted a Power of Attorney by facsimile November 8, 2012 indicating the requestor have Power of Attorney Applicant intended to file the terminal disclaimer via EFS E terminal disclaimer, but PAIR has not been updated to reflect the updated Power of Attorney As such, Applicant submits herewith a paper terminal disclaimer

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 reserves 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 canceled 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

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

Please charge any additional 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 or apply any credits to our PTO deposit account number 501358

Respectfully submitted,

LOWENSTEIN SANDLER LLP

Date Nov 16 2012

/Kevin O Grange/
Kevin O Grange
Reg No 60,793

Customer No 60909
Lowenstein Sandler LLP
390 Lytton Avenue
Palo Alto, CA 94301

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Please charge any additional 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, or apply any credits to our PTO deposit account number 501358

Respectfully submitted

LOWENSTEIN SANDLER LLP

Date Nov 16 2012

/Kevin O Grange/
Kevin O Grange
Reg No 60 793

Customer No 60909
Lowenstein Sandler LLP
390 Lytton Avenue
Palo Alto, CA 94301

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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 reserves 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 canceled 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

It ıs ıespectfully submıtted that ın vıew of the amendments and remarks set forth hereın the ıejectıons have been overcome If the Examıner belıeves a telephone ınterview would expedıte the prosecutıon of thıs applıcatıon the Examıner ıs ınvıted to contact Larry Johnson by telephone at (408) 545 7194

Please charge any addıtıonal fees under 37 C F R §§ 1 16 1 17, 1 18 1 20 and 1 21 that may be requıred to maıntaın pendency of the present applıcatıon, or apply any credıts to our PTO deposıt account number 501358

Respectfully submıtted,

LOWENSTEIN SANDLER LLP

Date Nov 16 2012

/Kevın O Grange/
Kevın O Grange
Reg No 60,793

Customer No 60909
Lowensteın Sandler LLP
390 Lytton Avenue
Palo Alto CA 94301

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TERMINAL DISCLAIMER TO OBVIATE A DOUBLE PATENTING REJECTION OVER A "PRIOR" PATENT	Docket Number (Optional) CD06039C2

In re Application of Jiang XiaoPing

Application No 13/442 716

Filed April 9 2012

For APPARATUS AND METHODS FOR DETECTING A CONDUCTIVE OBJECT AT A LOCATION

The owner CYPRESS SEMICONDUCTOR CORPORATION of 100 percent interest in the instant application hereby disclaims except as provided below the terminal part of the statutory term of any patent granted on the instant application which would extend beyond the expiration date of the full statutory term of **prior patent** No 8,004,497 as the term of said **prior patent** is presently shortened by any terminal disclaimer The owner hereby agrees that any patent so granted on the instant application shall be enforceable only for and during such period that it and the **prior patent** are commonly owned This agreement runs with any patent granted on the instant application and is binding upon the grantee its successors or assigns

In making the above disclaimer the owner does not disclaim the terminal part of the term of any patent granted on the instant application that would extend to the expiration date of the full statutory term of the **prior patent** as the term of said **prior patent** is presently shortened by any terminal disclaimer in the event that said **prior patent** later
- expires for failure to pay a maintenance fee
- is held unenforceable
- is found invalid by a court of competent jurisdiction
- is statutorily disclaimed in whole or terminally disclaimed under 37 CFR 1 321
- has all claims canceled by a reexamination certificate
- is reissued or
- is in any manner terminated prior to the expiration of its full statutory term as presently shortened by any terminal disclaimer

Check either box 1 or 2 below if appropriate

1 ☐ For submissions on behalf of a business/organization (e g corporation partnership university government agency etc) the undersigned is empowered to act on behalf of the business/organization

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 Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patent issued thereon

2 ☑ The undersigned is an attorney or agent of record Reg No 60 793

/Kevin O Grange/
Signature

November 16 2012
Date

Kevin O Grange
Typed or printed name

(650) 433 5800
Telephone Number

☑ Terminal disclaimer fee under 37 CFR 1 20(d) included

WARNING Information on this form may become public Credit card information should not be included on this form Provide credit card information and authorization on PTO 2038

Statement under 37 CFR 3 73(b) is required if terminal disclaimer is signed by the assignee (owner) Form PTO/SB/96 may be used for making this certification See MPEP § 324

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

Electronic Patent Application Fee Transmittal	
Application Number	13442716
Filing Date	09 Apr 2012
Title of Invention	APPARATUS AND METHODS FOR DETECTING A CONDUCTIVE OBJECT AT A LOCATION
First Named Inventor/Applicant Name	Jiang XIAOPING
Filer	Kevin Grange/Kitty Yuen
Attorney Docket Number	CD06039C2
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($)
Miscellaneous				
Statutory or terminal disclaimer	1814	1	160	160
		Total in USD ($)		**160**

Transaction History Date 2012-11-26
Date information retrieved from USPTO Patent Application Information Retrieval (PAIR) system records at www uspto gov

Application Number	Application/Control No	Applicant(s)/Patent under Reexamination	
	13/442 716	XIAOPING JIANG	

Document Code - DISQ	Internal Document – DO NOT MAIL

TERMINAL DISCLAIMER	☒ APPROVED	☐ DISAPPROVED
Date Filed 11/16/12	This patent is subject to a Terminal Disclaimer	

Approved/Disapproved by

jean proctor

U S Patent and Trademark Office

CY00002122

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
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Al andria, Virgini 2 313 1450
www spt g

APPLICATION NUMBER	FILING OR 371 (C) DATE	FIRST NAMED APPLICANT	ATTY DOCKET NO /TITLE
13/442 716	04/09/2012	Jiang XIAOPING	CD06039C2

CONFIRMATION NO 6333

60909
CYPRESS SEMICONDUCTOR CORPORATION
198 CHAMPION COURT
SAN JOSE CA 95134 1709

POA ACCEPTANCE LETTER

OC000000057779779

Date Mailed 11/30/2012

NOTICE OF ACCEPTANCE OF POWER OF ATTORNEY

This is in response to the Power of Attorney filed 11/08/2012

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

/agizaw/

Office of Data Management Application Assistance Unit (571) 272 4000 or (571) 272 4200 or 1 888 786 0101

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APPLICATION NUMBER	FILING OR 371(C) DATE	FIRST NAMED APPLICANT	ATTY DOCKET NO /TITLE
13/442 716	04/09/2012	Jiang XIAOPING	CD06039C2

CONFIRMATION NO 6333

POWER OF ATTORNEY NOTICE

60909
CYPRESS SEMICONDUCTOR CORPORATION
198 CHAMPION COURT
SAN JOSE CA 95134 1709

OC000000057779746

Date Mailed 11/30/2012

NOTICE REGARDING CHANGE OF POWER OF ATTORNEY

This is in response to the Power of Attorney filed 11/08/2012

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)

/agizaw/

Office of Data Management Application Assistance Unit (571) 272 4000 or (571) 272 4200 or 1 888 786 0101

Transaction History Date 2012-12-21
Date information retrieved from USPTO Patent Application Information Retrieval (PAIR) system records at www uspto gov

Notice of Allowability	Application No 13/442 716	Applicant(s) XIAOPING JIANG
	Examiner BENYAM KETEMA	Art Unit 2696

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 *11/16/2012*

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 *21 40* As a result of the allowed claim(s) you may be eligible to benefit from the **Patent Prosecution Highway** program at a participating intellectual property office for the corresponding application For more information please see http /www uspto gov/patents init events pph/index jsp or send an inquiry to PPHfeedback@uspto gov

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 ☐ CORRECTED DRAWINGS (as replacement sheets) must be submitted

☐ 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 ☐ Information Disclosure Statements (PTO/SB/08) Paper No /Mail Date _____
3 ☐ Examiner s Comment Regarding Requirement for Deposit of Biological Material
4 ☐ Interview Summary (PTO 413) Paper No /Mail Date _____
5 ☐ Examiner s Amendment/Comment
6 ☒ Examiner s Statement of Reasons for Allowance
7 ☐ Other _____

/B K/
Examiner Art Unit 2696

CY00002125

DETAILED ACTION

1 Claims 21 40 are presented for examination and are allowed

Terminal Disclaimer

2 The terminal disclaimer filed on November 16, 2012 disclaiming the terminal portion of any patent granted on this application which would extend beyond the expiration date of prior patent No 8,004,497 has been reviewed and is accepted The terminal disclaimer has been recorded

Specification

3 The substitute specification filed November 16, 2012 has been reviewed and entered

Examiner's Statement of Reasons for Allowance

3 The following is an examiner s statement of reasons for allowance The prior art of record fails to disclose the claimed invention **The features of independent claims** directed towards allowable subject matter is *determining capacitance variations of a first number of two or more sense elements of a touch screen device using a processing device to detect a presence of a conductive object on anyone of a second number of three or more button areas of the touch screen device, wherein the first number of sense elements is less than the second number of button areas, and*

recognizing an activation of one of the three or more button areas using the determined capacitance variations of the first number of two or more sense elements" **Tsujioka et al (US Pat NO 5,518,078)** discloses that the presence of users finger (i e conductive object) is detected by sensing device (col 9 10), the sensing device comprising at least two sensing areas each coupled to a capacitance measurement input (fig 5 & 6) wherein the user can perform multiple input operation using his/her finger or pen as it is clearly shown in fig 5 in order to perform an input operation But Tsujioka et al fails to disclose the first number of sense elements is less than the second number of button areas, and recognizing an activation of one of the three or more button areas using the determined capacitance variations of the first number of two or more sense elements Therefore, these features in combination with the remaining language of the claims are not taught by the prior arts of record Therefore claims 21 40 are found to be allowable over the prior art of record

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

4 Any inquiry concerning this communication or earlier communications from the examiner should be directed to BENYAM KETEMA whose telephone number is (571)270-7224 The examiner can normally be reached on Monday- Friday 8 00AM - 5 00PM

If attempts to reach the examiner by telephone are unsuccessful, the examiner s supervisor, Shalwala Bipin H can be reached on 571-272-7681 The fax phone number for the organization where this application or proceeding is assigned is 571 273 8300 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 Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866 217-9197 (toll-free) If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786 9199 (IN USA OR CANADA) or 571-272 1000

/B K/

Examiner, Art Unit 2696

/Bipin Shalwala/

Supervisory Patent Examiner Art Unit 2696

Notice of References Cited	Application/Control No 13/442 716	Applicant(s)/Patent Under Reexamination XIAOPING JIANG	
	Examiner BENYAM KETEMA	Art Unit 2696	Page 1 of 1

U S PATENT DOCUMENTS

*		Document Number Country Code Number Kind Code	Date MM YYYY	Name	Classification
*	A	US 2004/0239616	12 2004	Collins Ryan V	345/156
*	B	US 7 158 125	01 2007	Sinclair et al	345/173
*	C	US 7 253 643	08 2007	Seguine Ryan D	324/686
*	D	US 5 518 078	05 1996	Tsujioka et al	178/18 05
*	E	US 2006/0097992	05 2006	Gitzinger et al	345/173
*	F	US 2006/0227117	10 2006	Proctor David W	345/173
	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

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NOTICE OF ALLOWANCE AND FEE(S) DUE

60909 7590 12/21/2012
CYPRESS SEMICONDUCTOR CORPORATION
198 CHAMPION COURT
SAN JOSE CA 95134 1709

EXAMINER	
KETEMA BENYAM	
ART UNIT	PAPER NUMBER
2696	

DATE MAILED 12/21/2012

APPLICATION NO	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO	CONFIRMATION NO
13/442 716	04/09/2012	Jiang XIAOPING	CD06039C2	6333

TITLE OF INVENTION APPARATUS AND METHODS FOR DETECTING A CONDUCTIVE OBJECT AT A LOCATION

APPLN TYPE	SMALL ENTITY	ISSUE FEE DUE	PUBLICATION FEE DUE	PREV PAID ISSUE FEE	TOTAL FEE(S) DUE	DATE DUE
nonprovisional	NO	$1770	$0	$0	$1770	03/21/2013

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	If the SMALL ENTITY is shown as NO
A If the status is the same pay the TOTAL FEE(S) DUE shown above	A Pay TOTAL FEE(S) DUE shown above or
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	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 (N t Use Bl k l f any hang f ddr)

60909 7590 12/21/2012

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

(D pos t am)

(S gn t)

(D t)

APPLICATION NO	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO	CONFIRMATION NO
13/442 716	04/09/2012	Jiang XIAOPING	CD06039C2	6333

TITLE OF INVENTION APPARATUS AND METHODS FOR DETECTING A CONDUCTIVE OBJECT AT A LOCATION

APPLN TYPE	SMALL ENTITY	ISSUE FEE DUE	PUBLICATION FEE DUE	PREV PAID ISSUE FEE	TOTAL FEE(S) DUE	DATE DUE
nonprovisional	NO	$1770	$0	$0	$1770	03/21/2013

EXAMINER	ART UNIT	CLASS SUBCLASS
KETEMA BENYAM	2696	345 173000

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 ____________

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APPLICATION NO	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO	CONFIRMATION NO
13/442 716	04/09/2012	Jiang XIAOPING	CD06039C2	6333

60909 7590 12/21/2012
CYPRESS SEMICONDUCTOR CORPORATION
198 CHAMPION COURT
SAN JOSE CA 95134 1709

EXAMINER	
KETEMA BENYAM	
ART UNIT	PAPER NUMBER
2696	

DATE MAILED 12/21/2012

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 0 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 0 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 02/11)

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

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APPLICATION NUMBER	FILING or 371(c) DATE	GRP ART UNIT	FIL FEE REC D	ATTY DOCKET NO	TOT CLAIMS	IND CLAIMS
13/442 716	04/09/2012	2696	1380	CD06039C2	20	3

CONFIRMATION NO 6333

60909
CYPRESS SEMICONDUCTOR CORPORATION
198 CHAMPION COURT
SAN JOSE CA 95134 1709

CORRECTED FILING RECEIPT

OC000000058532045

Date Mailed 01/08/2013

Receipt is acknowledged of this non provisional patent application The application will be taken up for examination in due course Applicant will be notified as to the results of the examination Any correspondence concerning the application must include the following identification information the U S APPLICATION NUMBER FILING DATE NAME OF APPLICANT and TITLE OF INVENTION Fees transmitted by check or draft are subject to collection Please verify the accuracy of the data presented on this receipt **If an error is noted on this Filing Receipt, please submit a written request for a Filing Receipt Correction Please provide a copy of this Filing Receipt with the changes noted thereon If you received a Notice to File Missing Parts for this application, please submit any corrections to this Filing Receipt with your reply to the Notice When the USPTO processes the reply to the Notice, the USPTO will generate another Filing Receipt incorporating the requested corrections**

Inventor(s)

Jiang XIAOPING Shanghai CHINA

Applicant(s)

Jiang XIAOPING Shanghai CHINA

Assignment For Published Patent Application

CYPRESS SEMICONDUCTOR CORPORATION San Jose CA

Power of Attorney The patent practitioners associated with Customer Number 60909

Domestic Priority data as claimed by applicant

This application is a CON of 13/204 543 08/05/2011 PAT 8174507
which is a CON of 11/437 517 05/18/2006 PAT 8004497

Foreign Applications for which priority is claimed (You may be eligible to benefit from the **Patent Prosecution Highway** program at the USPTO Please see http //www uspto gov for more information) None
Foreign application information must be provided in an Application Data Sheet in order to constitute a claim to foreign priority See 37 CFR 1 55 and 1 76

If Required, Foreign Filing License Granted 04/20/2012

The country code and number of your priority application to be used for filing abroad under the Paris Convention is **US 13/442,716**

Projected Publication Date Request for Non Publication Acknowledged

Non Publication Request Yes

Early Publication Request No

Title

APPARATUS AND METHODS FOR DETECTING A CONDUCTIVE OBJECT AT A LOCATION

Preliminary Class

345

PROTECTING YOUR INVENTION OUTSIDE THE UNITED STATES

Since the rights granted by a U S patent extend only throughout the territory of the United States and have no effect in a foreign country an inventor who wishes patent protection in another country must apply for a patent in a specific country or in regional patent offices Applicants may wish to consider the filing of an international application under the Patent Cooperation Treaty (PCT) An international (PCT) application generally has the same effect as a regular national patent application in each PCT member country The PCT process **simplifies** the filing of patent applications on the same invention in member countries but **does not result** in a grant of an international patent and does not eliminate the need of applicants to file additional documents and fees in countries where patent protection is desired

Almost every country has its own patent law and a person desiring a patent in a particular country must make an application for patent in that country in accordance with its particular laws Since the laws of many countries differ in various respects from the patent law of the United States applicants are advised to seek guidance from specific foreign countries to ensure that patent rights are not lost prematurely

Applicants also are advised that in the case of inventions made in the United States the Director of the USPTO must issue a license before applicants can apply for a patent in a foreign country The filing of a U S patent application serves as a request for a foreign filing license The application s filing receipt contains further information and guidance as to the status of applicant s license for foreign filing

Applicants may wish to consult the USPTO booklet General Information Concerning Patents (specifically the section entitled Treaties and Foreign Patents) for more information on timeframes and deadlines for filing foreign patent applications The guide is available either by contacting the USPTO Contact Center at 800 786 9199 or it can be viewed on the USPTO website at http //www uspto gov/web/offices/pac/doc/general/index html

For information on preventing theft of your intellectual property (patents trademarks and copyrights) you may wish to consult the U S Government website http //www stopfakes gov Part of a Department of Commerce initiative this website includes self help toolkits giving innovators guidance on how to protect intellectual property in specific countries such as China Korea and Mexico For questions regarding patent enforcement issues applicants may call the U S Government hotline at 1 866 999 HALT (1 866 999 4158)

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Title 35, United States Code, Section 184

Title 37, Code of Federal Regulations, 5 11 & 5 15

GRANTED

The applicant has been granted a license under 35 U S C 184 if the phrase IF REQUIRED FOREIGN FILING LICENSE GRANTED followed by a date appears on this form Such licenses are issued in all applications where the conditions for issuance of a license have been met regardless of whether or not a license may be required as

set forth in 37 CFR 5 15 The scope and limitations of this license are set forth in 37 CFR 5 15(a) unless an earlier license has been issued under 37 CFR 5 15(b) The license is subject to revocation upon written notification The date indicated is the effective date of the license unless an earlier license of similar scope has been granted under 37 CFR 5 13 or 5 14

This license is to be retained by the licensee and may be used at any time on or after the effective date thereof unless it is revoked This license is automatically transferred to any related applications(s) filed under 37 CFR 1 53(d) This license is not retroactive

The grant of a license does not in any way lessen the responsibility of a licensee for the security of the subject matter as imposed by any Government contract or the provisions of existing laws relating to espionage and the national security or the export of technical data Licensees should apprise themselves of current regulations especially with respect to certain countries of other agencies particularly the Office of Defense Trade Controls Department of State (with respect to Arms Munitions and Implements of War (22 CFR 121 128)) the Bureau of Industry and Security Department of Commerce (15 CFR parts 730 774) the Office of Foreign AssetsControl Department of Treasury (31 CFR Parts 500+) and the Department of Energy

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Electronic Acknowledgement Receipt	
EFS ID	14709341
Application Number	13442716
International Application Number	
Confirmation Number	6333
Title of Invention	APPARATUS AND METHODS FOR DETECTING A CONDUCTIVE OBJECT AT A LOCATION
First Named Inventor/Applicant Name	Jiang XIAOPING
Customer Number	60909
Filer	Larry Joel Johnson/Lauren Navarro
Filer Authorized By	Larry Joel Johnson
Attorney Docket Number	CD06039C2
Receipt Date	15 JAN 2013
Filing Date	09 APR 2012
Time Stamp	21 54 19
Application Type	Utility under 35 USC 111(a)

Payment information

Submitted with Payment	yes
Payment Type	Deposit Account
Payment was successfully received in RAM	$930
RAM confirmation Number	7335
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	Transmittal Letter	CD06039C2_TransmittalLetter_01152013 pdf	28720 b6 59d75718a8 063bf038970a9 7b29 90686	no	2
Warnings					
Information					
2	Information Disclosure Statement (IDS) Form (SB08)	CD06039C2_IDSform_01152013 pdf	611592 0686b 23 703d 009e69992 b5166 275 3 f69db	no	4
Warnings					
Information					
A U S Patent Number Citation or a U S Publication Number Citation is required in the Information Disclosure Statement (IDS) form for autoloading of data into USPTO systems You may remove the form to add the required data in order to correct the Informational Message if you are citing U S References If you chose not to include U S References the image of the form will be processed and be made available within the Image File Wrapper (IFW) system However no data will be extracted from this form Any additional data such as Foreign Patent Documents or Non Patent Literature will be manually reviewed and keyed into USPTO systems					
3	Request for Continued Examination (RCE)	CD06039C2_RCE_01152013 pdf	699509 29f11b53ed9d4 7 85dff1f76f81e6d7 035 6 e8	no	3
Warnings					
Information					
4	Non Patent Literature	CD06039_NonfinalOA_08052009 pdf	308482 814f6 5488 17934103dd877fd4783885 d fd	no	9
Warnings					
Information					
5	Fee Worksheet (SB06)	fee info pdf	30686 9f d53d42595876348412 2b5d1b5ff970ff79 ca7	no	2
Warnings					
Information					
		Total Files Size (in bytes):	1678989		

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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

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Applıcatıon of	Examıner KETEMA BENYAM
Jıang XIAOPING	Group Art Unıt 2696
Applıcatıon No 13/442 716	Confirmatıon No 6333
Fıled Aprıl 9, 2012	
Foı APPARATUS AND METHODS FOR DETECTING A CONDUCTIVE OBJECT AT A LOCATION	

REQUEST FOR CONTINUED EXAMINATION AND INFORMATION DISCLOSURE STATEMENT

Commıssıoner for Patents
P O Box 1450
Alexandrıa VA 22313-1450

Sır

Applıcant hereby submıts the Request for Contınued Examınatıon to be consıdered wıth the IDS for the above referenced applıcatıon In complıance wıth the duty of dısclosure under 37 CFR § 1 56 and ın accordance wıth the practıce under 37 CFR §§ 1 97 and 1 98 the Examıner's attentıon ıs dırected to the documents lısted on the enclosed PTO-1449

In accoıdance wıth 37 CFR § 1 97(h) thıs Informatıon Dısclosure Statement ıs not to be construed as an admıssıon that the ınformatıon cıted ıs or ıs consıdered to be materıal to patentabılıty as defined ın 37 CFR § 1 56(b), nor as an admıssıon that the ınformatıon constıtutes prıor art wıthın the meanıng of 35 USC §§ 102 and/or 103

It ıs respectfully requested that the ınformatıon lısted on the PTO 1449 be consıdered by the Examıner and that an ınıtıaled copy of the PTO 1449 be returned ındıcatıng that such ınformatıon was consıdered

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 01/15/2013

By /Larry J Johnson/

Larry J 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

Customer No 60909

INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1 99)		
	Application Number	13442716
	Filing Date	2012 04 09
	First Named Inventor	XiaoPing Jiang
	Art Unit	2696
	Examiner Name	KETEMA BENYAM
	Attorney Docket Number	CD06039C2

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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INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1 99)	Application Number	13442716
	Filing Date	2012 04 09
	First Named Inventor	XiaoPing Jiang
	Art Unit	2696
	Examiner Name	KETEMA BENYAM
	Attorney Docket Number	CD06039C2

	1	USPTO Non Final Rejection for Application Number 11/437 517 (CD06039) dated 08/05/2009 9 pages	☐

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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	13442716
	Filing Date	2012 04 09
	First Named Inventor	XiaoPing Jiang
	Art Unit	2696
	Examiner Name	KETEMA BENYAM
	Attorney Docket Number	CD06039C2

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 J Johnson/	Date (YYYY-MM-DD)	2013 01 15
Name/Print	Larry J 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

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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

Doc code IDS
Doc description Information Disclosure Statement (IDS) Filed

PTO/SB/08a (01 10)
Approved for use through 07/31/2012 OMB 0651-0031
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INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1 99)		
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	Examiner Name	KETEMA BENYAM
	Attorney Docket Number	CD06039C2

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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 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
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Examiner Initial*	Cite No	Foreign Document Number[3]	Country Code[2]	Kind Code[4]	Publication Date	Name of Patentee or Applicant of cited Document	Pages Columns Lines where Relevant Passages or Relevant Figures Appear	T[5]
	1							☐

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NON PATENT LITERATURE DOCUMENTS — Remove

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	T[5]

INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1 99)		
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	1	USPTO Non Final Rejection for Application Number 11/437 517 (CD06039) dated 08/05/2009 9 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

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UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
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Alexandria, Virginia 22313 1450
www pt g

APPLICATION NO	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO	CONFIRMATION NO
11/437 517	05/18/2006	Jiang XiaoPing	CD06039	2623

60909 7590 08/05/2009
CYPRESS SEMICONDUCTOR CORPORATION
198 CHAMPION COURT
SAN JOSE CA 95134 1709

EXAMINER	
KETEMA BENYAM	

ART UNIT	PAPER NUMBER
2629	

MAIL DATE	DELIVERY MODE
08/05/2009	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

Office Action Summary	Application No	Applicant(s)
	11/437 517	XIAOPING JIANG
	Examiner	Art Unit
	BENYAM KETEMA	2629

-- 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 18 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 20 is/are pending in the application

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

5)☐ Claim(s) 5 17 is/are allowed

6)☒ Claim(s) 1 4, 18 20 is/are rejected

7)☐ Claim(s) _____ 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 18 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 05/18/2006, 08/14/2006

4) ☐ Interview Summary (PTO-413)
Paper No(s)/Mail Date _____

5) ☐ Notice of Informal Patent Application

6) ☐ Other _____

DETAILED ACTION

1 Claims 1-20 are presented for examination

Information Disclosure Statement

2 The information disclosure statement (IDS) submitted on 05/18/2006 and 08/14/2006 has been considered by the examiner

Claim Rejections - 35 USC § 102

3 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 –
>
> (b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country more than one year prior to the date of application for patent in the United States

4 Claims 1, 2 4 and 18 are rejected under 35 U S C 102(b) as being anticipated by Tsujioka et al (US Pat NO 5 518,078)

As in Claim 1, Tsujioka et al discloses *a method* (Column 1 line 5-10), *comprising*

- *detecting a presence of a conductive object on a sensing device,* (Column 9 line 65- Column 10 line 4)

- *recognizing three or more button* (Fig 5 item 49, buttons) *operations performed by the conductive object* (Fig 5 item 50 & 51 finger or pen) *using two sensing areas of the sensing device* (Fig 5 & 6 item 24 & 25, two sensing areas)

As in Claim 2, Tsujioka et al discloses *the method* (Column 1 line 5-10) *of claim 1, wherein recognizing three or more button operations* (Column 9 line 65- Column 10 line 6 and fig 5-8) *comprises recognizing on a first sensing area of the two sensing areas of the sensing device,* (Fig 5 and Column 9 line 65- Column 10 line 4) *recognizing a second button operation when the presence of the conductive object is detected on a second sensing area of the two sensing areas of the sensing device,* (Fig 5 and Column 9 line 65- Column 10 line 4) *recognizing one or more button operations when the presence of the conductive object is detected on the first and second sensing areas* (Fig 5)

As in Claim 4, Tsujioka et al discloses *the method* (Column 1 line 5-10) *of claim 1, further comprising scanning the two sensing areas of the sensing device* (Column 9 line 58 -61) *wherein recognizing the three or more button operations comprises recognizing a first button operation when a first sensing area of the two sensing areas detects the presence of the conductive object during the scanning of the two sensing areas,* (Fig 5 7 and 9 and Column 9 line 54- Column 10 line 6) *recognizing a second button operation when a second sensing area of the two sensing areas detects the presence of the conductive object during the scanning of the two sensing areas* (Fig 5 7 and 9 and

Column 9 line 54 Column 10 line 6) *recognizing a third button operation when the first and second sensing areas detect the presence of the conductive object during the scanning of the two sensing areas* (Fig 5 7 and 9 and Column 9 line 54- Column 10 line 6) discloses scanning the sensing areas (i e 24 & 25) and recognizing multiple button (i e 36, 39-42) operation for conductive objects (i e finger or pen)

As in Claim 18, Tsujioka et al discloses *an apparatus* (Column 1 touch panel), *comprising*

- *a first sensing area to detect a presence of a conductive object on a sensing device,* (Fig 9 item 25)
- *a second sensing area to detect the presence of the conductive object on the sensing device,* (Fig 9 item 24)
- *means for recognizing three or more button operations* (Fig 9 item 39-42) *performed by the conductive object* (Fig 5 item 51 or 50 finger or pen) *using two sensing areas on the sensing device* (Fig 9 item 24 & 25 two sensing areas)

Claim Rejections - 35 USC § 103

5 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

6 The factual inquiries set forth in *Graham* v *John Deere Co* , 383 U S 1, 148 USPQ 459 (1966) that are applied for establishing a background for determining obviousness under 35 U S C 103(a) are summarized as follows

1 Determining the scope and contents of the prior art
2 Ascertaining the differences between the prior art and the claims at issue
3 Resolving the level of ordinary skill in the pertinent art
4 Considering objective evidence present in the application indicating obviousness or nonobviousness

7 Claim 3 is rejected under 35 U S C 103(a) as being unpatentable over Tsujioka et al (US Pat NO 5 518,078) In view of Collins (PG Pub NO 2004/0239616)

As in Claim 3, Tsujioka et al discloses *the method* (Column 1 line 5-10) *of claim 1* but fails to disclose *determining a capacitance of the conductive object on the sensing device over time wherein determining the capacitance further comprises determining a capacitance of the two sensing areas of the sensing device, and wherein recognizing the button operation is based on the capacitance of the two sensing areas* However Collins discloses *determining a capacitance of the conductive object on the sensing device over time* (Paragraph 24 and Fig 2-3) *wherein determining the capacitance further comprises determining a capacitance of the two sensing areas of the sensing device* (Fig 3 item 200-1 & 200-3) *and wherein recognizing the button operation is based on the capacitance of the two sensing areas* (Paragraph 24-28 and Fig 3) discloses operation of buttons is recognized according to a signal produced (i e capacitance) when the user finger is in contact with sensing area

Tsujioka et al and Collins are analogous art because they are from the common area of user input device using touch sensor Tsujioka et al discloses an input device that has multiple sensing areas as well as buttons But fails to disclose capacitance sensor, However Collins discloses that capacitance sensors are used to determine the presence of conductive object (i e finger) on the sensing area in a system similar to that of Tsujioka et al Therefore it would have been obvious to one of ordinary skill in the art at the time of the invention to combine Tsujioka et al s sensing area to include Collins s capacitance sensor because using capacitance sensor or any other form of sensor in touch panel device would be an alternate design choose

8 Claims 19 and 20 are rejected under 35 U S C 103(a) as being unpatentable over Tsujioka et al (US Pat NO 5 518 078) In view of Gitzinger et al (PG Pub NO 2006/0097992)

As in Claim 19, Tsujioka et al discloses *the apparatus* (Column 1, touch panel), but fails to disclose *means for reducing a pin count of the sensing device* However Gitzinger et al discloses *means for reducing a pin count of the sensing device* (Fig 3 and Paragraph 29-32) discloses the reduction of pins by coupling the discrete surfaces (i e sensing area, 320, 322, 324) together and connecting them to the controller

As in Claim 20, Tsujioka et al discloses *the apparatus* (Column 1 touch panel) but fails to disclose *means for reducing scan time of the sensing device* However Gitzinger et al discloses *means for reducing scan time of the sensing device* (fig 3) discloses the sensing areas are coupled together and connected to the controller rather than being connected individually therefore it would be obvious to a skilled person that by reducing the number of connection between the sensing area and controller the scan time would be increased (faster)

Tsujioka et al and Gitzinger et al are analogous art because they are from the common area of user input device using touch sensor Tsujioka et al discloses an input device that has multiple sensing areas as well as buttons But fails to disclose reduction of connecter pins as well as the effect of scanning time when the numbers of pins are reduced, However Gitzinger et al discloses in Fig 3 the number of pins have been reduced in a system similar to that of Tsujioka et al Therefore it would have been obvious to one of ordinary skill in the art at the time of the invention to combine Tsujioka et al s sensing area to include Gitzinger et al s arrangement of reduced number of pins in order to reduced coast and material in the manufacturing of said device

Allowable Subject Matter

9 Claims 5-17 are allowable over the prior art of record

10 Any inquiry concerning this communication or earlier communications from the examiner should be directed to BENYAM KETEMA whose telephone number is (571)270-7224 The examiner can normally be reached on Monday- Friday 8 00AM - 5 00PM

If attempts to reach the examiner by telephone are unsuccessful the examiner s supervisor Shalwala Bipin H can be reached on (571)-272-7681 The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300 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 Should you have questions on access to the Private PAIR system contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free) If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571 272-1000

/ B K /

Examiner, Art Unit 2629

/Bipin Shalwala/

Supervisory Patent Examiner, Art Unit 2629

INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1 99)		
	Application Number	13442716
	Filing Date	2012 04 09
	First Named Inventor	XiaoPing Jiang
	Art Unit	2696
	Examiner Name	KETEMA BENYAM
	Attorney Docket Number	CD06039C2

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 J Johnson/	Date (YYYY-MM-DD)	2013 01 15
Name/Print	Larry J 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

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	13/442 716	Filing Date	2012 04 09	Docket Number (if applicable)	CD06039C2	Art Unit	2696
First Named Inventor	Jiang XIAOPING			Examiner Name	KETEMA BENYAM		

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

Doc code RCEX
Doc description Request for Continued Examination (RCE)

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

Signature of Registered U S Patent Practitioner			
Signature	/Larry J Johnson/	Date (YYYY-MM-DD)	2013 01 15
Name	Larry J Johnson	Registration Number	56861

This collection of information is required by 37 CFR 1 114 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 11 and 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

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

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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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

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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	13442716
Filing Date	09 Apr 2012
Title of Invention	APPARATUS AND METHODS FOR DETECTING A CONDUCTIVE OBJECT AT A I OCATION
First Named Inventor/Applicant Name	Jiang XIAOPING
Filer	Larry Joel Johnson/Lauren Navarro
Attorney Docket Number	CD06039C2
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($)
Miscellaneous				
Request for continued examination	1801	1	930	930
		Total in USD ($)		**930**

Transaction History Date 2013-04-22
Date information retrieved from USPTO Patent Application Information Retrieval (PAIR) system records at www uspto gov

Notice of Allowability	Application No 13/442 716	Applicant(s) XIAOPING JIANG	
	Examiner BENYAM KETEMA	Art Unit 2696	AIA (First Inventor to File) Status No

-- 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 *01/15/2013*

☐ A declaration(s)/affidavit(s) under **37 CFR 1 130(b)** was/were filed on______

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 *21 40* As a result of the allowed claim(s) you may be eligible to benefit from the **Patent Prosecution Highway** program at a participating intellectual property office for the corresponding application For more information please see http www uspto gov/patents init events/pph index jsp or send an inquiry to PPHfeedback@uspto gov

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

Certified copies

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 _____

Interim copies

a) ☐ All b) ☐ Some c) ☐ None of the Interim copies of the priority documents have been 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 ☐ CORRECTED DRAWINGS (as replacement sheets) must be submitted

☐ 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 ☒ Information Disclosure Statements (PTO/SB/08) Paper No /Mail Date _____
3 ☐ Examiner s Comment Regarding Requirement for Deposit of Biological Material
4 ☐ Interview Summary (PTO 413) Paper No /Mail Date _____
5 ☐ Examiner s Amendment/Comment
6 ☒ Examiner s Statement of Reasons for Allowance
7 ☐ Other _____

/B K/ Examiner Art Unit 2696	/Bipin Shalwala/ Supervisory Patent Examiner Art Unit 2696

DETAILED ACTION

1 Claims 21 40 are presented for examination and are allowed

Information Disclosure Statement

2 The information disclosure statement (IDS) submitted on 01/15/2013 was filed after the mailing date of the Notice of Allowance on 12/21/2012 The submission is in compliance with the provisions of 37 CFR 1 97 Accordingly, the information disclosure statement is being considered by the examiner

Terminal Disclaimer

3 The terminal disclaimer filed on November 16, 2012 disclaiming the terminal portion of any patent granted on this application which would extend beyond the expiration date of prior patent No 8,004,497 has been reviewed and is accepted The terminal disclaimer has been recorded

Specification

4 The substitute specification filed November 16, 2012 has been reviewed and entered

Examiner s Statement of Reasons for Allowance

5 The following is an examiner s statement of reasons for allowance The prior art of record fails to disclose the claimed invention **The features of independent claims** directed towards allowable subject matter is *determining capacitance variations of a first number of two or more sense elements of a touch screen device using a processing device to detect a presence of a conductive object on anyone of a second number of three or more button areas of the touch screen device, wherein the first number of sense elements is less than the second number of button areas and recognizing an activation of one of the three or more button areas using the determined capacitance variations of the first number of two or more sense elements"* **Tsujioka et al (US Pat NO 5,518,078)** discloses that the presence of users finger (i e conductive object) is detected by sensing device (col 9- 10), the sensing device comprising at least two sensing areas each coupled to a capacitance measurement input (fig 5 & 6) wherein the user can perform multiple input operation using his/her finger or pen as it is clearly shown in fig 5 in order to perform an input operation But Tsujioka et al fails to disclose the first number of sense elements is less than the second number of button areas, and recognizing an activation of one of the three or more button areas using the determined capacitance variations of the first number of two or more sense elements

Therefore these features in combination with the remaining language of the claims are not taught by the prior arts of record Therefore claims 21- 40 are found to be allowable over the prior art of record

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

6 Any inquiry concerning this communication or earlier communications from the examiner should be directed to BENYAM KETEMA whose telephone number is (571)270-7224 The examiner can normally be reached on Monday- Friday 8 00AM - 5 00PM

If attempts to reach the examiner by telephone are unsuccessful, the examiner s supervisor, Shalwala Bipin H can be reached on 571 272-7681 The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300 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 Should you have questions on access to the Private PAIR system contact the Electronic Business Center (EBC) at 866-217-9197 (toll free) If you would like assistance from a USPTO Customer Service Representative or access to the automated information system call 800-786-9199 (IN USA OR CANADA) or 571-272 1000

/B K /

Examiner, Art Unit 2696

/Bipin Shalwala/

Supervisory Patent Examiner, Art Unit 2696

Notice of References Cited	Application/Control No 13/442 716	Applicant(s)/Patent Under Reexamination XIAOPING JIANG	
	Examiner BENYAM KETEMA	Art Unit 2696	Page 1 of 1

U S PATENT DOCUMENTS

*		Document Number Country Code Number Kind Code	Date MM YYYY	Name	Classification
*	A	US 2006/0227117	10 2006	Proctor David W	345/173
*	B	US 2007/0268265	11 2007	XiaoPing Jiang	345/173
*	C	US 2008/0278178	11 2008	Philipp Harald	324/662
*	D	US 2007/0291013	12 2007	WON Jong Sung	345/173
*	E	US 5 518 078	05 1996	Tsujioka et al	178/18 05
*	F	US 7 158 125	01 2007	Sinclair et al	345/173
*	G	US 7 466 307	12 2008	Trent et al	345/173
*	H	US 2009/0128374	05 2009	REYNOLDS et al	341/33
	I	US			
	J	US			
	K	US			
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*		Document Number Country Code Number Kind Code	Date MM YYYY	Country	Name	Classification
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	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

INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1 99)		
	Application Number	13442716
	Filing Date	2012 04 09
	First Named Inventor	XiaoPing Jiang
	Art Unit	2696
	Examiner Name	KETEMA BENYAM
	Attorney Docket Number	CD06039C2

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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

 ALL REFERENCES CONSIDERED EXCEPT WHERE LINED THROUGH /B K /

INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1 99)	Application Number	13442716
	Filing Date	2012 04 09
	First Named Inventor	XiaoPing Jiang
	Art Unit	2696
	Examiner Name	KETEMA BENYAM
	Attorney Docket Number	CD06039C2

	1	USPTO Non Final Rejection for Application Number 11/437 517 (CD06039) dated 08/05/2009 9 pages	☐

If you wish to add additional non-patent literature document citation information please click the Add button Add

EXAMINER SIGNATURE

Examiner Signature	/Benyam Ketema/ (04/05/2013)	Date Considered	04/05/2013

*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

 ALL REFERENCES CONSIDERED EXCEPT WHERE LINED THROUGH /B K /

INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1 99)	Application Number	13442716
	Filing Date	2012 04 09
	First Named Inventor	XiaoPing Jiang
	Art Unit	2696
	Examiner Name	KETEMA BENYAM
	Attorney Docket Number	CD06039C2

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 J Johnson/	Date (YYYY MM-DD)	2013 01 15
Name/Print	Larry J Johnson	Registration Number	56861

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Privacy Act Statement

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

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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

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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

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NOTICE OF ALLOWANCE AND FEE(S) DUE

60909 7590 04/22/2013
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SAN JOSE CA 95134 1709

EXAMINER	
KETEMA BENYAM	
ART UNIT	PAPER NUMBER
2696	

DATE MAILED 04/22/2013

APPLICATION NO	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO	CONFIRMATION NO
13/442 716	04/09/2012	Jiang XIAOPING	CD06039C2	6333

TITLE OF INVENTION APPARATUS AND METHODS FOR DETECTING A CONDUCTIVE OBJECT AT A LOCATION

APPLN TYPE	ENTITY STATUS	ISSUE FEE DUE	PUBLICATION FEE DUE	PREV PAID ISSUE FEE	TOTAL FEE(S) DUE	DATE DUE
nonprovisional	UNDISCOUNTED	$1780	$0	$0	$1780	07/22/2013

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

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If the ENTITY STATUS is the same as shown above pay the TOTAL FEE(S) DUE shown above

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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

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APPLICATION NO	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO	CONFIRMATION NO
13/442 716	04/09/2012	Jiang XIAOPING	CD06039C2	6333

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nonprovisional	UNDISCOUNTED	$1780	$0	$0	$1780	07/22/2013

EXAMINER	ART UNIT	CLASS SUBCLASS
KETEMA BENYAM	2696	345 173000

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 ____________

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- ☐ 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)

PTOL 85 (Rev 02/11)

CY00002176

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

☐ Applicant certifying micro entity status See 37 CFR 1 29	NOTE Absent a valid certification of Micro Entity Status (see form PTO/SB/15A and 15B) issue fee payment in the micro entity amount will not be accepted at the risk of application abandonment
☐ Applicant asserting small entity status See 37 CFR 1 27	NOTE If the application was previously under micro entity status checking this box will be taken to be a notification of loss of entitlement to micro entity status
☐ Applicant changing to regular undiscounted fee status	NOTE Checking this box will be taken to be a notification of loss of entitlement to small or micro entity status as applicable

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 ______________________

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

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APPLICATION NO	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO	CONFIRMATION NO
13/442 716	04/09/2012	Jiang XIAOPING	CD06039C2	6333

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EXAMINER	
KETEMA BENYAM	
ART UNIT	PAPER NUMBER
2696	

DATE MAILED 04/22/2013

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 0 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 0 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

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Privacy Act Statement

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Electronic Acknowledgement Receipt	
EFS ID	15810601
Application Number	13442716
International Application Number	
Confirmation Number	6333
Title of Invention	APPARATUS AND METHODS FOR DETECTING A CONDUCTIVE OBJECT AT A LOCATION
First Named Inventor/Applicant Name	Jiang XIAOPING
Customer Number	60909
Filer	Andrew J Bateman/Adnan Fazlic
Filer Authorized By	Andrew J Bateman
Attorney Docket Number	CD06039C2
Receipt Date	17 MAY 2013
Filing Date	09 APR 2012
Time Stamp	18 12 09
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	Transmittal Letter	CD06039C2_TransmittalLetter_05172013 pdf	19106 241f 5d1 6b d4345b 735d935543bd2939 56 73	no	2

Warnings

Information

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2	Request for Continued Examination (RCE)	CD06039C2_RCE_05172013 pdf	700077 32d3 f 2f93f9227d 1bf a458f57 2dcb80 89e	no	3
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48	Non Patent Literature	CD05044_NOA_11062008 pdf	318001 3 1b498c875616f 8cb6fba4005d0 540c02 497	no	7
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49	Non Patent Literature	CD06039_NOA_02032011 pdf	428050 e4a4bf 30b0357 7b 62b755d353 62b3 d f 6b	no	10
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50	Non Patent Literature	CD06039_NOA_05192011 pdf	446302 6bd4e9 cf 98c d9c 7 01b21d4149b16fa eb0	no	9
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51	Non Patent Literature	CD06039_NOA_06162011 pdf	433334 76b 1f679f11b5b87f971f03bd26d 2bca 93d3	no	9
Warnings					
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52	Non Patent Literature	CD06043_NOA_06102010 pdf	253635 7e6bdd90f 9bb3028e641108110a1bfd66 9456f	no	4
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53	Non Patent Literature	CD06099_NOA_04092007 pdf	332935 4a4563697c82566f9 d54b0e966f bd6 4 e4	no	7
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		Total Files Size (in bytes):	19290990		

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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

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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

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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

Electronic Acknowledgement Receipt

EFS ID	15810766
Application Number	13442716
International Application Number	
Confirmation Number	6333
Title of Invention	APPARATUS AND METHODS FOR DETECTING A CONDUCTIVE OBJECT AT A LOCATION
First Named Inventor/Applicant Name	Jiang XIAOPING
Customer Number	60909
Filer	Andrew J Bateman/Adnan Fazlic
Filer Authorized By	Andrew J Bateman
Attorney Docket Number	CD06039C2
Receipt Date	17 MAY 2013
Filing Date	09 APR 2012
Time Stamp	18 28 18
Application Type	Utility under 35 USC 111(a)

Payment information

Submitted with Payment	yes
Payment Type	Deposit Account
Payment was successfully received in RAM	$1700
RAM confirmation Number	5583
Deposit Account	503781
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The Director of the USPTO is hereby authorized to charge indicated fees and credit any overpayment as follows

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File Listing

Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part / zip	Pages (if appl)
1	Non Patent Literature	CD06099_NOA_05242007 pdf	80345 014b 462330d f7 2 38b4b2bd8 70d63e d9 07	no	2
Warnings					
Information					
2	Non Patent Literature	CD06138_NOA_07272010 pdf	307703 cac8310e7171f78b2 54 7ca 7564dfd7ffc ca7	no	6
Warnings					
Information					
3	Non Patent Literature	CD06163_NOA_09162010 pdf	354858 0f79cf4d9d5db41c97 564b f 24041b 3 f6	no	8
Warnings					
Information					
4	Non Patent Literature	CD05044D1_NOA_08232010 pdf	336721 fbf280829f7884443e61f7 403db 007f4 4 d3f	no	7
Warnings					
Information					
5	Non Patent Literature	IBMPCKeyboardWikipedia pdf	187244 9c5b 9b 098f048 4363913b2752bb71 5 f5 59	no	3
Warnings					
Information					
6	Fee Worksheet (SB06)	fee info pdf	30582 d8710b7d c090b70 f3f16084991 8b3 d2 0 85	no	2
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New International Application Filed with the USPTO as a Receiving Office
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IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Application of	Examiner KETEMA BENYAM
Jiang Xiaoping	Group Art Unit 2696
Application No 13/442 716	Confirmation No 6333
Filed April 9th 2012	
For Apparatus and Methods For Detecting A Conductive Object At A Location	

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 05/17/2013

By /Larry J Johnson/

Larry J 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

Customer No 60909

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

Application Number	13/442 716	Filing Date	2012 04 09	Docket Number (if applicable)	CD06039C2	Art Unit	2696
First Named Inventor	Jiang XiaoPing			Examiner Name	KETEMA BENYAM		

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

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Approved for use through 07/31/2012 OMB 0651 0031
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Signature of Registered U S Patent Practitioner			
Signature	/Larry J Johnson/	Date (YYYY-MM-DD)	2013 05 17
Name	Larry J Johnson	Registration Number	56861

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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

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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

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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

Doc code IDS
Doc description Information Disclosure Statement (IDS) Filed

INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1 99)		
	Application Number	13442716
	Filing Date	2012 04 09
	First Named Inventor	XiaoPing Jiang
	Art Unit	2629
	Examiner Name	
	Attorney Docket Number	CD06039C2

U S PATENTS Remove

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	6353200	B1	2002 03 05	Schwankhart Gerhard	Entire Document
	2	3979745	A	1976 09 07	Bishop	Entire Document
	3	4039940	A	1977 08 02	Butler et al	Entire Document
	4	4113378	A	1978 09 12	Wirtz John	Entire Document
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INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1 99)	Application Number	13442716
	Filing Date	2012 04 09
	First Named Inventor	XiaoPing Jiang
	Art Unit	2629
	Examiner Name	
	Attorney Docket Number	CD06039C2

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INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1 99)	Application Number	13442716
	Filing Date	2012 04 09
	First Named Inventor	XiaoPing Jiang
	Art Unit	2629
	Examiner Name	
	Attorney Docket Number	CD06039C2

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INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1 99)		
	Application Number	13442716
	Filing Date	2012 04 09
	First Named Inventor	XiaoPing Jiang
	Art Unit	2629
	Examiner Name	
	Attorney Docket Number	CD06039C2

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INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1 99)	Application Number: 13442716
	Filing Date: 2012 04 09
	First Named Inventor: XiaoPing Jiang
	Art Unit: 2629
	Examiner Name:
	Attorney Docket Number: CD06039C2

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INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1 99)	Application Number	13442716
	Filing Date	2012 04 09
	First Named Inventor	XiaoPing Jiang
	Art Unit	2629
	Examiner Name	
	Attorney Docket Number	CD06039C2

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INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1 99)		
	Application Number	13442716
	Filing Date	2012 04 09
	First Named Inventor	XiaoPing Jiang
	Art Unit	2629
	Examiner Name	
	Attorney Docket Number	CD06039C2

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INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1 99)	Application Number: 13442716
	Filing Date: 2012 04 09
	First Named Inventor: XiaoPing Jiang
	Art Unit: 2629
	Examiner Name:
	Attorney Docket Number: CD06039C2

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INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1 99)	Application Number: 13442716 Filing Date: 2012 04 09 First Named Inventor: XiaoPing Jiang Art Unit: 2629 Examiner Name: Attorney Docket Number: CD06039C2

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	Filing Date	2012 04 09
	First Named Inventor	XiaoPing Jiang
	Art Unit	2629
	Examiner Name	
	Attorney Docket Number	CD06039C2

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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	20030091220	A	2003 05 15	Sato et al	Entire Document

INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1 99)	Application Number		13442716
	Filing Date		2012 04 09
	First Named Inventor	XiaoPing Jiang	
	Art Unit		2629
	Examiner Name		
	Attorney Docket Number		CD06039C2

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INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1 99)	Application Number		13442716
	Filing Date		2012 04 09
	First Named Inventor	XiaoPing Jiang	
	Art Unit		2629
	Examiner Name		
	Attorney Docket Number		CD06039C2

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INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1 99)	Application Number	13442716
	Filing Date	2012 04 09
	First Named Inventor	XiaoPing Jiang
	Art Unit	2629
	Examiner Name	
	Attorney Docket Number	CD06039C2

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	1	0574213	EP	A	1993 12 15	Miller et al	Entire Document	☐
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	2	Application Number 11/493 350 (CD06097) Technique for Increasing the Sensitivity of Capacitive Sensor Arrays Lee et al filed on 07/25/2006 48 pages	☐
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	4	The Authoritative Dictionary of IEEE Standards Terms 2000 IEEE Press Publications 7th Edition pp 1133 1134 4 pages	☐
	5	USPTO Advisory Action for Application Number 11/230 719 (CD05060) dated 11/30/2007 3 pages	☐
	6	USPTO Advisory Action for Application Number 11/395 417 (CD05044) dated 07/06/2007 3 pages	☐
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	8	USPTO Advisory Action for Application Number 11/477 179 (CD06065) dated 06/07/2010 3 pages	☐
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Name/Print	Larry Johnson	Registration Number	56861

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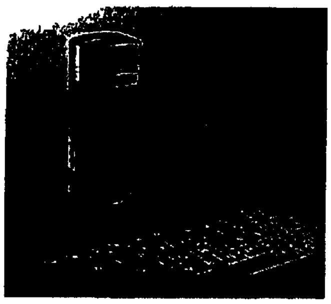

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I-Tech Bluetooth/Serial Virtual Laser Keyboard available now!

The Virtual Keyboard (VKB) How does it work?

You can use the VKB (Virtual PC Keyboard) with both your laptop and PC and with a compatible mobile device compatible Smartphone and PDA

The virtual laser keyboard (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 complete with realistic tapping sounds(!), which feeds into the compatible PDA Smartphone laptop or PC

The VKB Virtual Keyboard has a wide range of applications.

- Personal digital assistants
- Cellular telephones
- Space saving computers
- Tablet PCs
- Laptops
- Industrial environments
- Clean rooms
- Sterile and medical environments
- Test Equipment
- Transport (Air Rail Automotive)

Roughly the size of a disposable lighter, (90 x 34 x 24 mm) the VKB enables users to type email or long text as easily as with a conventional keyboard Imagine how much easier it would be if you had a proper mobile phone keyboard that fits in your pocket.

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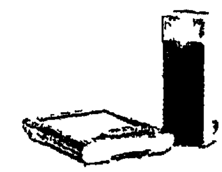

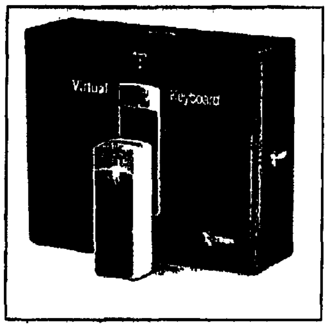

The VKB works either with your laptop, your PC or your compatible Smartphone and PDA

Virtual PC Keyboard (VKB) Settings

Using the VKB, the following settings can be controlled either via your laptop your PC or your compatible Smartphone and PDA

Sound Users can control the virtual keyboard sound effects (keyclicks)
Intensity Control the intensity of the projected virtual keyboard
Connection Connection to the appropriate Laptop/PC port
Sensitivity Users can adjust the sensitivity of the virtual keyboard
Timeouts Adjustable timeouts to conserve the virtual keyboard s battery life
Auto repeat. Allows the VKB to automatically repeat a key based on prescribed parameters

The Virtual Keyboard uses light to project a full sized computer keyboard onto almost any surface Used with Smart Phones and PDA s the VKB provides a practical way to do email, word processing and spreadsheet tasks allowing the user to leave the laptop computer at home VKB observes the user s finger movements to interpret and record keystrokes Since the virtual keyboard is an image projected in light it completely disappears when not in use

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Independent Reviews of the VKB:

www mobilitytoday.com
www trustedreviews.com
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Virtual Keyboard Supported Models:

Device Compatibility for VKB usage	Operating System
O2 XDA I O2 XDA II Orange SPV e200 Palm Tungsten T3 QTek 8080 Smartphone Palm m505 HP2210 HP3417 HP rx3715 (Use HP 5550 Driver) HP 3800/3900 Series (Use HP 5455 Driver) HP5455 HP5550	Pocket PC 2003 Smartphone 2003 Palm OS5 X Palm OS4 X Win XP 2000, NT, 98

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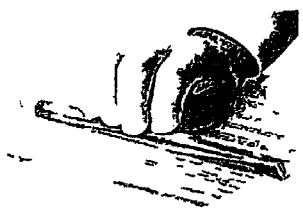
Laptops / Desktops via serial connector	

Virtual Keyboard BlueTooth Supported Models:

Device Compatibility for VKB usage	Operating System
SmartPhones **Blackberry** 7100g 7100t 7100i 7130e 7250 7250 7290 7290 7520 8700c 8700r HP 6300 Series HP 6500 Series Dopod 535 /Qtek 8080 / SPV E200 / Xphone Audiovox xv6600 / PPC6601 / Harrier Dopod 565 / i mate SP3 / Qtek 8010 / SPV C500 Dopod 576 / i mate SP3i / Qtek 8020 / SDA / Xphone II Dopod 585 / Qtek 8100 / SDA Music / Xphone IIm Dopod 699 / M2500 / Qtek 2020i / XDAIIi Dopod 700 / I mate PDA2K / MDAIII / Qtek 9090 / VPAIII / XDAIIs Dopod 818 / i mate Jam / M500 / MDA Compact / Qtek S100 / XDA Mini M2000 / MDA II / Qtek 2020 / XDA II I mate JasJar/sp3 Motorola A1000 Motorola MPx220 Nokia 3650 Nokia 6600 Nokia 6260 Nokia 6630 Nokia 6680 Nokia N70 Nokia 7650 Palm Treo 650 Samsung i730 Sony Ericsson P800 Sony Ericsson P900 Sony Ericsson P910i XPlore M68 **PDAs** Acer N50 Asus MyPal A716 Dell Axim 50/X50V HP iPAQ H1940 HP iPAQ H2210 HP iPAQ H2700 HP iPAQ rx 3417 HP iPAQ rx3715 HP iPAQ 4700 HP iPAQ H5550 MIO 336 BT Palm Tungsten T3 Palm Tungsten T5 Palm Zire 72 Palm TX Palm Life Drive Laptops and Desktops	Pocket PC 2003 Smartphone 2003 Palm OS5 X Win XP, 2000 Mac

Israel Flower | HandHeld Scanner | Spo2 | Pc NoteTaker | VKB

2P Gadget Ring

Previous		**Docupen** The DocuPen RC800 is the smallest handheld portable documents scanner in the world!	Next

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Attorney Docket No 16820P472
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APPLICATION FOR UNITED STATES LETTERS PATENT

FOR

TECHNIQUE FOR INCREASING THE SENSITIVITY OF CAPACITIVE SENSOR ARRAYS

INVENTOR(S) **MARK R LEE**
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PREPARED BY

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TECHNIQUE FOR INCREASING THE SENSITIVITY OF CAPACITIVE SENSOR ARRAYS

TECHNICAL FIELD

[0001] This disclosure relates generally to user interface devices, and in particular but not exclusively, relates to capacitive sense user interface devices

BACKGROUND INFORMATION

[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 devices ("HID") One type of user interface device that has become more common is a capacitive sense interface This technology is often referred to as capacitive touch-sense technology, however, this term is a misguided term since the user need not actually physically touch the interface to operate the technology Rather, the user need only bring a conductive object (e g , a finger) in close proximity to the capacitive sense interface

[0003] Capacitive sense interfaces may assume a variety of shapes and sizes FIG 1A illustrates a conventional circular slider interface 105 having a center mechanical button 110 The illustrated circular slider interface 105 includes eight radial capacitive sensors 115 encircling mechanical button 110 and a processing device 120 Processing device 120 monitors capacitive changes in each of capacitive sensors 115 to register user interactions with circular slider interface 105 Circular sliders may be used to convey absolute positional information of a conductive object, such as to emulate a mouse in controlling cursor positioning on a display, or to emulate a scrolling function of the mouse, but may also be used to actuate one or more functions associated with the sensing elements of the sensing device

[0004] FIG 1B illustrates a conventional linear slider interface 130 Linear slider interface 130 includes a surface area on which a conductive object may be used to position a cursor in the x- axis (or alternatively in the y axis) Linear slider interface 130 may include a one-dimensional array of capacitance sensors 135 When making contact or coming in proximity with a particular portion of linear slider interface 100, the individual capacitive sensors 135 will sense capacitive variations that are translated into absolute or relative user interaction position The capacitance variation may be sent as a signal to a coupled processing device (not illustrated) for analysis For example, by detecting the capacitance variation of each sensor element, the position of the changing capacitance can be pinpointed In other words, it can be determined which sensor element has detected the presence of the conductive object, and it can also be determined the motion and/or the position of the conductive object over multiple sensor elements

[0005] FIG 1C illustrates a conventional touch pad interface 140 Touchpad interface 140 is often used in notebooks to emulate the function of a personal computer ("PC ') mouse A touch-sensor pad is typically embedded into a PC notebook for built in portability Touch pad interface 140 can replicate mouse x/y movement by using two defined axes which contain a collection of sensor elements that detect the position of a conductive object, such as a finger Mouse right/left button clicks can be replicated by two mechanical buttons, located in the vicinity of the touchpad, or by tapping commands on touch pad interface 140 itself Touch pad interface 140 provides a user interface device for performing such functions as positioning a cursor, or selecting an item on a display Touch pad interface 140 may include multi-dimensional sensor arrays for detecting movement in multiple axes For example, touch pad interface 140 may be implemented as a two-dimensional array of linear sliders

[0006] As consumer electronic devices continue to shrink so to do their user interfaces A smaller capacitive sense user interface typically means smaller individual capacitive sensors within the user interface Shrinking the size of a capacitive sensor adversely affects its sensitivity, resulting in a detrimental effect on the user experience Decreased sensitivity due to shrinking sensor size can be partially compensated by increasing the sampling time of a particular capacitive sensor However, increasing the sampling time for each capacitive sensor within an array of capacitive sensors reduces the response time of the user interface—once again with detrimental effects on the user experience

[0007] As capacitive sense technology is introduced into other more durable consumer products, such as white goods (e g , kitchen appliances), the overlay material that protects the capacitive sensors must typically be thicker and more durable to protect the underlying electronics from harsher environments The thicker dielectric materials also adversely impact the sensitivity of capacitive sense user interfaces

BRIEF DESCRIPTION OF THE DRAWINGS

[0008] Non limiting and non-exhaustive embodiments of the invention are described with reference to the following figures, wherein like reference numerals refer to like parts throughout the various views unless otherwise specified

[0009] FIG 1A illustrates a conventional circular slider interface having a center mechanical button

[0010] FIG 1B illustrates a conventional linear slider interface

[0011] FIG 1C illustrates a conventional touch pad interface

[0012] FIG 2 illustrates a user finger interacting with a capacitance sensor, in accordance with an embodiment of the invention

[0013] FIG 3 is a diagram illustrating a capacitive sense interface including a circular slider array, in accordance with an embodiment of the invention

[0014] FIG 4 is a diagram illustrating a capacitive sense interface including a linear slider array, in accordance with an embodiment of the invention

[0015] FIG 5 is a flow chart illustrating a process to group scan a capacitive sense interface, in accordance with an embodiment of the invention

[0016] FIG 6A is a diagram illustrating a group scan of a circular slider array, in accordance with an embodiment of the invention

[0017] FIG 6B is a diagram illustrating a group scan of a linear slider array, in accordance with an embodiment of the invention

[0018] FIG 7 is a flow chart illustrating a process to perform quick discrete scans of a capacitive sense user interface until a user interaction is sensed and then perform a group scan to more precisely interpolate the location of the user interaction, in accordance with an embodiment of the invention

[0019] FIG 8 is a functional block diagram illustrating a demonstrative processing system for implementing a capacitance sense user interface, in accordance with an embodiment of the invention

[0020] FIG 9 is a circuit diagram illustrating a demonstrative capacitance sensor, in accordance with an embodiment of the invention

DETAILED DESCRIPTION

[0021] Embodiments of a method, apparatus, and system for implementing a capacitive sense user interface are described herein In the following description numerous specific details are set forth to provide a thorough understanding of the embodiments One skilled in the relevant art will recognize, however, that the techniques described herein can be practiced without one or more of the specific details, or with other methods, components, materials, etc In other instances, well-known structures, materials, or operations are not shown or described in detail to avoid obscuring certain aspects

[0022] Reference throughout this specification to "one embodiment" or "an embodiment" means that a particular feature, structure, or characteristic described in connection with the embodiment is included in at least one embodiment of the present invention Thus, the appearances of the phrases 'in one embodiment' or "in an embodiment" in various places throughout this specification are not necessarily all referring to the same embodiment Furthermore, the particular features, structures, or characteristics may be combined in any suitable manner in one or more embodiments

[0023] FIG 2 illustrates a user finger 205 interacting with a capacitance sensor 200, in accordance with an embodiment of the invention In short, when a conductive object, such as user finger 205, is moved into proximity with capacitance sensor 200, its baseline capacitance is increased, resulting in a measurable capacitance change By monitoring capacitance sensor 200 for a baseline capacitance deviation ΔC, capacitive sensor activations can be determined and registered within software Of course, a user interaction with capacitance sensor 200 is not limited to a finger Other conductive objects may be used to interact with capacitive sensor 200 including, a stylus, a pen, or any other conductive object

[0024] By grouping a plurality of capacitance sensors 200 into an array of capacitive sensors, such as a circular slider array, a linear slider array, a touch pad array, or the like, a variety of user interfaces may be implemented For example, capacitive sensor arrays may be used to implement user interfaces of a variety of products including door switches, white goods (e g , kitchen appliances), laptop computers, desktop computers, personal digital assistants ("PDAs"), portable music players (e g , MP3 players), wireless telephones, cellular telephones, radios, or the like Capacitive sensor arrays may also be used to implement position sensors

[0025] FIG 3 is a diagram illustrating a capacitive (CAP) sense interface 300 including a circular slider, in accordance with an embodiment of the invention The illustrated embodiment of CAP sense interface 300 includes a capacitance sensor circuit 305, an input/output ("I/O") interface 310, and a circular slider array 315 The illustrated embodiment of circular slider array 315 includes an array of pie slice-shaped CAP sensors 320A – 320L (collectively 320) Although FIG 3 illustrates twelve CAP sensors 320, it should be appreciated that other embodiments may include more or less CAP sensors 320 having regular or irregular sizes and shapes Furthermore, some embodiments may include a mechanical/CAP sense button positioned in the center of circular slider array 315

[0026] I/O interface 310 links each CAP sensor 320 to capacitance sensor circuit 305 In one embodiment, I/O interface 310 is a configurable analog interconnect between capacitance sensor circuit 305 and circular slider array 315 I/O interface 310 can be configured on the fly during regular operation to couple capacitance sensor circuit 305 to any one individual CAP sensor 320 at a time or to groups of CAP sensors 320 at a time Once connected, to an individual CAP sensor 320 or to a group of CAP sensors 320, capacitive sensor circuit 305 can measure the capacitance of the individual or group of CAP sensors 320 to determine whether its/their capacitance has deviated by a threshold amount for a threshold period of time, thus indicating that a user activation should be registered in software (i e , acknowledged in software such that an appropriate action or function is executed)

[0027] As mentioned, I/O interface 310 can be configured to sequentially couple capacitance sensor circuit 305 to discrete or individual CAP sensor 320 to perform a "discrete scan" of circular slider array 315 Alternatively, I/O interface 310 can be configured to sequentially couple capacitance sensor circuit 305 to groups of CAP sensors 320 at a time (referred to as sensor groups) to perform a "group scan" of circular slider array 315 Discrete scans can be performed quicker than group scans since the capacitive load of a single CAP sensor 320 is inherently smaller than a group of CAP sensors 320 Accordingly, discrete scans may be performed to quickly approximate the location on circular slider array 315 of a user interaction (e g , finger touch), while group scans may be performed to more precisely determine the location of the user interaction Of course, the speed of a group scan can be increased by increasing the drive current used to measure capacitance changes on the groups of CAP sensors 320 In environments where the signal to noise ratio ("SNR") of the discrete scan is not sufficient, then the group scans may be performed exclusively Use of the group scan technique may or may not increase the SNR, however, the absolute value of the signals measured from circular slider array 315 will increase thereby increasing the sensitivity of CAP sense interface 300

[0028] In one embodiment, CAP sensor circuit 305 includes driver circuitry of a relaxation oscillator In this embodiment, the driver circuitry within CAP sensor circuit 305 continually charges and discharges each CAP sensor 320 by reciprocally driving and discharging a current onto CAP sensors 320 When I/O interface 310 connects the driver circuitry to a particular discrete CAP sensor 320 or a sensor group, the relaxation oscillator circuit is formed The particular discrete CAP sensor 320 or sensor group determines the frequency at which the relaxation oscillator circuit will oscillate To measure a capacitive change ΔC of a discrete CAP sensor 320 or a sensor group, capacitance sensor circuit 305 measures either a frequency change or period change of the oscillation associated with a particular discrete CAP sensor 320 or a particular sensor group Accordingly, CAP sensor circuit 305 need not actually measure the absolute capacitance of a discrete CAP sensor 320 or sensor group to register an actuation, but rather can measure a value indicative of this capacitance This value may be a simple count deviation from a baseline unactuated count value related to the period or frequency of oscillation It should be appreciated that CAP sensor circuit 305 may be implemented with a variety of other capacitive sense technologies including a current versus voltage phase shift measurement technique, a resistor capacitor charge timing technique, a capacitive bridge divider technique, a charge transfer technique, or the like, described in greater detail below

[0029] Once CAP sensor circuit 305 senses that one or more CAP sensors 320 are being actuated (e g , threshold change in a baseline capacitance for a threshold duration), then the physical location of the user interaction on circular slider array 315 may be determined by analyzing the values measured by CAP sensor circuit 305 to determine which CAP sensors 320 are being actuated In an embodiment where analog values are being sequentially sensed for sensor groups, a more precise location may be interpolated from the values

[0030] FIG 4 is a diagram illustrating a CAP sense interface 400 including a linear slider, in accordance with an embodiment of the invention The illustrated embodiment of CAP sense interface 400 includes a CAP sensor circuit 405, an I/O interface 410, and a linear slider array 415 The illustrated embodiment of linear slider array 415 includes an array of CAP sensors 420A – 320G (collectively 420) Although FIG 4 illustrates seven CAP sensors 420, it should be appreciated that other embodiments may include more or less CAP sensors 420 having regular or irregular sizes and shapes

[0031] CAP sense interface 400 operates in a similar manner as discussed above in connection with CAP sense interface 300, except that it is implemented with a linear slider array as opposed to a circular slider array As in the case of CAP sensor 305, CAP sensor 405 can perform quick discrete scans of linear slider array 415 or more sensitive group scans of linear slider array 415 Furthermore, it should be appreciated that a two dimensional array of linear slider array 415 may be used to implement a CAP sense touch pad

[0032] FIG 5 is a flow chart illustrating a process 500 to group scan a CAP sense interface, in accordance with an embodiment of the invention Process 500 may be used in connection with CAP sense interfaces 300, 400, or otherwise Process 500 will be described with reference to FIGs 5, 6A, and 6B FIG 6A is a diagram illustrating a group scan of circular slider array 315, while FIG 6B is a diagram illustrating a group scan of a linear slider array 415, in accordance with an embodiment of the invention

[0033] The processes explained below are described in terms of computer software and hardware The techniques described may constitute machine-executable instructions embodied within a machine (e g , computer) readable medium, that when executed by a machine will cause the machine to perform the operations described Additionally, the processes may be embodied within hardware, such as an application specific integrated circuit ("ASIC") or the like The order in which some or all of the process blocks appear in each process should not be deemed limiting Rather, one of ordinary skill in the art having the benefit of the present disclosure will understand that some of the process blocks may be executed in a variety of orders not illustrated

[0034] In a process block 505, the group scan is commenced A first group of CAP sensors (e g , CAP sensors 320 or CAP sensors 420) are selected to be the current sensor group 605 For the sake of discussion, process 500 will be discussed with reference to FIG 6A and CAP sense interface 300, however, process 500 is equally applicable to CAP sense interface 400 and FIG 6B

[0035] FIGs 6A illustrates an embodiment where each sensor group includes three individual CAP sensors 320, however, it should be appreciated that sensor groups may include two or more CAP sensors 320 A sensor group is defined herein to include two or more CAP sensors 320 concurrently coupled to CAP sensor circuit 305 at a given instant in time via I/O interface 310, such that their collective group capacitance can be measured Accordingly, FIG 6A illustrates eight different current sensor groups 605 during eight different instants in time t0 to t7 Current sensor groups 605 are illustrated as the shaded pie-sliced CAP sensors 320

[0036] In a decision block 510, a user interacts with CAP sense interface 300 by bring a conductive object (e g , user's finger) in proximity to circular slider array 315 FIG 6A illustrates the physical location of a user interaction with circular slider array 315 with location circles 610 (only a portion are labeled so as not to clutter the figure)

[0037] In a process block 515, CAP sensor circuit 305 measures the combined capacitance of current sensor group 605 In one embodiment, CAP sensor circuit 305 in fact measures a value that is indicative of a combined capacitance or a combined capacitance deviation from a baseline value for current sensor group 605 Measuring a threshold capacitance deviation from the baseline value for a threshold period of time is an indication that a user is interacting with current sensor group 605 As mentioned above, the measured value is indicative of the capacitance or capacitance change/deviation and may include a count value related to a relaxation oscillator frequency or period

[0038] In one embodiment, the combined capacitance of current sensor group 605 is measured by electrically connecting CAP sensors 320 within current sensor group 605 and measuring this combined capacitance Accordingly, the logical groupings of CAP sensors 320 (i e , the sensor groups) are temporal electrical connections of two or more CAP sensors 320 to CAP sensor circuit 305 By electrically connected two or more CAP sensors 320, a larger (and therefore more sensitive) capacitance electrode is temporally created In one embodiment, the sensor groups are temporally connected through an analog bus to a shared relaxation oscillator circuit through low impedance switches The analog bus conducts an analog value indicative of the combined capacitance change of all electrically connected CAP sensors 320 within the current sensor group 605

[0039] FIG 6A illustrates values 615 measured at different times t0 – t7 for each sensor group At time t0, current sensor group 605 is only partially coincident with the user interaction location 610 Therefore, at time t0, the current sensor group 605 will register only a small baseline capacitance deviation, illustrated as value = 0 5 At times t1, t2, and t3 the measured value increases as the degree of coincidence between user interaction location 610 and current sensor groups 605 increases At times t4, t5, t6, and t7, the degree of coincidence is decreasing with each successive current sensor group 605 and therefore the measured values decrease

[0040] In a process block 520, the measured value for current sensor group 605 is buffered In a process block 525, the measured value for the current sensor group 605 is indexed or assigned to a nominal CAP sensor that is a member of the current sensor group 605 In the illustrated embodiment, the nominal CAP sensor is the particular CAP sensor 320 that is physically located in the middle of each sensor group FIGs 6A and 6B illustrate the nominal CAP sensor with the darkest shading It should be appreciated though that the nominal CAP sensor need not be the middle CAP sensor and in the case where each sensor group includes an even number of CAP sensors 320 there may not be a physically middle CAP sensor

[0041] In decision block 530, it is determine whether all sensor groups within circular slider array 315 have been scanned (e g , each combined group capacitance deviation value measured) If not, then process 500 continues to a process block 535 In process block 535, the next sensor group (e g , that illustrated at time t1) is updated to be the current sensor group 605 and the next nominal CAP sensor 320 is updated to be the current nominal CAP sensor 320 It should be appreciated that updating current sensor group 605 to be the next sensor group may be implemented by reconfiguring I/O interface 310 to couple CAP sensor circuit 305 to the individual CAP sensors 320 making up the next sensor group Accordingly, the CAP sensors 320 of the current logical sensor group are disconnected and the CAP sensors 320 of the next logical sensor group are electrically connected via I/O interface 310 In one embodiment, the electrically connected CAP sensors 320 of the current logical sensor group are temporally connected to a single CAP sensor circuit 305 for the next iteration through the loop within process 500 Once CAP sensor circuit 305 is coupled to the next sensor group to be scanned, process 500 returns to process block 515 and proceeds as described above

[0042] In an alternative embodiment, CAP sensor circuit 305 may include multiple relaxation oscillators and I/O interface 310 may be capable of coupling each relaxation oscillator to a different sensor group at the same time In this alternative embodiment, CAP sensor circuit 305 would be capable of completing a scanning cycle of the sensor groups in less time than an embodiment where each sensor group is sequentially measured

[0043] Returning to decision block 530, if all sensor groups have been scanned (i e , a capacitance related values for each sensor group has been measured and buffered in memory), then process 500 continues to a process block 540 In process block 540 the buffered values are analyzed to determine the physical location and/or the direction of motion (in the case of scrolling) of physical location 610 In a process block 545, measured values may be analyzed to interpolate the location 610 of the user interaction to a greater degree of accuracy/precision than the individual CAP sensors 320 using a discrete scan could provide To determine the location/motion of physical location 610, the measured values may be fed into a decision algorithm, which analyses the values, making use of the fact that each value depends on how centrally located the user interaction is relative to each sensor group In one embodiment, the decision algorithm is a software entity

[0044] Process 500 increases the SNR of a capacitive sense interface by logically combining discrete physical CAP sensors into sensor groups Values indicative of a combine group capacitance are then measured for each sensor group and assigned to a nominal CAP sensor, which is a member of the particular sensor group Since adjacent sensor groups may include common CAP sensors, the effective size and therefore resulting capacitance of each nominal CAP sensor is increased, thereby increasing the SNR To illustrate with reference to FIG 6A, current sensor group 605 at time t0 includes two common CAP sensors 320 with current sensor group 605 at time t1 Similarly, current sensor group 605 at time t1 includes two common CAP sensors 320 with current sensor group 605 at time t2 The increased SNR obtained by the group scan enables thicker dielectric protective overlays (e g , for use with white goods or other durable consumer goods) and/or shrinkage of physical CAP sense interfaces for use in ever smaller electronic devices

[0045] FIG 7 is a flow chart illustrating a process 700 to perform quick discrete scans of CAP sense interfaces 300 or 400 until a user interaction is sensed and then perform a group scan to more precisely interpolate the location of the user interaction, in accordance with an embodiment of the invention In other words, process 700 implements a coarse, but quick, search function using the discrete scan to determine an approximate location of a user interaction and then implements a slower, but more precise, find function using the group scan on a portion of circular slider array 315 to determine with greater accuracy and sensitivity the location of the user interaction Again, process 700 is described with reference to circular slider array 315, but is equally applicable to linear slider array 415 or a planar touch pad array (not illustrated)

[0046] In a process block 705, the individual CAP sensors 320 of circular slider array 315 are discretely scanned Discretely scanning CAP sensors 320 includes sequentially measuring a value indicative of a capacitance or capacitance change of each CAP sensor 320 In one embodiment, this is accomplished by configuring I/O interface 310 to sequentially couple each CAP sensor 320 to CAP sensor circuit 305 to measure each value in isolation Alternatively, CAP sensor circuit 305 may be capable of measuring multiple values for discrete CAP sensors 320 concurrently, as discussed above

[0047] In a decision block 710, if a user interaction with circular slider array 315 is detected, then process 700 continues to a process block 715 In process block 715, an approximate location of the user interaction is determined based on the measured values obtained from the discrete scan in process block 705 The approximate location determined via the quick discrete scan may limit the possible location of the user interaction to a portion of circular slider array 315, such as for example, the top half, the top quarter, etc

[0048] In a process block 720, a group scan (see process 500) is performed only on a portion of CAP sensors 320 localized about the approximate location of the user interaction determined in process block 715 The values indicative of the combined group capacitances or capacitance changes obtained from the localized group scan can then be used to more precisely, and with greater sensitivity, interpolate the location of the user interaction with circular slider array 315

[0049] FIG 8 is a functional block diagram illustrating a demonstrative system 800 for implementing a capacitance sense user interface, in accordance with an embodiment of the invention System 800 includes a processing device 810, a capacitive sense pad 820, a capacitive sense linear slider 830, a capacitive sense circular slider 840, a host processor 850, an embedded controller 860, and non-capacitance sensor elements 870 Processing device 810 may include analog and/or digital general purpose input/output ("GPIO") ports 807 GPIO ports 807 may be programmable GPIO ports 807 may be coupled to a Programmable Interconnect and Logic ("PIL"), which acts as an interconnect between GPIO ports 807 and a digital block array of processing device 810 (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 810 may also include memory, such as random access memory (RAM) 805 and program flash 804 RAM 805 may be static RAM ("SRAM"), and program flash 804 may be a non volatile storage, which may be used to store firmware (e g , control algorithms executable by processing core 802 to implement operations described herein such as the aforementioned decision algorithm) Processing device 810 may also include a memory controller unit ("MCU") 803 coupled to memory and the processing core 802

[0050] Processing device 810 may also include an analog block array (not illustrated) The analog block array is also coupled to the system bus The 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 807

[0051] As illustrated, capacitance sensor 801 may be integrated into processing device 810 Capacitance sensor 801 may include analog I/O for coupling to an external component, such as capacitive sense pad 820, capacitive sense linear slider 830, capacitive sense circular slider 840, and/or other devices Capacitance sensor 801 is described in more detail below

[0052] Processing device 810 may include internal oscillator/clocks 806 and communication block 808 The oscillator/clocks block 806 provides clock signals to one or more of the components of processing device 810 Communication block 808 may be used to communicate with an external component, such as a host processor 850, via host interface (I/F) line 851 Alternatively, processing device 810 may also be coupled to embedded controller 860 to communicate with the external components, such as host 850 Interfacing to the host 850 can be through various methods In one exemplary embodiment, interfacing with the host 850 may be done using a standard PS/2 interface to connect to embedded controller 860, which in turn sends data to the host 850 via low pin count (LPC) interface In some instances, it may be beneficial for processing device 810 to do both touch-sensor pad and keyboard control operations, thereby freeing up the embedded controller 860 for other housekeeping functions In another exemplary embodiment, interfacing may be done using a universal serial bus (USB) interface directly coupled to host 850 via host interface line 851 Alternatively, processing device 810 may communicate to external components, such as host 850 using industry standard interfaces, such as USB, PS/2, inter-integrated circuit (I2C) bus, or system packet interfaces (SPI) Host 850 and/or embedded controller 860 may be coupled to processing device 810 with a ribbon or flex cable from an assembly, which houses the sensing device and processing device

[0053] In one embodiment, processing device 810 is configured to communicate with embedded controller 860 or host 850 to send and/or receive data The data may be a command or alternatively a signal In an exemplary embodiment, system 800 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 850 These drivers enable processing device 810 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, processing device 810 may be configured to communicate with embedded controller 860 or host 850, using non OS drivers, such as dedicated touch-sensor pad drivers, or other drivers known by those of ordinary skill in the art

[0054] Processing device 810 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 810 may be one or more separate integrated circuits and/or discrete components In one exemplary embodiment, processing device 810 may be a Programmable System on a Chip (PSoC™) processing device, manufactured by Cypress Semiconductor Corporation, San Jose, California Alternatively, processing device 810 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, processing device 810 may be a network processor having multiple processors including a core unit and multiple microengines Additionally, processing device 810 may include any combination of general-purpose processing device(s) and special-purpose processing device(s)

[0055] Capacitance sensor 801 may be integrated into the IC of processing device 810, or alternatively, in a separate IC Descriptions of capacitance sensor 801 may be generated and compiled for incorporation into other integrated circuits For example, behavioral level code describing capacitance sensor 801, 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 801

[0056] In one embodiment, electronic system 800 may be used in a notebook computer Alternatively, system 800 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

[0057] In one embodiment, capacitance sensor 801 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 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, compensation, and decision software algorithms to convert the count value into a capacitive sensor detection decision

[0058] 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

[0059] 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 processing device 810 The charge transfer may be conceptually similar to an R-C charging circuit In this method, C_P is the capacitance being sensed and 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

[0060] FIG 9 illustrates one possible embodiment of capacitance sensor 801 implemented with a relaxation oscillator circuit 900 The illustrated embodiment of capacitance sensor 801 includes relaxation oscillator circuit 900, an analog multiplexer ("MUX") bus 901, a sensor array 910, and a digital counter 920 Analog MUX bus 901 and selection circuit 930 may collectively implement the functionality of I/O interconnects 310 and 410 The remaining portions of relaxation oscillator 900 and digital counter 920 may implement the functionality of CAP sensor circuits 305 and 405 Sensor array 910 may represent any of circular slider array 315, linear slider array 415, or a planar touch pad array

[0061] Relaxation oscillator 900 is formed by the capacitance to be measured on capacitor sensors 951, a charging current source 952, a comparator 953, and a reset switch 954 It should be noted that capacitor sensor 951 are representative of the capacitance measured on a sensor element of a CAP sensor array The relaxation oscillator is coupled to drive a charging current Ic in a single direction onto a device under test ("DUT") capacitor, any of capacitor sensors 951 As the charging current piles charge onto the capacitor 951, the voltage across the capacitor increases with time as a function of Ic and its capacitance C Equation (1) describes the relation between current, capacitance, voltage and time for a charging capacitor

$$CdV = I_C dt \qquad (1)$$

[0062] The relaxation oscillator begins by charging the capacitor sensor 951 from a ground potential or zero voltage and continues to pile charge on the capacitor 951 at a fixed charging current Ic until the voltage across the capacitor 951 at node 970 reaches a reference voltage or threshold voltage, V_{TH} 955 At V_{TH} 955, the relaxation oscillator allows the accumulated charge at node 955 to discharge (e g , the capacitor 951 to "relax" back to the ground potential) and then the process repeats itself In particular, the output of comparator 953 asserts a clock signal F_{OUT} 956 (e g , F_{OUT} 956 goes high), which enables the reset switch 954 This resets the voltage on the capacitor at node 970 to ground and the charge cycle starts again The relaxation oscillator outputs a relaxation oscillator clock signal (F_{OUT} 956) having a frequency (f_{RO}) dependent upon capacitance C of the capacitor 951 and charging current Ic

[0063] The comparator trip time of the comparator 953 and reset switch 954 add a fixed delay The output of the comparator 953 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 955 For example, if capacitance C of the capacitor 951 changes, then f_{RO} will change proportionally according to Equation (1) By comparing f_{RO} of F_{OUT} 956 against a 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} 956 and REF CLK is proportional to a change in capacitance of the capacitor 951

$$\Delta C \propto 1/\Delta f\text{, where} \qquad (2)$$

$$\Delta f = f_{RO} - f_{REF} \qquad (3)$$

[0064] In one embodiment, a frequency comparator may be coupled to receive relaxation oscillator clock signal (F_{OUT} 956) 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 951 has changed

[0065] In one exemplary embodiment, the relaxation oscillator 950 may be built using a programmable timer (e g , 555 timer) to implement the comparator 953 and reset switch 954 Alternatively, the relaxation oscillator 900 may be built using other circuits

[0066] Sensor array 910 includes a plurality of sensor elements 955(1)-955(N), where N is a positive integer value that represents the number of capacitive sensors within any of capacitive sense pad 820, capacitive sense linear slider 830, or capacitive sense circular slider 840 Relaxation oscillator 900 further includes a selection circuit 930 Selection circuit 930 is coupled to the plurality of sensor elements 951(1)-951(N), the reset switch 954, the current source 952, and the comparator 953 Selection circuit 930 may be used to allow the relaxation oscillator 900 to measure capacitance on multiple sensor elements (e g , rows or columns) The selection circuit 930 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 embodiment, selection circuit 930 is a multiplexer array of the relaxation oscillator 900 Alternatively, selection circuit may be other circuitry outside the relaxation oscillator 900, or even outside the capacitance sensor 801 to select the sensor element to be measured Capacitance sensor 801 may include one relaxation oscillator and digital counter for the plurality of sensor elements of the sensor array Alternatively, capacitance sensor 801 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 GPIO port 807

[0067] In another embodiment, the capacitance sensor 801 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

[0068] In one 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

[0069] 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

[0070] Digital counter 920 is coupled to the output of the relaxation oscillator 900 Digital counter 920 receives the relaxation oscillator output signal 956 (F_{OUT}) Digital counter 920 is configured to count at least one of a frequency or a period of the relaxation oscillator output received from the relaxation oscillator

[0071] When a finger or conductive object is placed on a sensor element 951, the capacitance increases so the relaxation oscillator output signal 956 (F_{OUT}) decreases The relaxation oscillator output signal 956 (F_{OUT}) is fed to the digital counter 920 for measurement There are at least two methods for counting the relaxation oscillator output signal 956, frequency measurement and period measurement In one embodiment, the digital counter 920 may include two multiplexers 923 and 924 Multiplexers 923 and 924 are configured to select the inputs for the PWM 921 and the timer 922 for the two measurement methods, frequency and period measurement methods Alternatively, other selection circuits may be used to select the inputs for the PWM 921 and the time 922 In another embodiment, multiplexers 923 and 924 are not included in the digital counter, for example, digital counter 920 may be configured in one, or the other, measurement configuration

[0072] In the frequency measurement method, the relaxation oscillator output signal 956 is counted for a fixed period of time The counter 922 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) 921 is clocked for a fixed period by a derivative of the system clock, VC3 926 (which is a divider from system clock 925, 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 926 The output of PWM 921 enables timer 922 (e g , 16 bit) The relaxation oscillator output signal 956 clocks the timer 922 The timer 922 is reset at the start of the sequence, and the count value is read out at the end of the gate period

[0073] In the period measurement method, the relaxation oscillator output signal 956 gates a timer 922, which is clocked by the system clock 925 (e g , 24 MHz) In order to improve sensitivity and resolution, multiple periods of the oscillator are counted with the PWM 921 The output of PWM 921 is used to gate the timer 922 In this method, the relaxation oscillator output signal 956 drives the clock input of PWM 921 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 956 The output of the PWM 921 enables timer 922 (e g , 16-bit), which is clocked at the system clock frequency 925 (e g , 24 MHz) When the output of PWM 921 is asserted (e g , goes high), the count starts by releasing the capture control When the terminal count of the PWM 921 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 900 is indexed to the next capacitive sensor (e g , capacitor 951(2)) to be measured and the count sequence is started again

[0074] The length of the counter 922 and the detection time required for capacitance sensor 801 are determined by sensitivity requirements Small changes in the capacitance on sensor element 951 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 capacitive sensors (e g , sensor elements 951(1)-(N)) are scanned and the count values for each capacitive sensors 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 capacitive sensors actuation and the acquired value with capacitive sensors actuation, referred to here as Δn The sensitivity of a single capacitive sensors is approximately

$$\frac{\Delta n}{n} = \frac{Cf}{Cp} \qquad (4)$$

The value of Δn should be large enough for reasonable resolution and clear indication of capacitive sensors actuation

[0076] Using the multiplexer array 930, 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 807 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 952) and reset switch 953 are connected to the analog mux bus This may limit the pin-count requirement to simply the number of capacitive sensors (e g , capacitors 951(1)-951(N)) to be addressed In one exemplary embodiment, no external resistors or capacitors are required inside or outside the processing device 910 to enable operation

[0077] The capacitor charging current for the relaxation oscillator 900 is generated in a register programmable current output DAC (also known as IDAC) Accordingly, the current source 952 is a current DAC or IDAC The IDAC output current may be set by an 8-bit value provided by the processing device 810, such as from the processing core 802 The 8-bit value may be stored in a register or in memory

[0078] 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

[0079] The above description of illustrated embodiments of the invention, including what is described in the Abstract, is not intended to be exhaustive or to limit the invention to the precise forms disclosed While specific embodiments of, and examples for, the invention are described herein for illustrative purposes, various modifications are possible within the scope of the invention, as those skilled in the relevant art will recognize

[0080] These modifications can be made to the invention in light of the above detailed description The terms used in the following claims should not be construed to limit the invention to the specific embodiments disclosed in the specification Rather, the scope of the invention is to be determined entirely by the following claims, which are to be construed in accordance with established doctrines of claim interpretation

CLAIMS

What is claimed is

1 A method, comprising

logically grouping capacitance sensors of an array of capacitance sensors into sensor groups, wherein each sensor group includes at least two of the capacitance sensors,

measuring a value indicative of a capacitance for each of the sensor groups, and

analyzing the values of the sensor groups to determine a location of a user interaction with the array of capacitance sensors

2 The method of claim 1, wherein logically grouping the capacitance sensors comprises sequentially connecting the sensor groups to a shared capacitance sensor circuit, wherein each of the sensor groups comprises a temporal electrical connection between a different set of two or more of the capacitance sensors

3 The method of claim 1, further comprising assigning the value measured for each of the sensor groups to a particular capacitance sensor within each corresponding one of the sensor groups

4 The method of claim 3, wherein the sensor groups include physically adjacent capacitance sensors within the array of capacitance sensors

5 The method of claim 4, wherein the sensor groups each comprise an odd number of the capacitance sensors and wherein assigning the value measured for each of the sensor groups to the particular capacitance sensor within each corresponding one of the sensor groups comprises assigning the value measured for each of the sensor groups to a middle capacitance sensor of each corresponding one of the sensor groups

6 The method of claim 4, wherein adjacent sensor groups include at least one common capacitance sensor

7 The method of claim 1, wherein analyzing the values of the sensor groups comprises interpolating a center of the location of the user interaction with the array of capacitance sensors based on the values

8 The method of claim 1, wherein the array of capacitance sensors comprises a linear slider of a user interface

9 The method of claim 1, wherein the array of capacitance sensors comprises a circular slider of a user interface

10 The method of claim 1, wherein the array of capacitance sensors comprises a touch pad of a user interface

11 The method of claim 1, further comprising

discretely scanning each of the capacitance sensors within the array of capacitance sensors individually, and

determining an approximate location of the user interaction based on the scanning,

wherein measuring the value indicative of the capacitance for each of the sensor groups comprises measuring the value indicative of the capacitance for a portion of the sensor groups localized about the approximate location to more precisely determine the location after discretely scanning each of the capacitance sensors,

wherein the portion of the sensor groups is less than all of the sensor groups within the array of capacitance sensors

12 A machine readable medium that provides instructions that, if executed by a machine, will cause the machine to perform operations comprising

measuring a value indicative of a combined capacitance of a sensor group including two or more capacitance sensors of an array of capacitance sensors,

scanning the array of capacitance sensors to obtain a plurality of values corresponding to a plurality of sensor groups each including two or more capacitance sensors within the array of capacitance sensors, and

determining a location of a user interaction with the array of capacitance sensors based on the plurality of values

13 The machine-readable medium of claim 12, wherein the sensor groups include physically adjacent capacitance sensors

14 The machine-readable medium of claim 13, wherein adjacent sensor groups include at least one common capacitance sensor

15 The machine-readable medium of claim 12, further providing instructions that, if executed by the machine, will cause the machine to perform further operations, comprising

discretely scanning each of the capacitance sensors within the array of capacitance sensors individually, and

determining an approximate location of the user interaction based on the scanning,

wherein scanning the array of capacitance sensors to obtain the plurality of values comprises scanning a portion of the array of capacitance sensor to obtain the plurality of values corresponding to sensor groups localized about the approximate location to more precisely determine the location after discretely scanning each of the capacitance sensors,

wherein the portion of the sensor groups is less than all of the sensor groups within the array of capacitance sensors

16 An apparatus, comprising

a processing device,

a user interface including an array of capacitance sensors coupled to the processing device, and a memory unit coupled to the processing device, the memory unit having stored therein instructions that, if executed by the processing device, will cause the processing device to perform operations comprising

measuring a value indicative of a combined capacitance of a sensor group including two or more capacitance sensors within the array of capacitance sensors,

scanning the array of capacitance sensors to obtain a plurality of values corresponding to a plurality of sensor groups each including two or more capacitance sensors within the array of capacitance sensors, and

determining a location of a user interaction with the array of capacitance sensors based on the plurality of values

17 The apparatus of claim 16, wherein the sensor groups include physically adjacent capacitance sensors and wherein adjacent sensor groups include at least one common capacitance sensor

18 The apparatus of claim 16, wherein the processing device includes

a capacitance sensor coupled to measure the plurality of values, and

an analog multiplexer bus coupled to sequentially couple the plurality of sensor groups to the capacitance sensor

19 The apparatus of claim 18, wherein the capacitance sensor includes a relaxation oscillator circuit

20 The apparatus of claim 19, wherein the user interface comprises one of a linear slider, a circular slider, or a touch pad

ABSTRACT OF DISCLOSURE

A technique for operating a capacitive sensor array The technique includes logically grouping capacitance sensors of an array of capacitance sensors into sensor groups The sensor groups each include at least two capacitance sensors of the array of capacitance sensors Values indicative of a capacitance for each of the sensor groups are measured The measured values are then analyzed to determine a location of a user interaction with the array of capacitance sensors

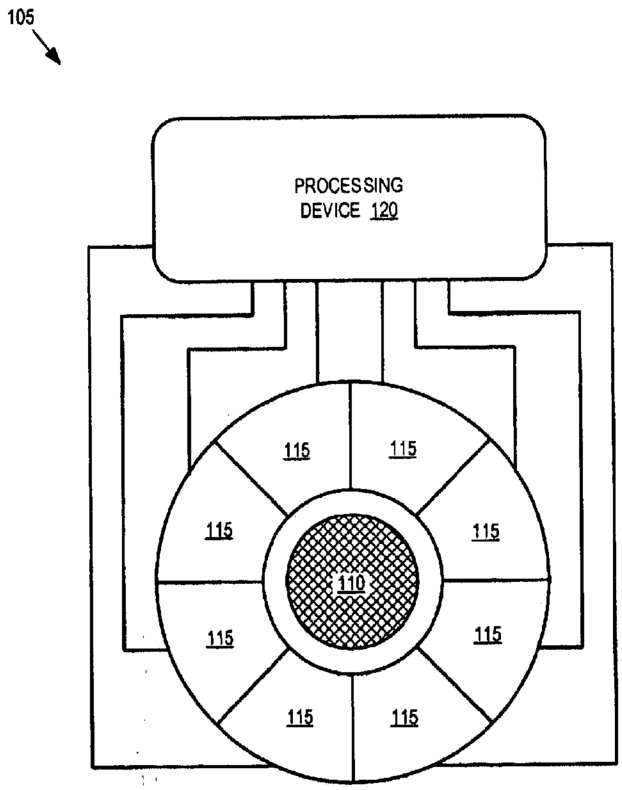


FIG. 1A
(PRIOR ART)

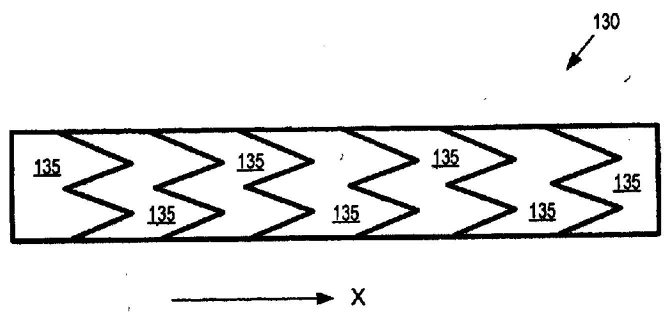


FIG. 1B
(PRIOR ART)

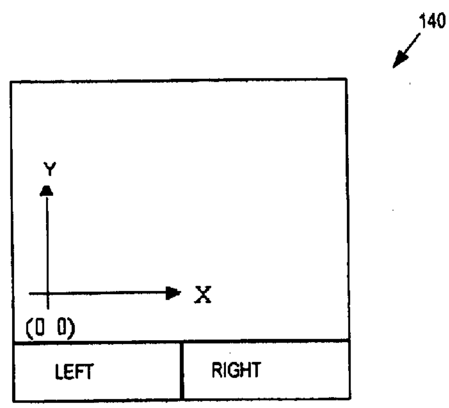


FIG 1C
(PRIOR ART)

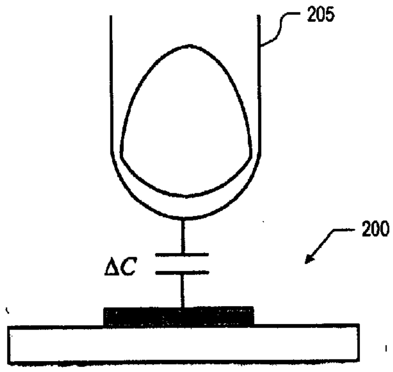


FIG. 2

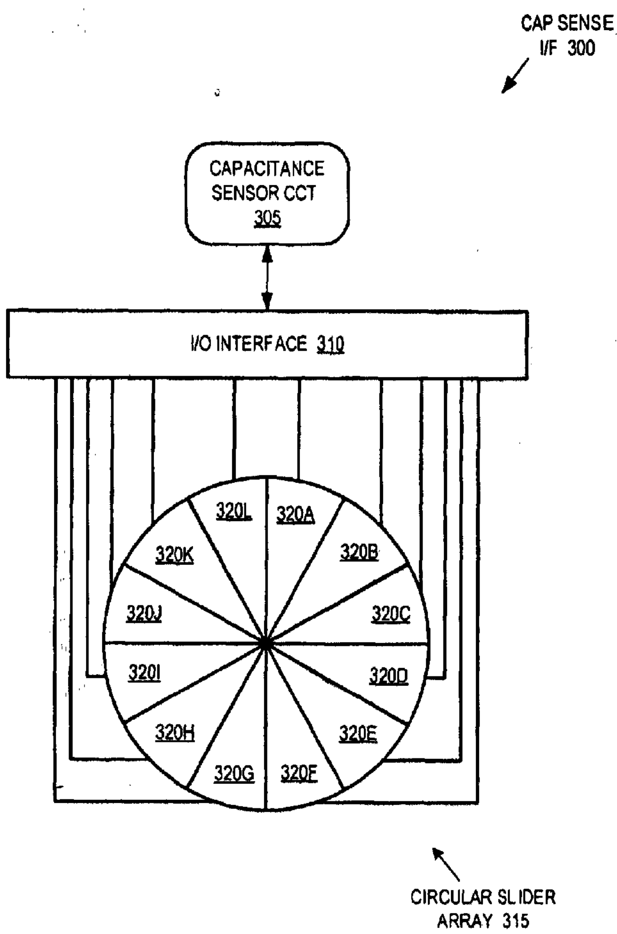

CAP SENSE
I/F 300
CAPACITANCE
SENSOR CCT
305
I/O INTERFACE 310
320L
320A
320K
320B
320J
320C
320I
320D
320H
320E
320G
320F
CIRCULAR SLIDER
ARRAY 315

FIG. 3

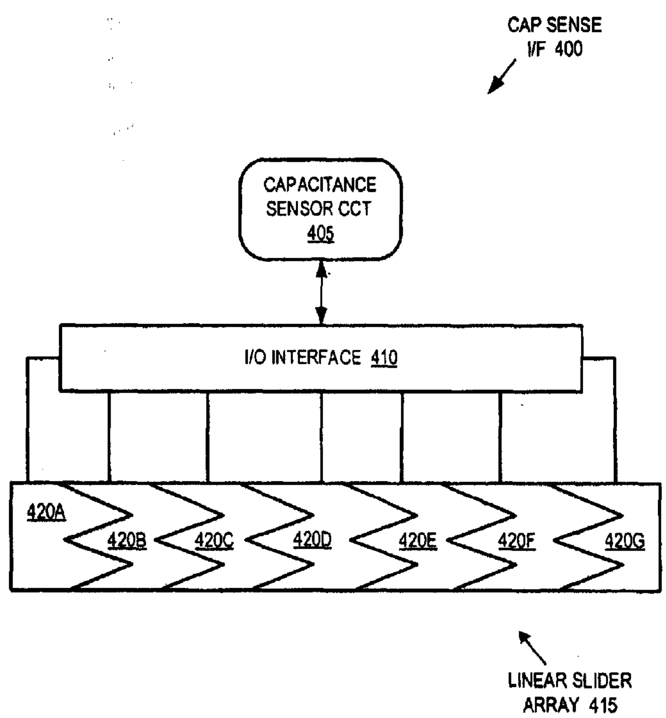
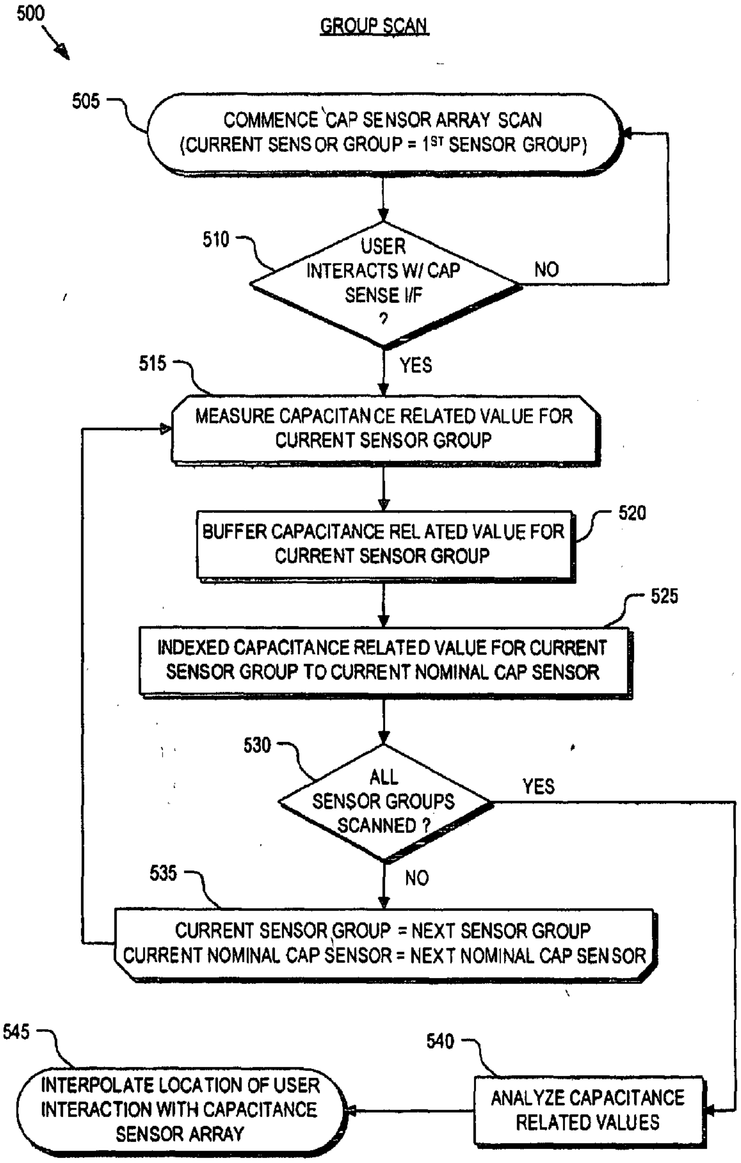

CAP SENSE
I/F 400
CAPACITANCE
SENSOR CCT
405
I/O INTERFACE 410
420A
420B
420C
420D
420E
420F
420G
LINEAR SLIDER
ARRAY 415

FIG. 4

500



GROUP SCAN
505
COMMENCE CAP SENSOR ARRAY SCAN
(CURRENT SENSOR GROUP = 1ST SENSOR GROUP)
510
USER INTERACTS W/ CAP SENSE I/F ?
NO
YES
515
MEASURE CAPACITANCE RELATED VALUE FOR CURRENT SENSOR GROUP
520
BUFFER CAPACITANCE RELATED VALUE FOR CURRENT SENSOR GROUP
525
INDEXED CAPACITANCE RELATED VALUE FOR CURRENT SENSOR GROUP TO CURRENT NOMINAL CAP SENSOR
530
ALL SENSOR GROUPS SCANNED ?
YES
NO
535
CURRENT SENSOR GROUP = NEXT SENSOR GROUP
CURRENT NOMINAL CAP SENSOR = NEXT NOMINAL CAP SENSOR
545
INTERPOLATE LOCATION OF USER INTERACTION WITH CAPACITANCE SENSOR ARRAY
540
ANALYZE CAPACITANCE RELATED VALUES

FIG. 5

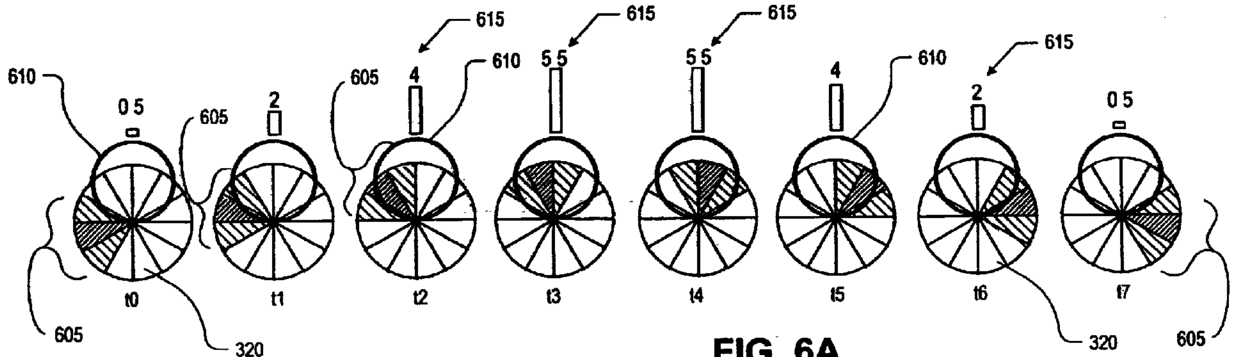


FIG 6A

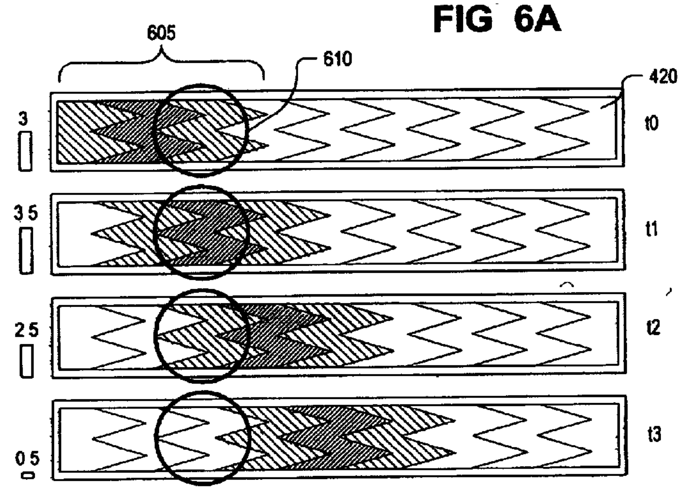


FIG 6B

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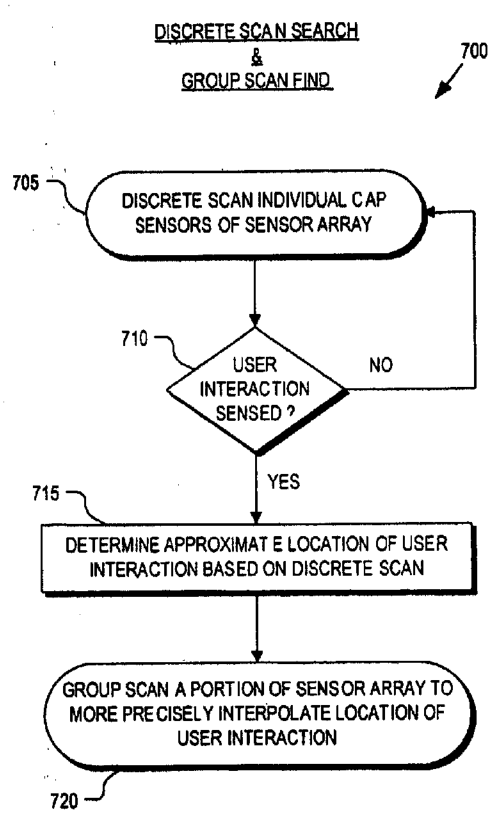

DISCRETE SCAN SEARCH
&
GROUP SCAN FIND
700
705
DISCRETE SCAN INDIVIDUAL CAP SENSORS OF SENSOR ARRAY
710
USER INTERACTION SENSED ?
NO
YES
715
DETERMINE APPROXIMATE LOCATION OF USER INTERACTION BASED ON DISCRETE SCAN
GROUP SCAN A PORTION OF SENSOR ARRAY TO MORE PRECISELY INTERPOLATE LOCATION OF USER INTERACTION
720

FIG. 7

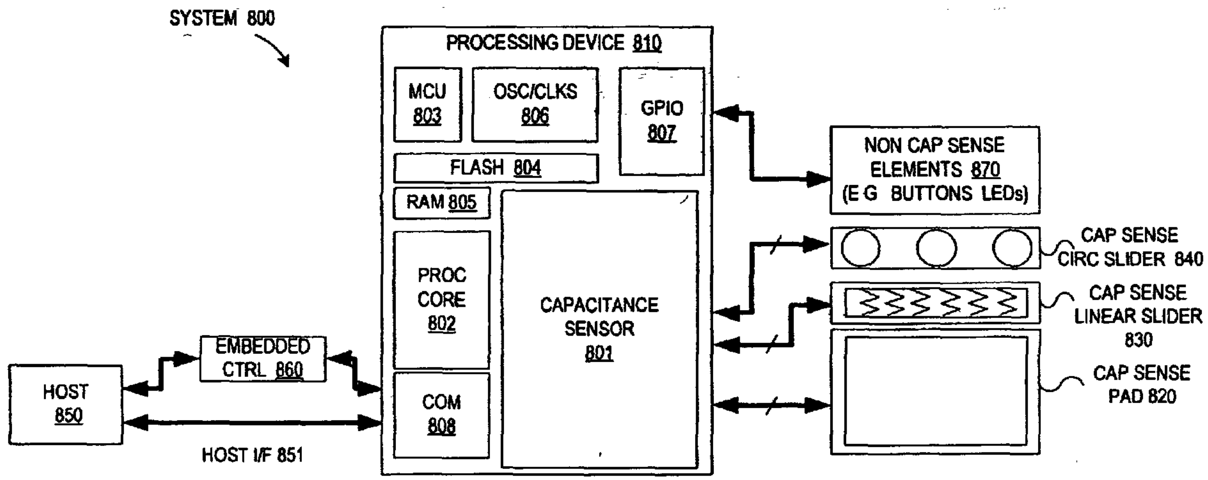


FIG. 8

CY00002288

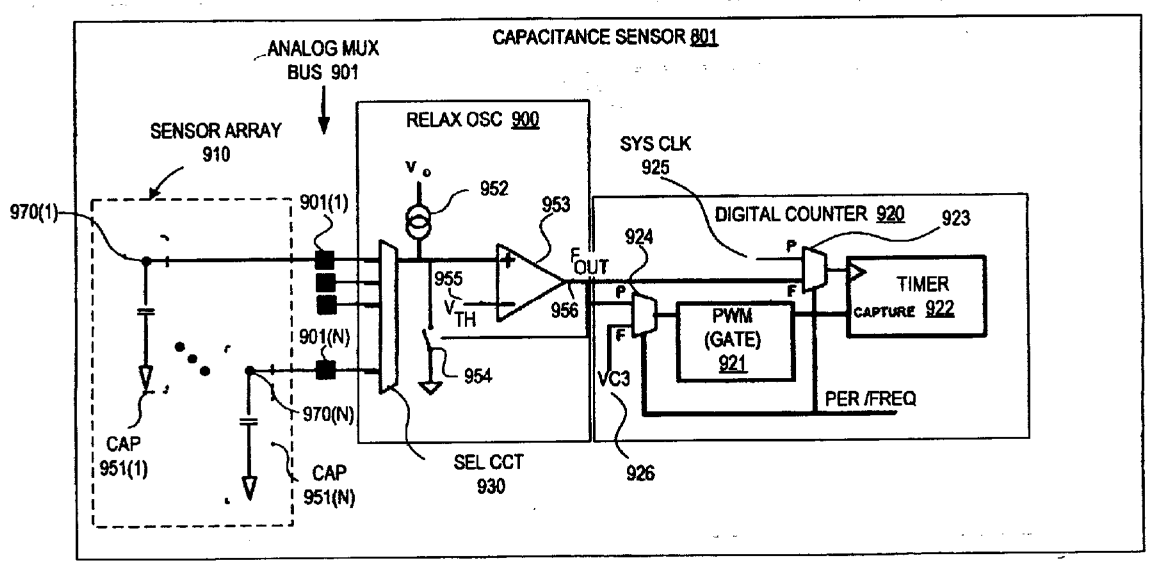


FIG 9

CY00002289

CYPRESS
PERFORM

Application Note

AN2394

CapSense Best Practices

Author Mark Lee
Associated Project No
Associated Part Family CY8C20x34 CY8C21x4 CY8C24x94
Software Version PSoC Designer™ 4 3
Associated Application Notes AN2233a AN2277 AN2292 AN2318 AN2355 AN2360

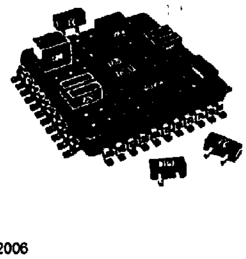
Abstract
Best Practices for the design of CapSense systems are presented Topics covered include an overview of sensing methods guidelines for layout and assembly and CapSense tools and techniques

Introduction

The adoption of capacitive sensing as an interface technology in high volume high visibility applications such as portable media players and mobile handsets has created demand for the same technology in more conventional consumer electronics This demand has led to significant innovation and several competitive technologies are available While these technologies each have their respective differences the underlying principle is the measurement of capacitance between a plate (the sensor) and its environment

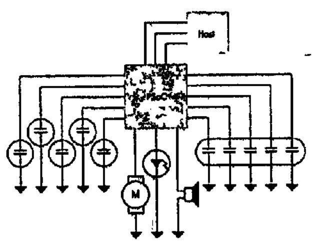
Compared to modules and fixed function ICs programmable ICs allow for more flexibility in design as custom code can be used to develop solutions PSoC® CapSense combines a microcontroller configurable digital and analog resources on board memory and other features that allow for the greatest flexibility in capacitive system design This Application Note gives an overview of Best Practices for CapSense design

Figure 1 PSoC Analog and Digital Blocks Can Be Configured for CapSense Plus Other Functions



The PSoC architecture allows designers to incorporate multiple capacitive sensing design elements into an application Buttons sliders touchpads and proximity detectors are supported simultaneously with the same device in the same circuit Use PSoC to scan capacitive sensors and use the activation status to drive LEDs control a motor drive a speaker etc as shown in Figure 2 A concept called dynamic reconfiguration allows the CapSense application to make use of greater than 100% of the system resources by reconfiguring as needed on the fly

Figure 2 Example Application with CapSense*Plus* Motor LED and Speaker with a Single PSoC



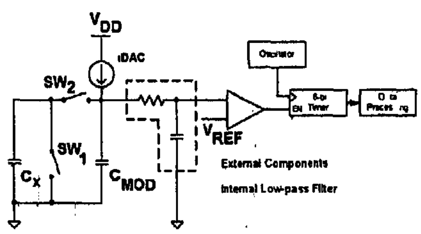
1 Easy-to-Configure Capacitive Sensing Solutions

PSoC can implement different methods of CapSense configured through firmware (see Reference [1]) Required features determine the sensing method If the most important features are maximum battery life and operation at 2 7V then the method called CSA is the clear choice If it is more important to have CapSense and other features high noise immunity and a thick overlay then the CSD method is the best choice

1 1 CSA Sensing Method

CSA stands for CapSense with Successive Approximation CSA is only implemented in the CY8C20x34 PSoC device family

Figure 3 CSA Configuration of CapSense



A block diagram of the CSA configuration is shown in Figure 3 CSA operates as follows

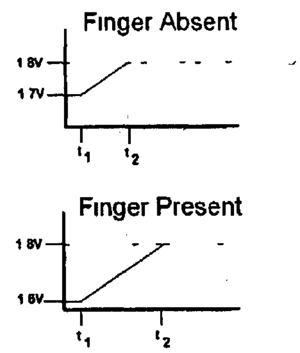
Switches SW_1 and SW_2 and the CapSense sensor C_X form a switched capacitor network with an equivalent circuit of a resistor to ground With the IDAC set to a calibrated level and SW_1 and SW_2 switching the average voltage on C_{MOD} settles at a level that varies with the value of C_X Setting the IDAC to a low current level with SW_2 open the voltage on C_{MOD} ramps up The time for the ramp voltage on C_{MOD} to reach V_{REF} is an indication of the value of C_X The timer on the output of the comparator converts the ramp time to a digital value

Self calibration of the system is accomplished through a successive approximation binary search to determine IDAC setting necessary to keep voltage on C_{MOD} at V_{REF} when no finger is present Individual calibrated IDAC settings are stored for all sensors

When a finger is present the voltage on C_{MOD} settles at a lower voltage requiring more time to reach the threshold voltage V_{REF} as shown in Figure 4 If (t2 t1) is long enough the button state is in Finger Present state otherwise the button is in the Finger Absent state

An internal capacitor programmable up to 100 pF can be used for C_{MOD} but a larger external capacitor improves performance 1000 pF for buttons and sliders and 10 nF for proximity sensors Series resistors 560 ohms are recommended in line with all CapSense inputs to prevent RF interference

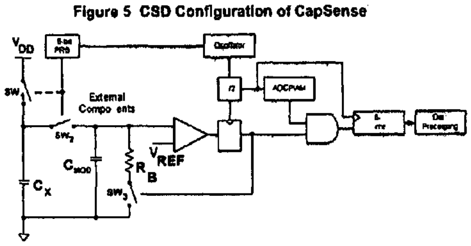
Figure 4 CSA Waveform Changes With Finger Absent/Present



1 2 CSD Sensing Method

CSD stands for CapSense with Sigma Delta A/D CSD is implemented in both the CY8C21x34 and CY8C24x94 PSoC device families

Figure 5 CSD Configuration of CapSense



A block diagram of the CSD configuration is shown in Figure 5 CSD operates as follows

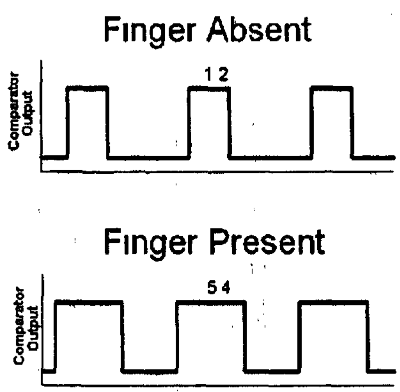
Switches SW_1 and SW_2 and the CapSense sensor C_X form a switched capacitor network with an equivalent circuit of a resistor between V_{DD} and C_{MOD} The equivalent resistor has a value controlled by C_X The switching of SW_1 and SW_2 is controlled by the pseudo random sequence of the PRS generator SW_3 operates asynchronously from SW_1 and SW_2 When R_B is switched to ground the voltage on C_{MOD} decreases When R_B is open the voltage on C_{MOD} increases The comparator changes state based on the voltage on C_{MOD} relative to V_{REF}

CY00002291

A Sigma Delta A/D is formed by the addition of a 16 bit timer to measure comparator high time to comparator low time

When a finger is present C_X is larger and the equivalent resistor to V_{DD} is smaller allowing more current to flow into C_{MOD} The comparator will spend more time in the CMPHIGH state and less time in CMPLOW If the ratio CMPHIGH CMPLOW is high enough a button is in the Finger Present state otherwise the button is in the Finger Absent state as shown in Figure 6

Figure 6 CSD Waveform Changes With Finger Absent/Present



The PRS lowers noise susceptibility and radiation emissions compared to a fixed clock source A C_{MOD} value of 3900 pF is recommended R_B requires tuning to sensors for optimal performance somewhere between 5K 10K Series resistors 560 ohms are recommended in line with all CapSense inputs to prevent RF interference

2 How to Design CapSense Printed Circuit Boards

In the typical CapSense application the capacitive sensors are formed by the traces of a printed circuit board (PCB) The following set of guidelines show how to design a CapSense PCB (see Reference [2])

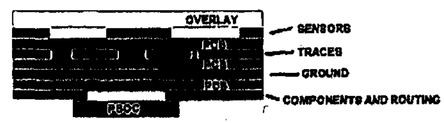
2 1 General Layout and Assembly Guidelines

Board Area The area required for CapSense is only slightly larger than the sensing area itself The electric fields around the sensors are very localized especially if the ground plane and sensor pad are placed on the same PCB layer

PSoC Placement It is good practice to minimize the distance between the PSoC and the sensors Typically the PSoC is mounted on the bottom layer along with the other components and the CapSense sensor pads are placed on the top layer

Board Layers The most common PCB format is two layers with sensor pads and gridded ground plane on top and everything else on the bottom Four layer boards are used when board area must be minimized The typical stack up involves sensors only on the top layer limited traces on layer two ground on layer three and everything else on the bottom layer as shown in Figure 7 Do not route traces directly under sensor pads

Figure 7 Four-Layer Stack-Up for CapSense Board When Board Space Is Limited

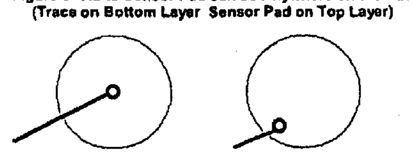


Board Thickness FR4 based designs have been found to perform well with standard board thickness of 0 020 (0 5 mm) 0 047 (1 2 mm) and 0 063 (1 6 mm) How thin can the board be? A rule of thumb is that the gap between sensor and ground should be smaller than vertical distance to ground

Trace Length and Width The parasitic capacitance of the traces and sensor pad C_P must be minimized to make the dynamic range of the system as large as possible How long can the traces be? The longest traces in a successful CapSense product are 9 (230 mm) for a slider and 12 (300 mm) for a button (This extreme example requires large sensing pads and a thin overlay in order to maximize the signal from the sensor) Trace width adds to the sensor C_P and increases coupling to elements on other layers Trace widths of 0 0065 0 008 (0 17 0 20 mm) suffice for most applications

Vias Use the minimum number of vias consistent with routing of the CapSense inputs to minimize C_P The placement of the via can be done at any location on the sensor pad as shown in Figure 8

Figure 8 Via to Sensor Pad can be Anywhere on the Pad (Trace on Bottom Layer Sensor Pad on Top Layer)



Via in center looks symmetrical

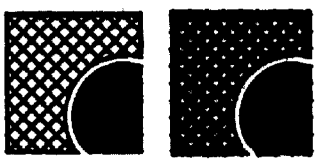
Via at edge same function, minimizes trace length

CY00002292

Communication Lines Do not run capacitive sensing traces in close proximity with and parallel to high frequency communication lines such as an I2C or SPI master If it is necessary to cross communication lines with sensor pins be sure the intersection is orthogonal One effective method for reducing the interaction between communication traces and sensor traces is to isolate each by port assignment Port pins P1[0] and P1[1] are used for programming and I2C and should only be used for CapSense if no other pins are available

Ground Fill To minimize C_P a 40% fill is recommended on the sensor layer and 60 80% fill on non sensor layers

Figure 9 Patial Ground Fill to Minimize C_P



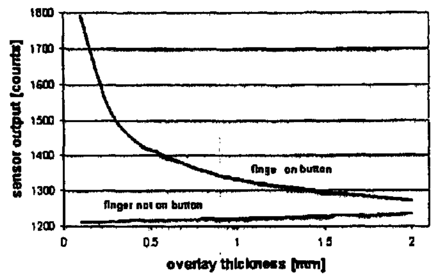
Overlay Thickness Table 1 lists the recommended maximum overlay thicknesses for PSoC CapSense applications (plastic overlay) The dielectric constant plays a role in how thick the overlay can be Common glass has a dielectric constant around $\varepsilon_r = 8$ while plastic is around $\varepsilon_r = 2\ 5$ The ratio of $\varepsilon_r / 2\ 5$ is an estimate of how thick the overlay can be relative to plastic for the same level of sensitivity Using this rule of thumb a common glass overlay can be about three times as thick as a plastic overlay for the same sensitivity

Table 1 Recommended Plastic Overlay Thickness for CapSense

Design Element	Overlay Thickness
Button	< 3 mm
Slider	< 1 mm
Touchpad	< 0 5 mm

Both signal and noise are affected by the overlay properties As the thickness of the overlay increases signal and noise both decrease A representative plot is shown in Figure 10 Signal is defined as the difference in average sensor output between the Finger Absent and Finger Present states Noise is defined in the peak to peak deviation in sensor output in the Finger Absent state

Figure 10 Signal Level Drops Off as Overlay Thickness Increases



Overlay Adhesive Overlay materials must have good mechanical contact with the sensing PCB Two widely used non-conductive adhesives for overlays are 467MP and 468MP made by 3M

Gloves If the sensors must work with a gloved hand then add the thickness of the glove material to the total overlay stack up when sizing the buttons Dry leather and rubber are similar to plastic with a dielectric constant of 2 5-3 5 Ski gloves have a dielectric constant of 2 or less depending on the air content of glove s thermal insulation

LED Backlighting CapSense works well with LED backlighting Just cut a hole in the sensor pad Keep LED traces on the bottom side of the board

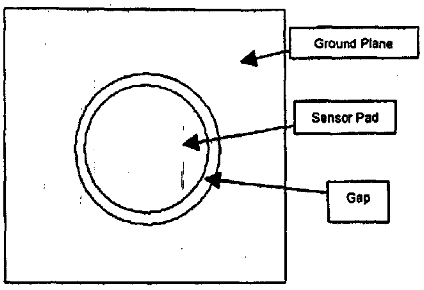
Multiple PSoC s on One PCB For systems with many buttons such as a keyboard the system design may require two or more PsoCs dedicated to CapSense If this is the case partition buttons so that a ground fill area separates the traces of each button group This will prevent coupling between the independent CapSense groups

2 2 Buttons

The function of a button is to determine the presence or absence of a conductive object A typical application of a CapSense button is to sense the presence of a finger

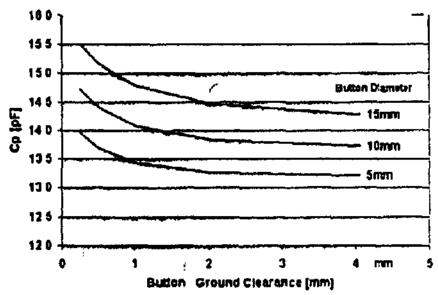
Shape The recommended shape for sensing a finger press is a solid round pattern as shown in Figure 11

Figure 11 Recommended Button Shape is Solid Round Pattern



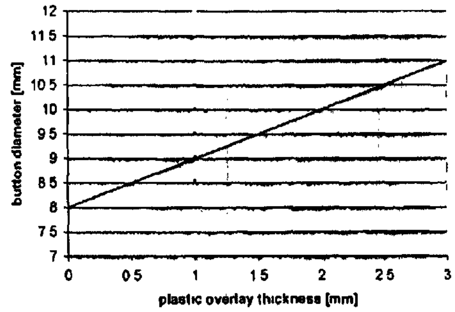
The capacitance C_P decreases as the clearance surrounding the button is increased An example of this dependence of C_P on the gap is shown in Figure 12 for three button sizes (5 mm 10 mm 15 mm diameter)

Figure 12 C_P as a function of Button-Ground Clearance and Button Diameter (0 062 Thick FR4)



The thicker the protective overlay the larger the button diameter should be Figure 13 shows a button diameter guideline For a 1 mm thick acrylic overlay the recommended button diameter is 9 mm

Figure 13 Guideline for Button Diameter Versus Overlay Thickness

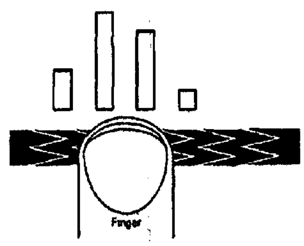


2 3 Sliders

A slider is a sensor array Changes between adjacent capacitive elements are used to determine the position of a conductive object Position is determined in firmware using a centroid (center of mass) calculation

The slider segments must be small enough so that multiple segments couple with each finger position yet large enough to produce the required signal level through the overlay A sawtooth pattern works well for sliders with a minimum of five segments The maximum length of the slider is only limited by the available IO pins of the PSoC A typical slider pattern is shown in Figure 14 The sensor output is represented by a bar graph above each slider segment

Figure 14 Sawtooth Pattern Used With Slider Sensor Pattern

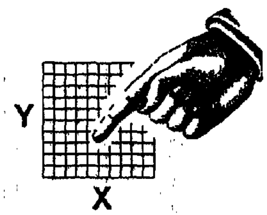


Slider Diplexing If IO pins are at a premium connecting two slider segments to a single PSoC pin increases the number of slider segments that can be sensed by the PSoC by two fold The CapSense User Module Wizard allows the user to select this as an option for pin assignment and the User Module API determines the correct half of the slider that the finger is touching Be aware that connecting each CapSense input pin to two slider elements will double C_P without any increase in signal

2 4 Touchpads

The CapSense User Module does not directly support touchpads Touchpads are implemented as two independent sliders All the guidelines that apply to sliders also apply to touchpads

Figure 15 Touchpads are Implemented Using Two CapSense Sliders One For X and One For Y

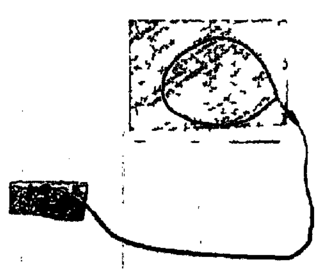


An example of a good CapSense touchpad is a commercially successful design with 20 position column slider (X) and 10 position row slider (Y) A total of 30 pins are assigned as CapSense inputs The dimensions of the active area are 3 9 x 1 9 (99 mm x 47 mm) The overlay is 0 010 (0 25 mm) ABS plastic The row and column sensors are spaced with a pitch of 0 2 (5 mm) The baseline noise level is a single count in the Finger Absent state A finger on the touchpad produces a difference signal of 15 counts which results in a signal to noise ratio (SNR) of 24 dB Setting the centroid algorithm to resolve 20 positions between each row pair and each column pair this touchpad system has a resolution of 100 counts per inch

2 5 Proximity Sensors

The CapSense User Module does not directly support proximity sensors A proximity sensor is implemented as a CapSense button with large C_P and small difference counts A dedicated proximity sensor is best implemented as a single length of wire as demonstrated in Figure 16 Connecting button and slider sensors already on the CapSense PCB into a single large sensor is another technique for implementing a proximity sensor

Figure 16 Rear View of a Proximity Sensor Prototype



2 6 Flex Circuits

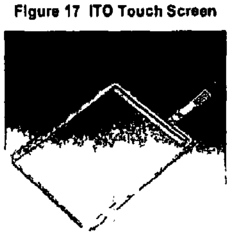
Flex circuits work well with CapSense All of the same guidelines presented for printed circuit boards also apply to flex A flex circuit is typically much thinner than a PCB Limit C_P by making the flex circuit no thinner than 0 01 (0 25 mm) and limiting trace lengths to a few inches One good feature of flex is the high breakdown voltage provided by the Kapton material (290 KV/mm)

2 7 ITO Touch Screens

ITO is an acronym for Indium Tin Oxide Films of this ceramic material are both electrically conductive and visually transparent An example ITO touch screen is shown in Figure 17 Sheet resistivity of ITO films range from 0 25 1000 ohms/square with the typical value of 100 500 ohms/square Thickness determines the sheet resistivity Thinner material passes more light and has higher resistance Thicker material blocks more light and has lower resistance

Touch screens can operate in either resistive or capacitive modes Both modes have their niche markets Resistive mode requires pressure for contact between conductive layers and is prone to wear tear and breakage Resistive mode is a four layer solution with poor transparency (<75%) Capacitive mode makes use of the finger as a conductive object Capacitive mode is a one layer or two layer solution with high transparency (>90%) Cypress supports both touch screen technologies

Figure 17 ITO Touch Screen



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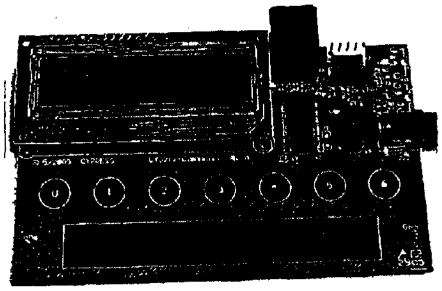
3 From Concept to Production CapSense Tools and Techniques

3 1 Evaluation Boards and Example Firmware

Figure 18 CY3212-CapSense Training Evaluation Board



The CY3212 board shown in Figure 18 is an evaluation board for development of CapSense applications Application firmware is written in C A library of common functions makes development of projects as simple as writing a few lines of code

Here is an example of the code required to scan two sensors in an array of buttons and save the result in an I2C array

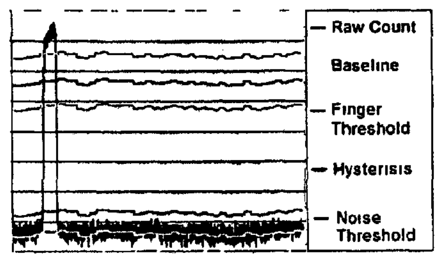
Code 1

```
// starting with sensor0 scan sensor single s an
mod
SensorArray_StartScan(0 2 0)

//scan compl te
while ( (SensorArray_GetScanStatus() &
              SensorArray_SCAN_SET_COMPLETE))

/  ave sensor a d se sor results in    ar av
info iRawCount[0]   SensorArray_waSnsResult[0]
info iRawCount[1]   SensorArray_iwaSnsResult[1];
```

3 2 Baseline Technique

The baseline is the reference for CapSense measurements Each capacitive sensor has its own baseline The baseline is a trend line for the capacitive sensor data that is computed by the Baseline function of the CapSense User Module The raw count data is processed using an Infinite Impulse Response (IIR) low pass filter as shown in Figure 19 High level decisions such as Finger Present and Finger Absent states are based on the reference level established by the baseline

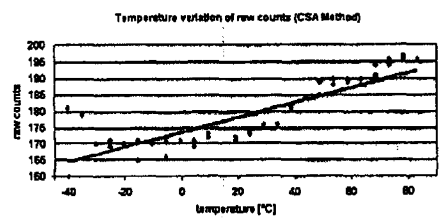
Figure 19 Baseline is Trend in CapSense Data that is Continuously Updated



3 3 Environmental Effects

Temperature and Humidity Temperature and humidity both cause the baseline counts to drift over time The CapSense User Module is characterized from -40°C to +85°C as shown in Figure 20 The trend that is tracked by the baseline automatically compensates for the effects of temperature and humidity

Figure 20 Temperature Variation
(Raw Counts Drift Over Temp Humidity has Similar Effect)



Water CapSense can function well in the presence of water as long as it is in the form of a mist settling on the overlay or small drops of water splashing on the sensors Water can be managed through smart mechanical design of the assembly Mount the sensors either vertically or at an angle to allow water to run off the surface Add channels to the overlay in areas that are free of sensors to assist the run off Construct bumps over buttons to prevent puddles from forming

CapSense will not work underwater or with a constant stream of water running over the sensors

3 4 Power Consumption and Sleep

Battery life is determined by mA hours The lower the average current the longer CapSense operates between recharges (see Reference [3]) The PSoC can be programmed so that it has different modes of power consumption

- A fast response mode during intervals of constant button presses
- A power saving slow response mode after a period of inactivity
- A deep sleep mode after a longer period of inactivity

One of the strengths of PSoC as compared to other capacitive sensing solutions is its programmability The user can make the power saving modes of CapSense as sophisticated as required CapSense buttons are fast taking as little as 200 microseconds for each button scanned This high scan speed can be combined with a low sleep current to achieve very low average currents One example of the real CapSense system is power saving slow response mode using a three button scan every 100 milliseconds while consuming less than 50 µA of average current

3 5 Noise Filtering

Noise is introduced into the CapSense system through both conductive and radiated sources Conductive noise enters the system through power and signal lines Radiated sources such as cell phones or fluorescent lamp ballasts introduce noise through the air Filtering techniques in firmware can be used to increase the signal to noise ratio of the CapSense system in the presence of both types of noise PSoC can implement Finite Impulse Response (FIR) and Infinite Impulse Response (IIR) digital filters with only a few lines of code

FIR Filter The frequency of finger pressing events is low compared to the frequency of power line noise A low pass filter (LPF) is an effective noise filtering solution for this situation An FIR LPF is defined by

$$y = (x1 + x2 + \quad + xN)/N \qquad (1)$$

Raw counts are sampled N times per cycle of the noise The N samples are combined together per Equation (1) With 50 Hz noise the sample period must be 18 ms/N The performance of the FIR filter increases with N so make N as large as the system will allow

IIR Filter An FIR filter has a disadvantage in that it needs to be a much higher order than an IIR filter to get the same result It may also be difficult to adjust the sample rate to fit the period of the noise So in some cases an IIR filter is a more appropriate choice for the LPF Table 2 compares the FIR and IIR filters

Table 2 Low Pass Filter Comparison – FIR versus IIR

Filter Type (order=N)	RAM	Response Time	Always Stable?
FIR LPF	1	N T	Yes
IIR LPF	N 2	T	No

3 6 RF Immunity Considerations

RF can interfere with the operation of any capacitive sensing system including CapSense (see Reference [4]) Where the electric field strength is high enough RF interference can cause false button presses or prevent real button presses from being sensed A cell phone is a good example of where an RF transmitter and buttons are purposely combined in close proximity

The electric field strength at a distance greater than 1/6 of a wavelength from a transmitter is approximated by Equation (2)

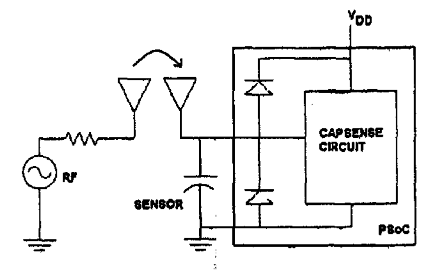
$$E = 6\ 85 * \frac{\sqrt{10^{(P/10)}}}{D} \qquad (2)$$

- E [volts/meter] = electric field
- P [dBm] = RF power fed to antenna
- D [inches] = distance from antenna to field sensor

For an 800 MHz cell phone transmitting at +28 dBm (0 6W) the electric field 3 from the antenna is estimated to be around 60 V/m

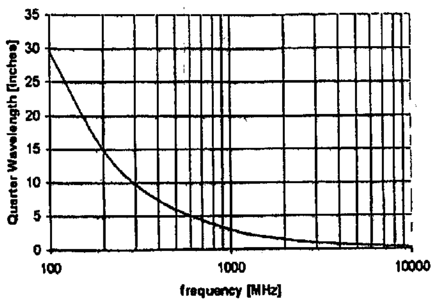
Figure 21 shows the equivalent circuit of the RF interference scenario with the PSoC configured to run CapSense Internal diodes protect the PSoC from ESD events up to 2 KV

Figure 21 Diodes at Input of PSoC Provide ESD Protection



The resonant effects of a circuit trace form the receiver antenna A quarter wavelength trace is an efficient antenna Figure 22 shows the length of a quarter wavelength antenna versus frequency

Figure 22 Quarter Wavelength Trace Is an Efficient Antenna



For a low level RF signal the CapSense circuit operates with no effect on the digital output of the system since low levels of RF look like background noise and are ignored by the system When the RF power increases the CapSense counts are offset a constant amount that is set by the power level of the interference The RF signal is AC but the effect on CapSense counts is DC due to the diodes on the CapSense input A positive shift in counts can cause false button presses A negative shift can prevent real button presses from being sensed The Finger and Noise Thresholds of the CapSense User Module allow normal operation in the presence of small shifts in the counts For higher levels of RF interference other measurements need to be taken Following are two solutions

- RF Solution #1 Coordinate RF and CapSense If the source of the interference is part of the same system in which CapSense is embedded then disable CapSense when RF is transmitting One pin on the PSoC is assigned to monitor a Transmit_Enable signal CapSense counts would continue to be effected by the high power RF but counts would only be valid with the transmitter turned off
- RF Solution #2 Damp the Resonance Resistors placed in series with the CapSense input will damp the resonance of each trace The recommended series resistance added to the CapSense inputs is 560 ohms Communication lines I2C and SPI benefit from 300 ohms in series

3 7 ESD Considerations

The electrostatic voltage on the human body can reach 15 KV when the humidity is low The type of clothes worn by the CapSense user makes a difference as shown in Figure 23

Figure 23 Electrostatic Voltage on a Human Body Versus Relative Humidity and Material Type

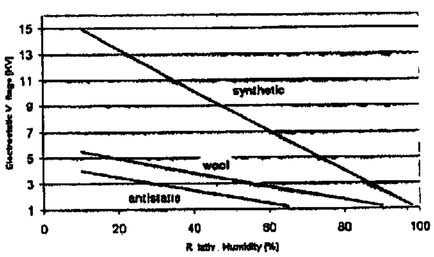


Table 3 shows the minimum thickness required to withstand 12 KV for common overlay materials The overlay in the CapSense system will protect the PSoC from permanent damage when the thickness guidelines of the table are followed A layer of Kapton tape works well in applications needing extra ESD protection

Table 3 Breakdown Voltage of Overlay Materials and Minimum Thickness to Prevent Breakdown

Material	Breakdown Voltage [V/mm]	Min Overlay Thickness at 12 KV [mm]
Air	1200 – 2800	10
Glass Common	7900	1 5
Glass Borosilicate (Pyrex)	13 000	0 9
Formica	18,000	0 7
ABS	16 000	0 8
Acrylic (Plexiglass)	13 000	0 9
Polycarbonate (Lexan)	16 000	0 8
PET Film (Mylar)	280 000	0 04
Polyimide Film (Kapton)	290 000	0 04
FR-4	28 000	0 4
Wood Dry	3900	3

Conclusion

The Best Practices for CapSense designs presented in this Application Note enable engineers to successfully add capacitive sensing features to their products

References

[1] Application Note AN2233a Capacitive Switch Scan Cypress Semiconductor

[2] Application Note AN2292 Layout Guidelines for PSoC CapSense Cypress Semiconductor

[3] Application Note AN2360 Power Consumption and Sleep Considerations with CapSense Cypress Semiconductor

[4] Application Note AN2318 EMC Design Considerations for PSoC CapSense Applications Cypress Semiconductor

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s) The minimum possible
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doff interval *See also* os
(IM/HFIM) [40]

ep

sweep reset (oscilloscopes) In oscilloscopes with single sweep operation the arming of the sweep generator to allow it to cycle once *See also* oscillograph (IM/HFIM) [40]

sweep sine wave *See* sine wave sweep

sweep, stairstep *See* stairstep sweep

sweep switching (automatic) Alternate display of two or more time bases or other sweeps using a single beam cathode ray tube comparable to dual or multiple trace operation of the deflection amplifier (IM) 311 1970w

sweep time (acoustically tunable optical filter) The time to continuously tune the filter over its spectral range (UFFC) [17]

sweep time division (spectrum analyzer) The nominal time required for the spot in the reference coordinate to move from one graticule division to the next Also the name of the control used to select this time (IM) 748 1979w

swell (1) A momentary increase in the power frequency voltage delivered by the mains outside of the normal tolerances with a duration of more than one cycle and less than a few seconds *See also* surge (SPD/PE) C62 48 1995 C62 41 1991r
(2) An rms increase in the ac voltage at the power frequency for durations from a half cycle to a few seconds *See also* overvoltage surge (PE/T&D) 1250 1995
(3) An increase in rms voltage or current at the power frequency for durations from 0 5 cycles to 1 min Typical values are 1 1 to 1 8 pu See the figure below (SCC22/IA/PSE) 1346 1998 1100 1999

swellable powder A powder that swells upon contact with moisture A jelly like material is formed to block the longitudinal transmission of moisture (PE/IC) 1142 1995

swim The visual misrepresentation that occurs when images on a display surface appear to move about their normal positions (C) 610 6 1991w

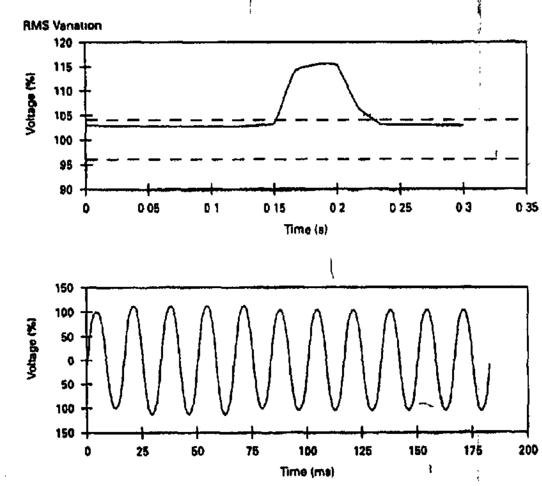
swing A transient power flow due to change in relative angles of generation on the system caused by a change in transmission or generation configuration (PE/PSR) C37 113 1999

swinging compass (navigation aid terms) An accurate portable magnetic compass used to indicate magnetic headings during aircraft magnetic compass calibration (AES/GCS) 172 1983w

swingout panel (packaging machinery) A panel that is hinge mounted in such a manner that the back of the panel may be made accessible from the front of the enclosure (IA/PKG) 333 1980w

swing rack cabinet An assembly enclosed at the top side and rear with front hinged door for front access having a swing open frame for equipment mounting (e g nominal 19 inch wide chassis and subpanel assemblies) (SWG/PE) C37 100 1992 C37 21 1985r

switch (1) (telephone loop performance) (switching system) A system that establishes communication channels among two or more of its interfaces at customers demand (COM/TA) 820 1984r
(2) **(high voltage switchgear)** A device designed to close or open or both one or more electric circuits *See also* switching device (SWG/PE) C37 40 1993
(3) **(computers)** A device or programming technique for making a selection for example a toggle a conditional jump (C) [20] [85]
(4) **(electric and electronics parts and equipment)** A device for making breaking or changing the connections in an electric circuit *Note* a switch may be operated by manual mechanical hydraulic thermal barometric or gravitational means or by electromechanical means not falling within the definition of relay (GSD) 200 1975w
(5) A device that connects ringlets and has queues It can behave as a consumer (when accepting remote subactions) and as a producer (when forwarding the subaction to another ringlet) It may be visible as a node with a nodeId or be transparent with no nodeId A switch differs from a bridge in that a switch may connect more than two ringlets but a bridge connects only two A switch is generally assumed to connect multiple instances of the same bus standard while a bridge may connect different bus standards (C/MM) 1596 1992
(6) A routing device (for example a box or board) providing a set of numbered node interfaces constructed from one or more switch chips (or by other methods) *See also* switch chip fabric node interface (C/BA) 1355 1995
(7) (A) An electrical or mechanical device used for opening closing or changing the connection of a circuit *Synonym*



Swells occurring upon recovery from a remote system fault
swell

switchpoint *See also* DIP switch display switch sense switch function switch relay (B) To open close or change the connection of a circuit as in definition (A) (C) A device used for making a selection as in a toggle
(C) 610 10 1994
(8) A device for opening and closing or for changing the con nection of a circuit In these rules a switch is understood to be manually operable unless otherwise stated
(NESC/T&D) C2 1997 C2 2 1960
(9) In a propulsion system the historic name for the lowest level of positive tractive effort and power so called because it is typically utilized for slow speed switching movements such as yard moves train makeup etc (VT) 1475 1999
(10) A layer 2 interconnection device that conforms to the ISO/IEC 10038 [ANSI/IEEE 802 1D 1990] International Standard *Synonym* bridge (C/LM) 802 3 1998
(11) An electronic device connected between two data lines A switch can exist in one of two states referred to as open and closed The state at any time depends on a digital con trol variable When the switch is open the pathway between the two data lines has a very high impedance (ideally infinite) so that signals appearing on the data lines should be com pletely independent When the switch is closed the pathway between the two data lines has a very low impedance (ideally zero) so that signals on the two data lines should be identical *Notes* 1 Practical electronic switches implemented in silicon depart from the ideal in at least three ways

a) In the on state the pathway between the two data lines may have significant impedance or the relationship be tween voltage and current may be nonlinear (e g a volt age dependent impedance)
b) In the off state there may be significant interaction be tween the signals on the two data lines due to for example stray capacitance
c) In either state there may be significant leakage pathways through which current can pass from the data lines to the surrounding circuitry or vice versa

The effects of all these characteristics will need to be consid ered as part of the detailed implementation especially in a system containing multiple switch networks 2 A switching action effectively in series with the function signal pathway can sometimes be obtained without a physically separate de vice by incorporating a high Z or enable facility into the func tional circuitry 3 Data transmission through a switch is nor mally assumed to be bidirectional (as with electromechanical devices such as relays or semiconductor switches such as transmission gates) Some forms of switch can implement only unidirectional voltage or current dependence *See also* conceptual switch high Z (C/TT) 1149 4 1999

switch base The main members to which the insulator units are attached (SWG/PE) C37 30 1992s

switchboard (1) (electric power system) A large single panel frame or assembly of panels on which are mounted on the face or back or both switches overcurrent and other protec tive devices buses and usually instruments *Note* Switch boards are generally accessible from the rear as well as from the front and are not intended to be installed in cabinets *See also* panelboard center of distribution distribution center
(NESC) [86]
(2) A type of switchgear assembly that consists of one or more panels with electric devices mounted thereon and as sociated framework *Note* Switchboards may be classified by function that is power switchboards or control switchboards Both power and control switchboards may be further classi fied by construction as defined
(SWG/PE/NESC) C37 100-1992 C2 1997
(3) When referred to in connection with supply of electricity a large single panel frame or assembly of panels on which are mounted (on the face or back or both) switches fuses buses and usually instruments (T&D) C2 2 1960

switchboard cord A cord that is used in conjunction with switchboard apparatus to complete or build up a telephone connection (EEC/PE) [119]

switchboard lamp (switchboard) A small electric lamp asso ciated with the wiring in such a way as to give a visual in dication of the status of a call or to give information con cerning the condition of trunks subscriber lines and apparatus (EEC/PE) [119]

switchboard position (telephone switching systems) That por tion of a manual switchboard normally provided for the use of one operator (COM) 312 1977w

switchboards and panels (electric installations on shipboard) A generator and distribution switchboard receives energy from the generating plant and distributes directly or indirectly to all equipment supplied by the generating plant A subdis tribution switchboard is essentially a section of the generator and distribution switchboard (connected thereto by a bus feeder and remotely located for reasons of convenience or economy) that distributes energy for lighting heating and power circuits in a certain section of the vessel A distribution panel receives energy from a distribution or subdistribution switchboard and distributes energy to energy consuming de vices or other distribution panels or panelboards A panel board is a distribution panel enclosed in a metal cabinet
(IA/MT) 45 1983s

switchboard section (telephone switching systems) A struc tural unit providing for one or more operator positions A complete switchboard may consist of one or more sections
(COM) 312 1977w

switchboard supervisory lamp (cord circuit or trunk circuit) A lamp that is controlled by one or other of the users to attract the attention of the operator (EEC/PE) [119]

switchboard supervisory relay A relay that controls a switch board supervisory lamp (EEC/PE) [119]

switch chip A VLSI integrated circuit with two or more link interfaces between which it provides packet routing *See also* link switch (C/BA) 1355 1995

switch compartment (metal enclosed interrupter switch gear) That portion of the switchgear assembly that contains one switching device such as an interrupter switch power fuse interrupter switch combination etc and the associated primary conductors (SWG/PE) C37 20 3 1996

switch core A magnetic core in which the core material gen erally has a high residual flux density and a high ratio of residual to saturated flux density Switching does not occur when the magnetic force imposed on the core is below a threshold value (C) 610 10-1994w

switched bank A capacitor bank designed for controlled oper ation power systems relaying
(T&D/PE) 1036 1992 C37 99 2000

switched current The prospective current to be broken during a switching operation by each set of main switching or tran sition contacts (resistance type LTC) or transfer contacts (re actance type LTC) incorporated in the arcing switch or arcing tap switch (PE/TR) C57 131 1995

switched network (1) A computer interconnect that uses switches to allow intermodule communications
(C/BA) 14536-1995
(2) A network using a switching technique to direct messa ges from the sender to the ultimate recipient *See also* circuit switched network store and forward switched network
(C) 610 7 1995

switched service network (telephone switching systems) An arrangement of dedicated switching facilities to provide tele communications services for a specific customer
(COM) 312 1977w

switched virtual circuit A virtual circuit that is established on an as needed basis to interconnect any two end users attached to a network *Note* SVC service requires the definition of some call control procedures for the establishment mainte nance and termination of the virtual circuit An SVC may not be available when the user wants if too many SVCs are open at once *See also* permanent virtual circuit
(C) 610 7 1995

switched way

switched way (1)
pole group oper
(2) A way conn

(3) A way conne
operated switch

switchgear (1) A
rupting devices a
instrumentation
also assemblies
tions accessorie
connection with
and conversion c
(SV
C3
(2) (hydroelectri
used to switch n

switchgear assemb
door) including
ing categories s
tion metering p
with their suppor
trical interconnec
(SWG/PE) C37

switchgear potheai
where the inside
It may be an indo
modified by silve
carrying parts an
the higher operati

switchgear protec
switch hook (hook
ciated with the s
It is operated by
or handset on the
stick
switch indicator (1
to indicate the pr

(2) An indicator t
flag
switching (1) The p
is reversed (or re
equal and opposi
fields or mechani
(2) (single phase
at which the stat
connection arrang
machine
(3) (test measure
of manually mec
for opening or clo
(4) In networking
lished by closing
sage switching d

(5) The process of
switching amplifier
so that its output
dependent upon t
feedback control s
switching array (tel
of multipled cross
switching branch (s
circuit including a
two principal term
clude one or mc
switching element

CY00002303

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APPLICATION NO	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO	CONFIRMATION NO
11/230 719	09/19/2005	Harold Kutz	CD05060	4591

28960 7590 11/30/2007
HAVERSTOCK & OWENS LLP
162 N WOLFE ROAD
SUNNYVALE CA 94086

EXAMINER	
NGUYEN VINCENT Q	

ART UNIT	PAPER NUMBER
2858	

MAIL DATE	DELIVERY MODE
11/30/2007	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)

Advisory Action Before the Filing of an Appeal Brief	Application No 11/230 719	Applicant(s) KUTZ ET AL	
	Examiner Vincent Q Nguyen	Art Unit 2858	

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

THE REPLY FILED 07 November 2007 FAILS TO PLACE THIS APPLICATION IN CONDITION FOR ALLOWANCE

1 ☒ The reply was filed after a final rejection but prior to or on the same day as filing a Notice of Appeal To avoid abandonment of this application applicant must timely file one of the following replies (1) an amendment affidavit or other evidence which places the application in condition for allowance (2) a Notice of Appeal (with appeal fee) in compliance with 37 CFR 41 31 or (3) a Request for Continued Examination (RCE) in compliance with 37 CFR 1 114 The reply must be filed within one of the following time periods

a) ☐ The period for reply expires ______months from the mailing date of the final rejection

b) ☒ The period for reply expires on (1) the mailing date of this Advisory Action or (2) the date set forth in the final rejection whichever is later In no event however will the statutory period for reply expire later than SIX MONTHS from the mailing date of the final rejection

Examiner Note If box 1 is checked check either box (a) or (b) ONLY CHECK BOX (b) WHEN THE FIRST REPLY WAS FILED WITHIN TWO MONTHS OF THE FINAL REJECTION See MPEP 706 07(f)

Extensions of time may be obtained under 37 CFR 1 136(a) The date on which the petition under 37 CFR 1 136(a) and the appropriate extension fee have been filed is the date for purposes of determining the period of extension and the corresponding amount of the fee The appropriate extension fee under 37 CFR 1 17(a) is calculated from (1) the expiration date of the shortened statutory period for reply originally set in the final Office action or (2) as set forth in (b) above if checked Any reply received by the Office later than three months after the mailing date of the final rejection even if timely filed may reduce any earned patent term adjustment See 37 CFR 1 704(b)

NOTICE OF APPEAL

2 ☐ The Notice of Appeal was filed on _____ A brief in compliance with 37 CFR 41 37 must be filed within two months of the date of filing the Notice of Appeal (37 CFR 41 37(a)) or any extension thereof (37 CFR 41 37(e)) to avoid dismissal of the appeal Since a Notice of Appeal has been filed any reply must be filed within the time period set forth in 37 CFR 41 37(a)

AMENDMENTS

3 ☐ The proposed amendment(s) filed after a final rejection but prior to the date of filing a brief will not be entered because

(a) ☐ They raise new issues that would require further consideration and/or search (see NOTE below)

(b) ☐ They raise the issue of new matter (see NOTE below)

(c) ☐ They are not deemed to place the application in better form for appeal by materially reducing or simplifying the issues for appeal and/or

(d) ☐ They present additional claims without canceling a corresponding number of finally rejected claims

NOTE _____ (See 37 CFR 1 116 and 41 33(a))

4 ☐ The amendments are not in compliance with 37 CFR 1 121 See attached Notice of Non Compliant Amendment (PTOL 324)

5 ☐ Applicant s reply has overcome the following rejection(s) _____

6 ☐ Newly proposed or amended claim(s) _____ would be allowable if submitted in a separate timely filed amendment canceling the non allowable claim(s)

7 ☒ For purposes of appeal the proposed amendment(s) a) ☒ will not be entered or b) ☐ will be entered and an explanation of how the new or amended claims would be rejected is provided below or appended

The status of the claim(s) is (or will be) as follows

Claim(s) allowed *15-17,19 and 20*

Claim(s) objected to *4,5,9,10,12 and 13*

Claim(s) rejected *1,2,6 8,11 and 14*

Claim(s) withdrawn from consideration _____

AFFIDAVIT OR OTHER EVIDENCE

8 ☐ The affidavit or other evidence filed after a final action but before or on the date of filing a Notice of Appeal will not be entered because applicant failed to provide a showing of good and sufficient reasons why the affidavit or other evidence is necessary and was not earlier presented See 37 CFR 1 116(e)

9 ☐ The affidavit or other evidence filed after the date of filing a Notice of Appeal but prior to the date of filing a brief will not be entered because the affidavit or other evidence failed to overcome all rejections under appeal and/or appellant fails to provide a showing a good and sufficient reasons why it is necessary and was not earlier presented See 37 CFR 41 33(d)(1)

10 ☐ The affidavit or other evidence is entered An explanation of the status of the claims after entry is below or attached

REQUEST FOR RECONSIDERATION/OTHER

11 ☐ The request for reconsideration has been considered but does NOT place the application in condition for allowance because

12 ☐ Note the attached Information Disclosure Statement(s) (PTO/SB/08) Paper No(s) _____

13 ☒ Other See Continuation Sheet

V. Nguyen

Vincent Q Nguyen
Primary Examiner
Art Unit 2858

Continuation of 13 Other Claims read on the prior art as examiner interpreted in the Office aciton

06

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APPLICATION NO	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO	CONFIRMATION NO
11/395 417	03/31/2006	Dennis Seguine	CD05044	3171

7590 07/06/2007

WALKER & SAKO LLP
Suite 235
300 South First Street
San Jose CA 95113

EXAMINER	
ZHU JOHN X	

ART UNIT	PAPER NUMBER
2858	

MAIL DATE	DELIVERY MODE
07/06/2007	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

Advisory Action Before the Filing of an Appeal Brief	Application No 11/395 417	Applicant(s) SEGUINE DENNIS	
	Examiner John Zhu	Art Unit 2858	

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

THE REPLY FILED 22 June 2007 FAILS TO PLACE THIS APPLICATION IN CONDITION FOR ALLOWANCE

1 ☒ The reply was filed after a final rejection but prior to or on the same day as filing a Notice of Appeal To avoid abandonment of this application applicant must timely file one of the following replies (1) an amendment affidavit or other evidence which places the application in condition for allowance (2) a Notice of Appeal (with appeal fee) in compliance with 37 CFR 41 31 or (3) a Request for Continued Examination (RCE) in compliance with 37 CFR 1 114 The reply must be filed within one of the following time periods

a) ☐ The period for reply expires ______months from the mailing date of the final rejection

b) ☒ The period for reply expires on (1) the mailing date of this Advisory Action or (2) the date set forth in the final rejection whichever is later In no event however will the statutory period for reply expire later than SIX MONTHS from the mailing date of the final rejection

Examiner Note If box 1 is checked check either box (a) or (b) ONLY CHECK BOX (b) WHEN THE FIRST REPLY WAS FILED WITHIN TWO MONTHS OF THE FINAL REJECTION See MPEP 706 07(f)

Extensions of time may be obtained under 37 CFR 1 136(a) The date on which the petition under 37 CFR 1 136(a) and the appropriate extension fee have been filed is the date for purposes of determining the period of extension and the corresponding amount of the fee The appropriate extension fee under 37 CFR 1 17(a) is calculated from (1) the expiration date of the shortened statutory period for reply originally set in the final Office action or (2) as set forth in (b) above if checked Any reply received by the Office later than three months after the mailing date of the final rejection even if timely filed may reduce any earned patent term adjustment See 37 CFR 1 704(b)

NOTICE OF APPEAL

2 ☐ The Notice of Appeal was filed on _____ A brief in compliance with 37 CFR 41 37 must be filed within two months of the date of filing the Notice of Appeal (37 CFR 41 37(a)) or any extension thereof (37 CFR 41 37(e)) to avoid dismissal of the appeal Since a Notice of Appeal has been filed any reply must be filed within the time period set forth in 37 CFR 41 37(a)

AMENDMENTS

3 ☒ The proposed amendment(s) filed after a final rejection but prior to the date of filing a brief will not be entered because

(a) ☒ They raise new issues that would require further consideration and/or search (see NOTE below)

(b) ☐ They raise the issue of new matter (see NOTE below)

(c) ☒ They are not deemed to place the application in better form for appeal by materially reducing or simplifying the issues for appeal and/or

(d) ☐ They present additional claims without canceling a corresponding number of finally rejected claims

NOTE *See Continuation Sheet* (See 37 CFR 1 116 and 41 33(a))

4 ☐ The amendments are not in compliance with 37 CFR 1 121 See attached Notice of Non Compliant Amendment (PTOL 324)

5 ☐ Applicant s reply has overcome the following rejection(s) _____

6 ☐ Newly proposed or amended claim(s) _____ would be allowable if submitted in a separate timely filed amendment canceling the non allowable claim(s)

7 ☒ For purposes of appeal the proposed amendment(s) a) ☒ will not be entered or b) ☐ will be entered and an explanation of how the new or amended claims would be rejected is provided below or appended

The status of the claim(s) is (or will be) as follows

Claim(s) allowed _____

Claim(s) objected to _____

Claim(s) rejected *1 9*

Claim(s) withdrawn from consideration *10 20*

AFFIDAVIT OR OTHER EVIDENCE

8 ☐ The affidavit or other evidence filed after a final action but before or on the date of filing a Notice of Appeal will not be entered because applicant failed to provide a showing of good and sufficient reasons why the affidavit or other evidence is necessary and was not earlier presented See 37 CFR 1 116(e)

9 ☐ The affidavit or other evidence filed after the date of filing a Notice of Appeal but prior to the date of filing a brief will not be entered because the affidavit or other evidence failed to overcome all rejections under appeal and/or appellant fails to provide a showing a good and sufficient reasons why it is necessary and was not earlier presented See 37 CFR 41 33(d)(1)

10 ☐ The affidavit or other evidence is entered An explanation of the status of the claims after entry is below or attached

REQUEST FOR RECONSIDERATION/OTHER

11 ☐ The request for reconsideration has been considered but does NOT place the application in condition for allowance because _____

12 ☐ Note the attached Information Disclosure Statement(s) (PTO/SB/08) Paper No(s) _____

13 ☐ Other _____

John Zhu

Continuation of 3 NOTE The newly added limitation of enabling or disabling a low impedance raises new issues that require futher consideration and search

ANJAN DEB
PRIMARY EXAMINER

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APPLICATION NO	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO	CONFIRMATION NO
11/437 517	05/18/2006	Jiang XiaoPing	CD06039	2623

60909 7590 04/07/2010
CYPRESS SEMICONDUCTOR CORPORATION
198 CHAMPION COURT
SAN JOSE CA 95134 1709

EXAMINER	
KETEMA BENYAM	
ART UNIT	**PAPER NUMBER**
2629	
MAIL DATE	**DELIVERY MODE**
04/07/2010	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)

CY00002310

Advisory Action Before the Filing of an Appeal Brief	**Application No** 11/437 517	**Applicant(s)** XIAOPING JIANG	
	Examiner BENYAM KETEMA	**Art Unit** 2629	

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

THE REPLY FILED 26 March 2010 FAILS TO PLACE THIS APPLICATION IN CONDITION FOR ALLOWANCE

1 ☒ The reply was filed after a final rejection but prior to or on the same day as filing a Notice of Appeal To avoid abandonment of this application applicant must timely file one of the following replies (1) an amendment affidavit or other evidence which places the application in condition for allowance (2) a Notice of Appeal (with appeal fee) in compliance with 37 CFR 41 31 or (3) a Request for Continued Examination (RCE) in compliance with 37 CFR 1 114 The reply must be filed within one of the following time periods

a) ☐ The period for reply expires ____months from the mailing date of the final rejection

b) ☒ The period for reply expires on (1) the mailing date of this Advisory Action or (2) the date set forth in the final rejection whichever is later In no event however will the statutory period for reply expire later than SIX MONTHS from the mailing date of the final rejection

Examiner Note If box 1 is checked check either box (a) or (b) ONLY CHECK BOX (b) WHEN THE FIRST REPLY WAS FILED WITHIN TWO MONTHS OF THE FINAL REJECTION See MPEP 706 07(f)

Extensions of time may be obtained under 37 CFR 1 136(a) The date on which the petition under 37 CFR 1 136(a) and the appropriate extension fee have been filed is the date for purposes of determining the period of extension and the corresponding amount of the fee The appropriate extension fee under 37 CFR 1 17(a) is calculated from (1) the expiration date of the shortened statutory period for reply originally set in the final Office action or (2) as set forth in (b) above if checked Any reply received by the Office later than three months after the mailing date of the final rejection even if timely filed may reduce any earned patent term adjustment See 37 CFR 1 704(b)

NOTICE OF APPEAL

2 ☐ The Notice of Appeal was filed on ____ A brief in compliance with 37 CFR 41 37 must be filed within two months of the date of filing the Notice of Appeal (37 CFR 41 37(a)) or any extension thereof (37 CFR 41 37(e)) to avoid dismissal of the appeal Since a Notice of Appeal has been filed any reply must be filed within the time period set forth in 37 CFR 41 37(a)

AMENDMENTS

3 ☐ The proposed amendment(s) filed after a final rejection but prior to the date of filing a brief will not be entered because

(a) ☐ They raise new issues that would require further consideration and/or search (see NOTE below)

(b) ☐ They raise the issue of new matter (see NOTE below)

(c) ☐ They are not deemed to place the application in better form for appeal by materially reducing or simplifying the issues for appeal and/or

(d) ☐ They present additional claims without canceling a corresponding number of finally rejected claims

NOTE ____ (See 37 CFR 1 116 and 41 33(a))

4 ☐ The amendments are not in compliance with 37 CFR 1 121 See attached Notice of Non Compliant Amendment (PTOL 324)

5 ☐ Applicant s reply has overcome the following rejection(s) ____

6 ☐ Newly proposed or amended claim(s) ____ would be allowable if submitted in a separate timely filed amendment canceling the non allowable claim(s)

7 ☒ For purposes of appeal the proposed amendment(s) a) ☐ will not be entered or b) ☒ will be entered and an explanation of how the new or amended claims would be rejected is provided below or appended

The status of the claim(s) is (or will be) as follows

Claim(s) allowed ____

Claim(s) objected to *5 17*

Claim(s) rejected *1 4 and 18 20*

Claim(s) withdrawn from consideration ____

AFFIDAVIT OR OTHER EVIDENCE

8 ☐ The affidavit or other evidence filed after a final action but before or on the date of filing a Notice of Appeal will not be entered because applicant failed to provide a showing of good and sufficient reasons why the affidavit or other evidence is necessary and was not earlier presented See 37 CFR 1 116(e)

9 ☐ The affidavit or other evidence filed after the date of filing a Notice of Appeal but prior to the date of filing a brief will not be entered because the affidavit or other evidence failed to overcome all rejections under appeal and/or appellant fails to provide a showing a good and sufficient reasons why it is necessary and was not earlier presented See 37 CFR 41 33(d)(1)

10 ☐ The affidavit or other evidence is entered An explanation of the status of the claims after entry is below or attached

REQUEST FOR RECONSIDERATION/OTHER

11 ☒ The request for reconsideration has been considered but does NOT place the application in condition for allowance because Examiner disagrees with the assertion of Tsujioka not disclosing three or more button operations using two areas of the sensing device as it is recited in claim 1 Tsujioka (fig 5) discloses two sensing area (24 and 25), further more (Fig.5) discloses three or more button operations (49 and input 50) Therefore one can see that multiple input operations (i e button operations) are done using two areas (24 and 25) of the sensing device (i e input device 21)

12 ☐ Note the attached Information *Disclosure Statement*(s) (PTO/SB/08) Paper No(s) ____

13 ☐ Other ____

/Bipin Shalwala/
Supervisory Patent Examiner Art Unit 2629

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APPLICATION NO	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO	CONFIRMATION NO
11/477 179	06/27/2006	Li GuangHai	CD06065	4534

60909 7590 06/07/2010
CYPRESS SEMICONDUCTOR CORPORATION
198 CHAMPION COURT
SAN JOSE CA 95134 1709

EXAMINER	
ZHOU HONG	

ART UNIT	PAPER NUMBER
2629	

MAIL DATE	DELIVERY MODE
06/07/2010	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)

Advisory Action Before the Filing of an Appeal Brief	**Application No** 11/477 179	**Applicant(s)** GUANGHAI LI
	Examiner HONG ZHOU	**Art Unit** 2629

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

THE REPLY FILED 25 May 2010 FAILS TO PLACE THIS APPLICATION IN CONDITION FOR ALLOWANCE

1 ☒ The reply was filed after a final rejection but prior to or on the same day as filing a Notice of Appeal To avoid abandonment of this application applicant must timely file one of the following replies (1) an amendment affidavit or other evidence which places the application in condition for allowance (2) a Notice of Appeal (with appeal fee) in compliance with 37 CFR 41 31 or (3) a Request for Continued Examination (RCE) in compliance with 37 CFR 1 114 The reply must be filed within one of the following time periods

a) ☐ The period for reply expires ____ months from the mailing date of the final rejection

b) ☒ The period for reply expires on (1) the mailing date of this Advisory Action or (2) the date set forth in the final rejection whichever is later In no event however will the statutory period for reply expire later than SIX MONTHS from the mailing date of the final rejection

Examiner Note If box 1 is checked check either box (a) or (b) ONLY CHECK BOX (b) WHEN THE FIRST REPLY WAS FILED WITHIN TWO MONTHS OF THE FINAL REJECTION See MPEP 706 07(f)

Extensions of time may be obtained under 37 CFR 1 136(a) The date on which the petition under 37 CFR 1 136(a) and the appropriate extension fee have been filed is the date for purposes of determining the period of extension and the corresponding amount of the fee The appropriate extension fee under 37 CFR 1 17(a) is calculated from (1) the expiration date of the shortened statutory period for reply originally set in the final Office action or (2) as set forth in (b) above if checked Any reply received by the Office later than three months after the mailing date of the final rejection even if timely filed may reduce any earned patent term adjustment See 37 CFR 1 704(b)

NOTICE OF APPEAL

2 ☐ The Notice of Appeal was filed on ____ A brief in compliance with 37 CFR 41 37 must be filed within two months of the date of filing the Notice of Appeal (37 CFR 41 37(a)) or any extension thereof (37 CFR 41 37(e)) to avoid dismissal of the appeal Since a Notice of Appeal has been filed any reply must be filed within the time period set forth in 37 CFR 41 37(a)

AMENDMENTS

3 ☐ The proposed amendment(s) filed after a final rejection but prior to the date of filing a brief will not be entered because

(a) ☐ They raise new issues that would require further consideration and/or search (see NOTE below)

(b) ☐ They raise the issue of new matter (see NOTE below)

(c) ☐ They are not deemed to place the application in better form for appeal by materially reducing or simplifying the issues for appeal and/or

(d) ☐ They present additional claims without canceling a corresponding number of finally rejected claims

NOTE ____ (See 37 CFR 1 116 and 41 33(a))

4 ☐ The amendments are not in compliance with 37 CFR 1 121 See attached Notice of Non Compliant Amendment (PTOL 324)

5 ☐ Applicant s reply has overcome the following rejection(s) ____

6 ☐ Newly proposed or amended claim(s) ____ would be allowable if submitted in a separate timely filed amendment canceling the non allowable claim(s)

7 ☒ For purposes of appeal the proposed amendment(s) a) ☐ will not be entered or b) ☒ will be entered and an explanation of how the new or amended claims would be rejected is provided below or appended

The status of the claim(s) is (or will be) as follows

Claim(s) allowed ____

Claim(s) objected to ____

Claim(s) rejected *22 and 24 31*

Claim(s) withdrawn from consideration ____

AFFIDAVIT OR OTHER EVIDENCE

8 ☐ The affidavit or other evidence filed after a final action but before or on the date of filing a Notice of Appeal will not be entered because applicant failed to provide a showing of good and sufficient reasons why the affidavit or other evidence is necessary and was not earlier presented See 37 CFR 1 116(e)

9 ☐ The affidavit or other evidence filed after the date of filing a Notice of Appeal but prior to the date of filing a brief will not be entered because the affidavit or other evidence failed to overcome all rejections under appeal and/or appellant fails to provide a showing a good and sufficient reasons why it is necessary and was not earlier presented See 37 CFR 41 33(d)(1)

10 ☐ The affidavit or other evidence is entered An explanation of the status of the claims after entry is below or attached

REQUEST FOR RECONSIDERATION/OTHER

11 ☒ The request for reconsideration has been considered but does NOT place the application in condition for allowance because See Continuation Sheet

12 ☐ Note the attached Information *Disclosure Statement*(s) (PTO/SB/08) Paper No(s) ____

13 ☐ Other ____

/Amare Mengistu/
Supervisory Patent Examiner Art Unit 2629

Continuation Sheet (PTOL 303) **Application No**

Continuation of 11 does NOT place the application in condition for allowance because On pages 5 7 of the response the Applicant argues against the combination of Chien and Gitzinger to teach the claimed limitations The Applicant first argues Gitzinger fails to disclose the feature of a pad layer that does not directly contact the routing layer when the particular key is pressed as recited in claim 22 The Applicant then argues Gitzinger fails to to disclose that the insulting layer is disposed between the routing layer and the pad layer as set forth in claim 22 The Examiner respectfully disagrees with this argument As can be seen from Fig 15 of Chien Chien discloses a pad layer comprising conductive material that corresponds tto a plurality of keys (conductor 954 are corresponding to keys 1 2 3 see [0031]) Chien further discloses an insulting layer is disposed between the routing layer and a pad layer (e g insulting layer 956 separates the pad layer 954 and routing layer 9682) The invehtion disclosed by Chien is missing only the limitation wherein the pad layer does not directly contact the routing layer when a particular key is pressed as recited in claim 22 However Gitizinger discloses a keypad wherein an insulting layer (e g plastic housing member 722 Fig 8) is disposed between a conductive object (e g a finger) and a routing layer (e g 826 828 and 830 Fig 8) and the conductive object does not directly contact the routing layer when a particular key is pressed Gitizinger teaches that by providing a routing layer with different discrete surfaces the processing device of the keypad would distiguish a particular key operation when faced in close proximity by a conductive object based on different capacitance produced by the discete surface thus if the invention of Chien is modified with the features of the insulting layer the routing layer and the processing device of Gitizinger then the keypad would have a simpler interconenct lower weight and more reliability thus one of ordinary skill in the art would have motivated to combine the references to obtain the invention as claimed in claim 22 Thus the rejection is maintained

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APPLICATION NO	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO	CONFIRMATION NO
12/367 279	02/06/2009	Dennis Seguine	CD05044DIV	9537

60909 7590 06/25/2010
CYPRESS SEMICONDUCTOR CORPORATION
198 CHAMPION COURT
SAN JOSE CA 95134 1709

EXAMINER	
ZHU JOHN X	

ART UNIT	PAPER NUMBER
2831	

MAIL DATE	DELIVERY MODE
06/25/2010	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)

Advisory Action *Before the Filing of an Appeal Brief*	Application No 12/367 279	Applicant(s) SEGUINE DENNIS
	Examiner JOHN ZHU	Art Unit 2831

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

THE REPLY FILED 01 June 2010 FAILS TO PLACE THIS APPLICATION IN CONDITION FOR ALLOWANCE

1 ☒ The reply was filed after a final rejection but prior to or on the same day as filing a Notice of Appeal To avoid abandonment of this application applicant must timely file one of the following replies (1) an amendment affidavit or other evidence which places the application in condition for allowance (2) a Notice of Appeal (with appeal fee) in compliance with 37 CFR 41 31 or (3) a Request for Continued Examination (RCE) in compliance with 37 CFR 1 114 The reply must be filed within one of the following time periods

a) ☐ The period for reply expires ____ months from the mailing date of the final rejection

b) ☒ The period for reply expires on (1) the mailing date of this Advisory Action or (2) the date set forth in the final rejection whichever is later In no event however will the statutory period for reply expire later than SIX MONTHS from the mailing date of the final rejection

Examiner Note If box 1 is checked check either box (a) or (b) ONLY CHECK BOX (b) WHEN THE FIRST REPLY WAS FILED WITHIN TWO MONTHS OF THE FINAL REJECTION See MPEP 706 07(f)

Extensions of time may be obtained under 37 CFR 1 136(a) The date on which the petition under 37 CFR 1 136(a) and the appropriate extension fee have been filed is the date for purposes of determining the period of extension and the corresponding amount of the fee The appropriate extension fee under 37 CFR 1 17(a) is calculated from (1) the expiration date of the shortened statutory period for reply originally set in the final Office action or (2) as set forth in (b) above if checked Any reply received by the Office later than three months after the mailing date of the final rejection even if timely filed may reduce any earned patent term adjustment See 37 CFR 1 704(b)

NOTICE OF APPEAL

2 ☐ The Notice of Appeal was filed on ____ A brief in compliance with 37 CFR 41 37 must be filed within two months of the date of filing the Notice of Appeal (37 CFR 41 37(a)) or any extension thereof (37 CFR 41 37(e)) to avoid dismissal of the appeal Since a Notice of Appeal has been filed any reply must be filed within the time period set forth in 37 CFR 41 37(a)

AMENDMENTS

3 ☐ The proposed amendment(s) filed after a final rejection but prior to the date of filing a brief will not be entered because

(a) ☐ They raise new issues that would require further consideration and/or search (see NOTE below)

(b) ☐ They raise the issue of new matter (see NOTE below)

(c) ☐ They are not deemed to place the application in better form for appeal by materially reducing or simplifying the issues for appeal and/or

(d) ☐ They present additional claims without canceling a corresponding number of finally rejected claims

NOTE ____ (See 37 CFR 1 116 and 41 33(a))

4 ☐ The amendments are not in compliance with 37 CFR 1 121 See attached Notice of Non Compliant Amendment (PTOL 324)

5 ☐ Applicant s reply has overcome the following rejection(s) ____

6 ☐ Newly proposed or amended claim(s) ____ would be allowable if submitted in a separate timely filed amendment canceling the non allowable claim(s)

7 ☒ For purposes of appeal the proposed amendment(s) a) ☐ will not be entered or b) ☒ will be entered and an explanation of how the new or amended claims would be rejected is provided below or appended

The status of the claim(s) is (or will be) as follows

Claim(s) allowed *10 18,21,22 and 28*

Claim(s) objected to ____

Claim(s) rejected *23 27*

Claim(s) withdrawn from consideration ____

AFFIDAVIT OR OTHER EVIDENCE

8 ☐ The affidavit or other evidence filed after a final action but before or on the date of filing a Notice of Appeal will not be entered because applicant failed to provide a showing of good and sufficient reasons why the affidavit or other evidence is necessary and was not earlier presented See 37 CFR 1 116(e)

9 ☐ The affidavit or other evidence filed after the date of filing a Notice of Appeal but prior to the date of filing a brief will not be entered because the affidavit or other evidence failed to overcome all rejections under appeal and/or appellant fails to provide a showing a good and sufficient reasons why it is necessary and was not earlier presented See 37 CFR 41 33(d)(1)

10 ☐ The affidavit or other evidence is entered An explanation of the status of the claims after entry is below or attached

REQUEST FOR RECONSIDERATION/OTHER

11 ☒ The request for reconsideration has been considered but does NOT place the application in condition for allowance because See Continuation Sheet

12 ☐ Note the attached Information *Disclosure Statement*(s) (PTO/SB/08) Paper No(s) ____

13 ☒ Other As the double patenting rejection stands because of the improper Terminal Disclaimer, the application is not in condition for allowance The changes to the claims are minor and regard to issues not affecting the scope of the invention, and thus will be entered

/Diego Gutierrez/
Supervisory Patent Examiner Art Unit 2831

/John Zhu/
Examiner Art Unit 2831

Continuation of 11 does NOT place the application in condition for allowance because the Terminal Disclaimer filed on 6/1/10 is not approved because it failed to state capacity to sign on behalf of assignee

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11 D

APPLICATION NO	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO	CONFIRMATION NO
11/230 719	09/19/2005	Harold Kutz	CD05060	4591

28960 7590 09/07/2007
HAVERSTOCK & OWENS LLP
162 N WOLFE ROAD
SUNNYVALE CA 94086

EXAMINER
NGUYEN VINCENT Q

ART UNIT	PAPER NUMBER
2858	

MAIL DATE	DELIVERY MODE
09/07/2007	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

Office Action Summary	Application No	Applicant(s)
	11/230 719	KUTZ ET AL
	Examiner	Art Unit
	Vincent Q Nguyen	2858

-- 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 *27 August 2007*

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) *1,2,4-17,19 and 20* is/are pending in the application

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

5)☒ Claim(s) *15-17,19 and 20* is/are allowed

6)☒ Claim(s) *1,2,6-8,11 and 14* is/are rejected

7)☒ Claim(s) *4,5,9,10,12,13* 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 1449 or PTO/SB/08) Paper No(s)/Mail Date _____
4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date _____
5) ☐ Notice of Informal Patent Application (PTO 152)
6) ☐ Other _____

DETAILED ACTION

Objections

1 With respect to the amendments (cancellations) of claims 3 and 18, the text of the claims must not be presented (See 37 CFR 1 121) In addition, the identifiers are misspelling Appropriate correction is required

Claim Rejections - 35 USC § 102

2 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

3 Claims 1, 6-9, 14 are rejected under 35 U S C 102(e) as being anticipated by Hara (2005/0031175)

With respect to claims 1, 6, Hara discloses a method comprising the steps of sequentially connecting different sets of N capacitive sensor inputs (31) to a common sense node (38), where N is an integer greater than 1 and for each set of N capacitive sensor inputs (Any combination of elements 38 selected by element 10), detecting if a capacitance at the N capacitive sensor inputs (31) is within a predetermined range (Paragraphs 12-17 and 76-79)

With respect to claim 7 Hara discloses a plurality of switch devices (14) that connect capacitive sensor inputs (31) to a common node (38) when enabled a measuring circuit (Figure 4) coupled to the common node (38) that determines when the capacitance at the common node is outside of a predetermined range, a switch controller (51) that sequentially enables different sets of N switch devices essentially simultaneously

With respect to claim 8 Hara discloses a capacitive sensor coupled to each capacitive sensor input (31), the capacitive sensors arranged into an array for sensing the position of an object with respect to the array (Figure 1)

With respect to claim 9, Hara discloses each capacitive sensor comprises a single sensor plate (31) coupled to a corresponding switch device (14) and separated from an adjacent sensor plate by a ground plate that is essentially coplanar to the sensor plate and adjacent sensor plate (The limitations such as plates coplanar are principle structure of the capacitor and is inherent in figure 1)

With respect to claim 14, Hara discloses the switch controller (51) sequentially enables different sets of M switch devices (14) in a second mode (Register mode, Para 64) where M < N (Decoder 51 can select any combination of the switches 14)

Allowable Subject Matter

4 Claims 15-17, 19, 20 are allowed

5 Claims 2, 4-5, 10-13, 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

Response to Arguments

6 Applicant's arguments filed 8/27/2007 have been fully considered but they are not persuasive

a) In response to Applicant s argument that Accordingly, because Hara et al only teaches the measurement of a current for one sensing circuit, Applicants do not believe the reference can show or suggest "detecting if a capacitance at " multiple "sensor inputs is within a predetermined range", as recited in claim 1 "

Contrarily to Applicant's belief Hara et al <u>explicitly disclose</u> "detecting if a capacitance at " multiple "sensor inputs is within a predetermined range" as recited in claim 1 ' In particular, Hara et al disclose multiple sensor inputs (Elements 31) (Figure 1) are selected to read the detected information (The information is the scanned capacitance, see Hara et al 's para 07) "from all sensor cells to determine particular sensor cells to be selected and then in the post processing device to read the detected information from the determined particular sensor cells in the second and the subsequent field scans " (Hara et al 's para 12, 15) Accordingly, the steps of "detecting if a capacitance at multiple inputs is within a predetermined range" is adequately read on Hara et al

b) In response to Applicant's argument that 'Applicants do not believe a prima facie showing has been presented as the limitations of claim 6 were not addressed by the rejection " For this reason alone the rejection of claim 6 is traversed

In addition or alternatively, claim 6 recites that the method further includes sequentially connecting M capacitive sensor inputs to a common sense node, where M is less than N Further, for each M capacitive sensor inputs, detecting if a capacitance at the M capacitive sensor inputs is within another predetermined range

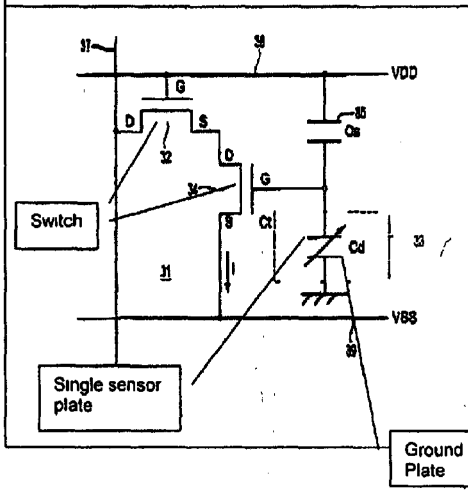
It is noted that the claim does not recite how many inputs for M and/or how many inputs for N, the number of inputs M or N are the inputs selected by the decoder 51, 52 The number of M and N are selected and performed in the steps of preprocessing and the postprocessing (Hara et al 's para 12, 15)

c) In response to Applicant s argument that "Applicants agree that Hara et el teaches a data decoder circuit (51) that enables switch elements (14) However as noted by the emphasis Hara et al never shows the enabling of multiple switching dements "essentially simultaneously", as the selection is explicitly indicated as being sequential

Accordingly because the cited reference does not show or suggest all the limitations of claim 7, this ground for rejection is traversed'

It is not necessary for Hara et al to explicitly disclose 'the enabling of multiple switching dements "essentially simultaneously", as the selection is explicitly indicated as being sequential " because it is the principle of the decoder (Elements 51, 52) It is well known in the art that the decoder decodes to select any arbitrary switch, switches, or set of switches sequentially or simultaneously Accordingly, the limitations as recited in the claim "essentially simultaneously" adequately read on Hara et al

d) In response to Applicant s argument that "The reference shows only a general position for sensing circuits (3), and not the physical structure of such circuits Applicant also requests the examiner 'to provide a basis in fact and/or technical reasoning to reasonably support the determination allegedly inherent characteristic necessarily flows from the teachings of the applied prior art "

Prior Art (Figure 2)	***Claimed Invention***
	9 (Original) The system of claim 8 wherein each capacitive sensor comprises a single sensor plate coupled to a corresponding switch device and separated from an adjacent sensor plate by a ground plate that is essentially coplanar to the sensor plate and adjacent sensor plate

The switches (See the legend above) couple the sensor plate to a corresponding switch (Element 14 or any switch selected by the decoder 51 or 52)

e) In response to Applicant response that 'Applicants' claim 15 invention includes '"charging and discharging the common node within a given time period to generate a count value corresponding to the capacitance" and alleges that Hara does not teach or suggest the features

Applicant's argument is persuasive, accordingly the claim 15 is allowed Claims 16, 17, 19 20 are allowed for being dependent upon claim 15

Conclusion

7 **THIS ACTION IS MADE FINAL** Applicant is reminded of the extension of time policy as set forth in 37 CFR 1 136(a)

A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action In the event a first reply is filed within TWO MONTHS of the mailing date of this final action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1 136(a) will be calculated from the mailing date of the advisory action In no event however will the statutory period for reply expire later than SIX MONTHS from the mailing date of this final action

Contact Information

8 Any inquiry concerning this communication or earlier communications from the examiner should be directed to Vincent Q Nguyen whose telephone number is (571) 272-2234 The examiner can normally be reached on 8 30-5 00

If attempts to reach the examiner by telephone are unsuccessful the examiner's supervisor, Andrew Hirshfeld can be reached on (571) 272-2168 The fax phone number for the organization where this application or proceeding is assigned is 703-872-9306

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 Should you have questions on access to the Private PAIR system contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free)

V. Nguyen

September 3, 2007

VINCENT Q NGUYEN
PRIMARY EXAMINER

Vincent Q Nguyen
Primary Examiner
Art Unit 2858

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APPLICATION NO	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO	CONFIRMATION NO
11/273 708	11/14/2005	Warren S Snyder	16820 P385	5052

8791 7590 07/05/2007
BLAKELY SOKOLOFF TAYLOR & ZAFMAN
1279 OAKMEAD PARKWAY
SUNNYVALE, CA 94085-4040

EXAMINER	
GANNON LEVI	
ART UNIT	**PAPER NUMBER**
2817	

MAIL DATE	DELIVERY MODE
07/05/2007	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)

7 #

Office Action Summary	Application No	Applicant(s)	
	11/273 708	SNYDER ET AL	
	Examiner	Art Unit	
	Levi Gannon	2817	

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 *11 April 2007*

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) *1-21* is/are pending in the application

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

5)☒ Claim(s) *1-13* is/are allowed

6)☒ Claim(s) *14,18 and 21* is/are rejected

7)☒ Claim(s) *15 17, 19, and 20* 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 *4/11/07*
4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date _____
5) ☐ Notice of Informal Patent Application
6) ☐ Other _____

DETAILED ACTION

Claim Rejections - 35 USC § 103

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

Claims 14, 18, and 21 are rejected under 35 U S C 103(a) as being unpatentable over Kitano et al (hereinafter Kitano) (US Patent 7 119,550) in view of Copper et al (hereinafter Cooper) (US Patent 5,670,915)

Regarding claim 14, Kitano teaches a capacitance sensor (figure 4), comprising a first oscillator (30) coupled to charge and discharge a reference capacitor (C1) with a first drive current (current produced by oscillator of figure 5) at a first frequency (frequency of FA), a second oscillator (32) to charge and discharge a device under test ("DUT") capacitor (C2) with a second drive current (current produced by oscillator of figure 5) at a second frequency (frequency of FB), and a frequency comparator (38) coupled to the first and second oscillators (30, 32) to output a signal (VCMP) indicative of a capacitance change across the DUT capacitor (C2) based on a frequency difference between the first and second frequencies (column 7 lines 39-44)

Kitano does not teach a voltage source to generate a reference voltage and a voltage scaler coupled to scale the reference voltage to generate a low voltage reference and a high voltage reference the voltage scaler coupled to provide the low and high voltage references to the first and second oscillators, wherein the first and second oscillators are coupled to oscillate the reference capacitor and the DUT capacitor between the low and high voltage references

Cooper teaches an oscillator with voltage control comprising a voltage source to generate a reference voltage (VDD), and a voltage scaler (voltage divider, R1-R3 30, 38 40, 28, 36) coupled to scale the reference voltage (VDD) to generate a low voltage reference (VL) and a high voltage reference (VH), the voltage scaler coupled to provide the low and high voltage references (VH, VL) to the oscillator (12-22) wherein the oscillator is coupled to oscillate a capacitor between the low and high voltage references (VH, VL) (see abstract)

It would have been obvious to one of ordinary skill in the art at the time of the invention to replace the oscillator of Kitano with the well-known oscillator of Cooper because such a modification would have been a mere substitution of art recognized equivalent oscillator circuits

As for claim 18, Kitano discloses the capacitance sensor of claim 14, but fails to expressly teach the frequency comparator including a divider circuit coupled to receive a clock signal from the second oscillator having the second frequency and to divide the clock signal by 2N to generate a divided clock signal and an N-bit register counter coupled to count a number pulses of the divided clock signal that occur during a single pulse of a reference clock signal generated by the first oscillator and having the first frequency

However, this type of frequency comparison circuit used for determining the difference between two frequencies is a well-known frequency comparison circuit to those of ordinary skill in the art

Therefore, it would have been obvious to one of ordinary skill in the art at the time of the invention to replace the frequency comparator of Kitano with a frequency comparator including a divider circuit coupled to receive a clock signal from the second oscillator having the second frequency and to divide the clock signal by 2N to generate a divided clock signal and an N-bit register counter coupled to count a number pulses of the divided clock signal that occur during a single pulse of a reference clock signal generated by the first oscillator and having the first frequency because such a modification would have been a mere substitution of a well known frequency comparator circuit

In terms of claim 21, Kitano modified by Cooper teaches the first and second drive currents are each asymmetrical for charging and discharging (replacing the oscillators of Kitano with the oscillator of Cooper would provide identical oscillators with identical drive currents)

Response to Arguments

Applicant's arguments, see pages 12 and 13 filed 4/11/07, with respect to claims 1 and 7 have been fully considered and are persuasive The rejection of claims 1 and 7 has been withdrawn

Applicant's arguments filed 4/11/07 have been fully considered but they are not persuasive Regarding Applicant's comment directed to claim 14, Applicant states,

Finally, it is noted that independent claim 14 has been amended to include subject matter of allowable claim 15 As such it is believed that claim 14 now includes subject matter already deemed allowable by the Examiner "

However, this argument is not persuasive because the allowable subject matter set forth by the Examiner in the office action mailed 3/19/07 was directed to the current scaler coupled to the first and second oscillators

Allowable Subject Matter

Claims 1-13 are allowed

Claims 15-17, 19 and 20 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

The following is a statement of reasons for the indication of allowable subject matter The best art of record, Dening, does not teach a digital current control signal as set forth in claim 1

The following is a statement of reasons for the indication of allowable subject matter The best art of record, Kitano, does not teach scaling from a common reference current as set forth in claim 7, a current scaler coupled to scale the first reference current to generate second and third reference currents wherein the first and second oscillators mirror the second and third reference currents respectively, to generate the first and second drive currents, respectively, as set forth in claim 15, or a current driver, as set forth in claim 19

Conclusion

THIS ACTION IS MADE FINAL Applicant is reminded of the extension of time policy as set forth in 37 CFR 1 136(a)

A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action In the event a first reply is filed within TWO MONTHS of the mailing date of this final action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1 136(a) will be calculated from the mailing date of the advisory action In no event, however, will the statutory period for reply expire later than SIX MONTHS from the mailing date of this final action

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Levi Gannon whose telephone number is (571) 272-7971 The examiner can normally be reached on Monday-Friday 9 30AM-6 00 PM

If attempts to reach the examiner by telephone are unsuccessful the examiner s supervisor Robert Pascal can be reached on (571) 272-1769 The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300

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 Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free) If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000

LG

Robert Pascal
Supervisory Patent Examiner
Technology Center 2800

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APPLICATION NO	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO	CONFIRMATION NO
11/395 417	03/31/2006	Dennis Seguine	CD05044	3171

7590 04/24/2007

WALKER & SAKO, LLP
Suite 235
300 South First Street
San Jose CA 95113

EXAMINER	
ZHU JOHN X	
ART UNIT	**PAPER NUMBER**
2858	

SHORTENED STATUTORY PERIOD OF RESPONSE	MAIL DATE	DELIVERY MODE
3 MONTHS	04/24/2007	PAPER

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

If NO period for reply is specified above, the maximum statutory period will apply and will expire 6 MONTHS from the mailing date of this communication

Office Action Summary	Application No	Applicant(s)	
	11/395 417	SEGUINE DENNIS	
	Examiner	Art Unit	
	John Zhu	2858	

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 *30 January 2007*

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 20* 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 9* is/are rejected

7)☐ Claim(s) _____ is/are objected to

8)☒ Claim(s) *10-20* 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 *30 January 2007* 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 *1/30/2007*

4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date _____

5) ☐ Notice of Informal Patent Application

6) ☐ Other _____

DETAILED ACTION

1 Response to communications filed on 1/30/2007

Election/Restrictions

2 Applicant's election without traverse of group I claims 1-9 in the reply filed on 1/30/2007 is acknowledged

Claim Rejections - 35 USC § 112

3 The following is a quotation of the first paragraph of 35 U S C 112

> The specification shall contain a written description of the invention and of the manner and process of making and using it in such full clear concise and exact terms as to enable any person skilled in the art to which it pertains or with which it is most nearly connected to make and use the same and shall set forth the best mode contemplated by the inventor of carrying out his invention

4 Claims 5-9 are 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

More specifically there seems to be a lack of support for the newly added limitation in claim 5, which states *"the counter circuit generating count values corresponding to each capacitance source in the initial mode"*

Claim Rejections - 35 USC § 102

5 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 –
>
> (b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country more than one year prior to the date of application for patent in the United States

6 Claim 1 is rejected under 35 U S C 102(b) as being anticipated by Kim (US PG Pub no 2003/0210809 A1)

With respect to claim 1, Kim discloses a circuit, comprising

a plurality of input switches (Fig 11 sensing points SP 65 66), each coupled between a corresponding capacitance source (C5) and a common node (node P4), each capacitance source having an essentially constant value in an initial mode and subject to potential variation in a run-time mode (runtime mode occurs when object is in proximity)

a common current source (I3) coupled to the common mode, and

a comparator circuit (61) having a first input coupled to the common mode (node P4) and a second input coupled to a reference value (Vm) that compares capacitance values corresponding to each capacitance source to the reference value in the initial mode and subsequently compares capacitance values corresponding to each capacitance source to the reference value in the run-time mode

Claim Rejections - 35 USC § 103

7 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

8 Claims 2 and 3 are rejected under 35 U S C 103(a) as being unpatentable over Kim and Miller et al (5,841,078)

With respect to claims 2 and 3, Kim discloses all aspects of the claim including the comparator having an output (Fig 11, element 300) and the common current source is coupled between a high power supply node 200 and the common node P4

Kim does not explicitly disclose a common node set switch coupled between the common node and a predetermined voltage node that is enabled in response to the output of the comparator or the switch is coupled between the common node and a low power supply node

Miller disclose a feedback component, including a common node set switch (Fig 6A, element 102) coupled between the common node and a predetermined voltage node that is enabled in response to the output of the comparator (element 72) and that the switch is coupled between the common node (V- of the amp 72) and a lower power supply node 104

Accordingly it would have been obvious to one of ordinary skill in the art at the time the invention was made to modify Kim to include the feedback component with the common node set switch coupled between a common node and a lower power supply node as taught by Miller for the purpose of resetting the amplifier

9 Claim 4 is rejected under 35 U S C 103(a) as being unpatentable over Kim in view of Von Basse et al (6,583 632 B2)

With respect to claim 4 Kim does not explicitly disclose a counter circuit coupled to an output of the comparator that generates a count value corresponding to each capacitance source based on transitions in the output of the comparator circuit

Von Basse discloses a circuit with a counter circuit (Fig 2, element Ct) coupled to an output of the comparator K that generates a count value corresponding to each capacitance source Cs based on transitions in the output of the comparator circuit

Accordingly it would have been obvious to one of ordinary skill in the art at the time the invention was made to modify Kim to include the counter circuit of Von Basse for the purpose of accounting of the number of cycles necessary to charge the capacitor to a predetermined reference voltage

Allowable Subject Matter

10 Claims 5-9 would be allowable if rewritten to overcome the rejection(s) under 35 U S C 112, 1st paragraph, set forth in this Office action and to include all of the limitations of the base claim and any intervening claims

11 The following is a statement of reasons for the indication of allowable subject matter claim 5 would be allowable over the art of record because the prior art does not

teach or render obvious the entire combination including specifically a circuit comprising a counter circuit generating count values corresponding to each capacitance source in initial mode and a computation circuit that generates a correction factor based on the generated count values

Claims 6-9 are allowable as they depend from claim 5

Response to Arguments

12 Applicant's arguments filed 1/30/2007 have been fully considered but they are not persuasive

In response to applicant's argument that Kim ('809) does not teach the input switches of the application (Response to Office Action, page 13-14), the examiner respectfully disagrees and contends input switches are taught As applicant points out, Kim discloses

"If sensing point 37 connected to selecting node 33 is in contact with a human body part, then the process just described with respect to selecting node 32 repeats for selecting node 33 However, if activated selected node 33 is not in contact with the human body, then additional voltage has been applied to node p3 " (Paragraph 0045)

Hence the sensing points are read as input switches as it controls the voltage supplied from nodes 32-35 to common node P3

IEEE Standards define a switch as "an electrical or mechanical device used for opening, closing or changing the connection of a circuit ' (Page 1133, Switch, paragraph 7) and can include devices such as a sense switch' (Page 1134 column 1, line 1) Under this definition, the sensing point of Kim is read as a switch because in the presence of a human body, the connection between the input and output is changed (i e a capacitance is added which changes the flow of the circuit)

Furthermore it is noted applicant s own disclosure supports that sensing elements such as capacitive sensors could be considered switches (Page 2 lines 8-18)

Applicant's argument regarding claims 2-3 (Pages 14-17) have been considered but are moot in view of the new ground of rejection

13 Applicant's submission of an information disclosure statement under 37 CFR 1 97(c) with the fee set forth in 37 CFR 1 17(p) on 1/30/2007 prompted the new ground(s) of rejection presented in this Office action Accordingly, **THIS ACTION IS MADE FINAL** See MPEP § 609 04(b) Applicant is reminded of the extension of time policy as set forth in 37 CFR 1 136(a)

A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action In the event a first reply is filed within TWO MONTHS of the mailing date of this final action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1 136(a) will be calculated from the mailing date of the advisory action In no event, however, will the statutory period for reply expire later than SIX MONTHS from the mailing date of this final action

Any inquiry concerning this communication or earlier communications from the examiner should be directed to John Zhu whose telephone number is (571) 272-5920 The examiner can normally be reached on M-F, 8-4 30

If attempts to reach the examiner by telephone are unsuccessful, the examiner s supervisor, Andrew Hirshfeld can be reached on (571) 272-2168 The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300

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 Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free) If you would like assistance from a USPTO Customer Service Representative or access to the automated information system call 800-786-9199 (IN USA OR CANADA) or 571-272-1000

John Zhu
Examiner
Art Unit 2858

JZ

ANDREW H HIRSHFELD
SUPERVISORY PATENT EXAMINER
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APPLICATION NO	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO	CONFIRMATION NO
11/437 517	05/18/2006	Jiang XiaoPing	CD06039	2623

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198 CHAMPION COURT
SAN JOSE CA 95134 1709

EXAMINER	
KETEMA BENYAM	

ART UNIT	PAPER NUMBER
2629	

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01/26/2010	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)

CY00002345

Office Action Summary	Application No 11/437 517	Applicant(s) XIAOPING JIANG
	Examiner BENYAM KETEMA	Art Unit 2629

-- 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 05 November 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 20 is/are pending in the application

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

5)☒ Claim(s) 5 17 is/are allowed

6)☒ Claim(s) 1 4 and 18 20 is/are rejected

7)☐ Claim(s) _____ 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 05/18/2006 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

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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

Response to Amendment

1 In an amendment dated, November 5, 2009, claims 1-20 are presented for examination

2 Applicant's arguments with respect to claims 1-4 and 18- 20 have been considered but is not persuasive

On page 8 and 9 of the Remarks, the Applicants argue that Tsujioka et al fails to teach the claimed feature of *detecting a presence of a* ***conductive object*** *on a sensing device* " as recited in independent Claims 1 and 18 The Examiner must respectfully disagree Tsujioka et al discloses that as the user (i e operator) presses any one of the input region using his/her finger the corresponding signal that is associated with anyone of the input region is converted into digital signal and fed into the control device so that the appropriate action (command) would be initiated This process would show that the device had to detect operator s finger (i e *conductive object*) in order to process inputted information Further more applicants discloses that ***conductive object"*** *as* being user finger (Paragraph 50 & 51) Therefor one can see Tsujioka s device detects users finger (***conductive object***) as it is used to input information or command on any one of the pressing regions (Fig 5)

Claim Rejections - 35 USC § 102

3 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 –
>
> (b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country more than one year prior to the date of application for patent in the United States

4 Claims 1 2, 4 and 18 are rejected under 35 U S C 102(b) as being anticipated by Tsujioka et al (US Pat NO 5 518 078)

As in Claim 1, Tsujioka et al discloses *a method* (Column 1 line 5-10) *comprising*

- *detecting a presence of a conductive object on a sensing device,* (Column 9 line 65- Column 10 line 4)
- *recognizing three or more button* (Fig 5 item 49, buttons) *operations performed by the conductive object* (Fig 5 item 50 & 51 finger or pen) *using two sensing areas of the sensing device* (Fig 5 & 6 item 24 & 25 two sensing areas)

As in Claim 2, Tsujioka et al discloses *the method* (Column 1 line 5-10) *of claim 1, wherein recognizing three or more button operations* (Column 9 line 65- Column 10 line 6 and fig 5-8) *comprises recognizing on a first sensing area of* *the two sensing areas of the sensing device* (Fig 5 and Column 9 line 65- Column 10 line 4) *recognizing a second button operation when the presence of the conductive object is detected on a second sensing area of the two sensing areas of the sensing device* (Fig 5 and Column 9 line 65- Column 10 line 4) *recognizing one or more button operations when the presence of the conductive object is detected on the first and second sensing areas* (Fig 5)

As in Claim 4, Tsujioka et al discloses *the method* (Column 1 line 5-10) *of claim 1 further comprising scanning the two sensing areas of the sensing device,* (Column 9 line 58 -61) *wherein recognizing the three or more button operations comprises recognizing a first button operation when a first sensing area of the two sensing areas detects the presence of the conductive object during the scanning of the two sensing areas* (Fig 5 7 and 9 and Column 9 line 54- Column 10 line 6) *recognizing a second button operation when a second sensing area of the two sensing areas detects the presence of the conductive object during the scanning of the two sensing areas,* (Fig 5 7 and 9 and Column 9 line 54- Column 10 line 6) *recognizing a third button operation when the first and second sensing areas detect the presence of the conductive object during the scanning of the two sensing areas* (Fig 5, 7 and 9 and Column 9 line 54- Column 10 line 6) discloses scanning the sensing areas (i e 24 & 25) and recognizing multiple button (i e 36 39-42) operation for conductive objects (i e finger or pen)

As in Claim 18, Tsujioka et al discloses *an apparatus* (Column 1, touch panel) *comprising*

- *a first sensing area to detect a presence of a conductive object on a sensing device* (Fig 9 item 25)
- *a second sensing area to detect the presence of the conductive object on the sensing device* (Fig 9 item 24)
- *means for recognizing three or more button operations* (Fig 9 item 39-42) *performed by the conductive object* (Fig 5 item 51 or 50, finger or pen) *using two sensing areas on the sensing device* (Fig 9 item 24 & 25, two sensing areas)

Claim Rejections - 35 USC § 103

5 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

6 The factual inquiries set forth in *Graham* **v** *John Deere Co* , 383 U S 1, 148 USPQ 459 (1966), that are applied for establishing a background for determining obviousness under 35 U S C 103(a) are summarized as follows

1 Determining the scope and contents of the prior art
2 Ascertaining the differences between the prior art and the claims at issue
3 Resolving the level of ordinary skill in the pertinent art

4 Considering objective evidence present in the application indicating obviousness or nonobviousness

7 Claim 3 is rejected under 35 U S C 103(a) as being unpatentable over Tsujioka et al (US Pat NO 5,518,078) in view of Collins (PG Pub NO 2004/0239616)

As in Claim 3, Tsujioka et al discloses *the method* (Column 1 line 5-10) *of claim 1* but fails to disclose *determining a capacitance of the conductive object on the sensing device over time, wherein determining the capacitance further comprises determining a capacitance of the two sensing areas of the sensing device and wherein recognizing the button operation is based on the capacitance of the two sensing areas* However Collins discloses *determining a capacitance of the conductive object on the sensing device over time* (Paragraph 24 and Fig 2-3) *wherein determining the capacitance further comprises determining a capacitance of the two sensing areas of the sensing device,* (Fig 3 item 200 1 & 200-3) *and wherein recognizing the button operation is based on the capacitance of the two sensing areas* (Paragraph 24-28 and Fig 3) discloses operation of buttons is recognized according to a signal produced (i e capacitance) when the user finger is in contact with sensing area

Tsujioka et al and Collins are analogous art because they are from the common area of user input device using touch sensor Tsujioka et al discloses an input device that has multiple sensing areas as well as buttons But fails to disclose capacitance sensor However Collins discloses that capacitance sensors are used to determine the presence of conductive object (i e finger) on the sensing area in a system similar to that of Tsujioka et al Therefore it would have been obvious to one of ordinary skill in the art at the time of the invention to combine Tsujioka et al s sensing area to include Collins s capacitance sensor because using capacitance sensor or any other form of sensor in touch panel device would be an alternate design choose

8 Claims 19 and 20 are rejected under 35 U S C 103(a) as being unpatentable over Tsujioka et al (US Pat NO 5 518 078) in view of Gitzinger et al (PG Pub NO 2006/0097992)

As in Claim 19, Tsujioka et al discloses *the apparatus* (Column 1 touch panel) but fails to disclose *means for reducing a pin count of the sensing device* However Gitzinger et al discloses *means for reducing a pin count of the sensing device* (Fig 3 and Paragraph 29-32) discloses the reduction of pins by coupling the discrete surfaces (i e sensing area 320 322, 324) together and connecting them to the controller

Tsujioka et al and Gitzinger et al are analogous art because they are from the common area of user input device using touch sensor Tsujioka et al discloses an input device that has multiple sensing areas as well as buttons But fails to disclose reduction of connecter pins as well as the effect of scanning time when the numbers of pins are reduced, However Gitzinger et al discloses in Fig 3 the number of pins have been reduced in a system similar to that of Tsujioka et al Therefore it would have been obvious to one of ordinary skill in the art at the time of the invention to combine Tsujioka et al s sensing area to include Gitzinger et al s arrangement of reduced number of pins in order to reduced coast and material in the manufacturing of said device

As in Claim 20, Tsujioka et al discloses *the apparatus* (Column 1, touch panel), but fails to disclose *means for reducing scan time of the sensing device* However Gitzinger et al discloses *means for reducing scan time of the sensing device* (fig 3) discloses the sensing areas are coupled together and connected to the controller rather than being connected individually, therefore it would be obvious to a skilled person that by reducing the number of connection between the sensing area and controller the scan time would be increased (faster)

Allowable Subject Matter

9 Claims 5-17 are allowable over the prior art of record

10 Applicant's amendment necessitated the new ground(s) of rejection presented in this Office action Accordingly, **THIS ACTION IS MADE FINAL** See MPEP § 706 07(a) Applicant is reminded of the extension of time policy as set forth in 37 CFR 1 136(a)

A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action In the event a first reply is filed within TWO MONTHS of the mailing date of this final action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1 136(a) will be calculated from the mailing date of the advisory action In no event however will the statutory period for reply expire later than SIX MONTHS from the date of this final action

11 Any inquiry concerning this communication or earlier communications from the examiner should be directed to BENYAM KETEMA whose telephone number is (571)270-7224 The examiner can normally be reached on Monday-Friday 8 00AM - 5 00PM

If attempts to reach the examiner by telephone are unsuccessful, the examiner s supervisor, Shalwala Bipin H can be reached on (571)-272-7681 The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300 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 Should you have questions on access to the Private PAIR system contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free) If you would like assistance from a USPTO

Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000

/ B K /

Examiner, Art Unit 2629

/Bipin Shalwala/

Supervisory Patent Examiner Art Unit 2629