This file wrapper was thoroughly reviewed by our technical staff. The file history jacket cover and table of contents are missing from the original USPTO file history.

This has been brought to your attention so that you will know it has not been overlooked.

Electronic Acknowledgement Receipt	
EFS ID:	29378361
Application Number:	15611970
International Application Number:	
Confirmation Number:	5932
Title of Invention:	ELECTRONIC DEVICE FOR USE IN MOTION DETECTION AND METHOD FOR OBTAINING RESULTANT DEVIATION THEREOF
First Named Inventor/Applicant Name:	Shun-Nan Liou
Customer Number:	109673
Filer:	Michael P. Qualey/Alison Anderson
Filer Authorized By:	Michael P. Qualey
Attorney Docket Number:	250303-1021
Receipt Date:	02-JUN-2017
Filing Date:	
Time Stamp:	11:42:20
Application Type:	Utility under 35 USC 111(a)

Payment information:

Submitted with Payment	yes
Payment Type	CARD
Payment was successfully received in RAM	$730
RAM confirmation Number	060217INTEFSW11431700
Deposit Account	505954
Authorized User	Alison Anderson
The Director of the USPTO is hereby authorized to charge indicated fees and credit any overpayment as follows: 37 CFR 1.17 (Patent application and reexamination processing fees) 37 CFR 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	Application Data Sheet	00460588.PDF	1823534 fe8a62d4929dadfe0a8a44e3741012f6ba343177	no	9
Warnings:					
Information:					
2	Oath or Declaration filed	00460570.PDF	2468205 7990680a443fbdae0a191cc04a6083d110722989	no	8
Warnings:					
Information:					
3		00460577.PDF	267045 bcc7eeb8431fe66e29458e3cf86dcac0f3081dd4	yes	66

Multipart Description/PDF files in .zip description

Document Description	Start	End
Specification	1	59
Claims	60	65
Abstract	66	66

Warnings:					
Information:					
4	Drawings-only black and white line drawings	00459903.PDF	327358 8b6bab02ca09530d5018cbf6f5136c373b2f0bff	no	10
Warnings:					
Information:					
5	Transmittal Letter	00460746.PDF	72513 c5df7bf52b177d3bef0d991a308ba988fa4dc425	no	2

Warnings:					
Information:					
6	Information Disclosure Statement (IDS) Form (SB08)	00460586.PDF	1035956 877a246ef848d50617268e665a02399b5ce41d73	no	5
Warnings:					
Information:					
7	Fee Worksheet (SB06)	fee-info.pdf	34968 01a6ec20a7c44f39e0a6b7125323c17d0e52e053	no	2
Warnings:					
Information:					
		Total Files Size (in bytes):	6029579		

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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.

Electronic Patent Application Fee Transmittal	
Application Number:	
Filing Date:	
Title of Invention:	ELECTRONIC DEVICE FOR USE IN MOTION DETECTION AND METHOD FOR OBTAINING RESULTANT DEVIATION THEREOF
First Named Inventor/Applicant Name:	Shun-Nan Liou
Filer:	Michael P. Qualey/Alison Anderson
Attorney Docket Number:	250303-1021
Filed as Small Entity	
Filing Fees for Utility under 35 USC 111(a)	

Description	Fee Code	Quantity	Amount	Sub-Total in USD($)
Basic Filing:				
UTILITY FILING FEE (ELECTRONIC FILING)	4011	1	70	70
UTILITY SEARCH FEE	2111	1	300	300
UTILITY EXAMINATION FEE	2311	1	360	360
Pages:				
Claims:				
Miscellaneous-Filing:				
Petition:				
Patent-Appeals-and-Interference:				

Description	Fee Code	Quantity	Amount	Sub-Total in USD($)
Post-Allowance-and-Post-Issuance:				
Extension-of-Time:				
Miscellaneous:				
		Total in USD ($)		**730**

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Application Data Sheet 37 CFR 1.76	Attorney Docket Number	250303-1021
	Application Number	
Title of Invention	ELECTRONIC DEVICE FOR USE IN MOTION DETECTION AND METHOD FOR OBTAINING RESULTANT DEVIATION THEREOF	

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.)

Inventor Information:

Inventor 1 Remove

Legal Name

Prefix	Given Name	Middle Name	Family Name	Suffix
	Shun-Nan		Liou	

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

City	Country of Residence [i]
Taipei	TW

Mailing Address of Inventor:

Address 1	5F-2, No.12, Wenhu St., Neihu Dist.
Address 2	
City	Taipei
State/Province	
Postal Code	11445
Country [i]	TW

Inventor 2 Remove

Legal Name

Prefix	Given Name	Middle Name	Family Name	Suffix
	Zhou		Ye	

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

City	Country of Residence [i]
Taipei	TW

Mailing Address of Inventor:

Address 1	5F-2, No.12, Wenhu St., Neihu Dist.
Address 2	
City	Taipei
State/Province	
Postal Code	11445
Country [i]	TW

Inventor 3 Remove

Legal Name

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Application Data Sheet 37 CFR 1.76	Attorney Docket Number	250303-1021
	Application Number	
Title of Invention	ELECTRONIC DEVICE FOR USE IN MOTION DETECTION AND METHOD FOR OBTAINING RESULTANT DEVIATION THEREOF	

Prefix	Given Name	Middle Name	Family Name	Suffix
	Chin-Lung		Li	

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

City	Taipei	Country of Residence	TW

Mailing Address of Inventor:

Address 1	5F-2, No.12, Wenhu St., Neihu Dist.		
Address 2			
City	Taipei	**State/Province**	
Postal Code	11445	**Country**	TW

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	109673		
Email Address	paul.qualey@mqrlaw.com	Add Email	Remove Email

Application Information:

Title of the Invention	ELECTRONIC DEVICE FOR USE IN MOTION DETECTION AND METHOD FOR OBTAINING RESULTANT DEVIATION THEREOF		
Attorney Docket Number	250303-1021	**Small Entity Status Claimed**	☒
Application Type	Nonprovisional		
Subject Matter	Utility		
Total Number of Drawing Sheets (if any)	10	**Suggested Figure for Publication (if any)**	

Filing By Reference:

Only complete this section when filing an application by reference under 35 U.S.C. 111(c) and 37 CFR 1.57(a). Do not complete this section if application papers including a specification and any drawings are being filed. Any domestic benefit or foreign priority information must be provided in the appropriate section(s) below (i.e., "Domestic Benefit/National Stage Information" and "Foreign Priority Information").

For the purposes of a filing date under 37 CFR 1.53(b), the description and any drawings of the present application are replaced by this reference to the previously filed application, subject to conditions and requirements of 37 CFR 1.57(a).

Application number of the previously filed application	Filing date (YYYY-MM-DD)	Intellectual Property Authority or Country

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Application Data Sheet 37 CFR 1.76	Attorney Docket Number	250303-1021
	Application Number	
Title of Invention	ELECTRONIC DEVICE FOR USE IN MOTION DETECTION AND METHOD FOR OBTAINING RESULTANT DEVIATION THEREOF	

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).
Either enter 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	109673		

Domestic Benefit/National Stage Information:

This section allows for the applicant to either claim benefit under 35 U.S.C. 119(e), 120, 121, 365(c), or 386(c) or indicate National Stage entry from a PCT application. Providing benefit claim 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.
When referring to the current application, please leave the "Application Number" field blank.

Prior Application Status	Pending		Remove
Application Number	Continuity Type	Prior Application Number	Filing or 371(c) Date (YYYY-MM-DD)
	Continuation of	13072794	2011-03-28

Prior Application Status	Patented				Remove
Application Number	Continuity Type	Prior Application Number	Filing Date (YYYY-MM-DD)	Patent Number	Issue Date (YYYY-MM-DD)
13072794	Continuation in part of	12943934	2010-11-11	8441438	2013-05-14

Prior Application Status	Expired		Remove
Application Number	Continuity Type	Prior Application Number	Filing or 371(c) Date (YYYY-MM-DD)
12943934	Claims benefit of provisional	61292558	2010-01-06

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

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Application Data Sheet 37 CFR 1.76	Attorney Docket Number	250303-1021
	Application Number	
Title of Invention	ELECTRONIC DEVICE FOR USE IN MOTION DETECTION AND METHOD FOR OBTAINING RESULTANT DEVIATION THEREOF	

Foreign Priority Information:

This section allows for the applicant to claim priority to a foreign application. 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. When priority is claimed to a foreign application that is eligible for retrieval under the priority document exchange program (PDX)[i] the information will be used by the Office to automatically attempt retrieval pursuant to 37 CFR 1.55(i)(1) and (2). Under the PDX program, applicant bears the ultimate responsibility for ensuring that a copy of the foreign application is received by the Office from the participating foreign intellectual property office, or a certified copy of the foreign priority application is filed, within the time period specified in 37 CFR 1.55(g)(1).

Remove

Application Number	Country[i]	Filing Date (YYYY-MM-DD)	Access Code[i] (if applicable)

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

Statement under 37 CFR 1.55 or 1.78 for AIA (First Inventor to File) Transition Applications

☐ This application (1) claims priority to or the benefit of an application filed before March 16, 2013 and (2) also contains, or contained at any time, a claim to a claimed invention that has an effective filing date on or after March 16, 2013.
NOTE: By providing this statement under 37 CFR 1.55 or 1.78, this application, with a filing date on or after March 16, 2013, will be examined under the first inventor to file provisions of the AIA.

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Application Data Sheet 37 CFR 1.76		Attorney Docket Number	250303-1021
		Application Number	
Title of Invention	ELECTRONIC DEVICE FOR USE IN MOTION DETECTION AND METHOD FOR OBTAINING RESULTANT DEVIATION THEREOF		

Authorization or Opt-Out of Authorization to Permit Access:

When this Application Data Sheet is properly signed and filed with the application, applicant has provided written authority to permit a participating foreign intellectual property (IP) office access to the instant application-as-filed (see paragraph A in subsection 1 below) and the European Patent Office (EPO) access to any search results from the instant application (see paragraph B in subsection 1 below).

Should applicant choose not to provide an authorization identified in subsection 1 below, applicant **must opt-out** of the authorization by checking the corresponding box A or B or both in subsection 2 below.

NOTE: This section of the Application Data Sheet is **ONLY** reviewed and processed with the **INITIAL** filing of an application. After the initial filing of an application, an Application Data Sheet cannot be used to provide or rescind authorization for access by a foreign IP office(s). Instead, Form PTO/SB/39 or PTO/SB/69 must be used as appropriate.

1. Authorization to Permit Access by a Foreign Intellectual Property Office(s)

A. Priority Document Exchange (PDX) - Unless box A in subsection 2 (opt-out of authorization) is checked, the undersigned hereby **grants the USPTO authority** to provide the European Patent Office (EPO), the Japan Patent Office (JPO), the Korean Intellectual Property Office (KIPO), the State Intellectual Property Office of the People's Republic of China (SIPO), the World Intellectual Property Organization (WIPO), and any other foreign intellectual property office participating with the USPTO in a bilateral or multilateral priority document exchange agreement in which a foreign application claiming priority to the instant patent application is filed, access to: (1) the instant patent application-as-filed and its related bibliographic data, (2) any foreign or domestic application to which priority or benefit is claimed by the instant application and its related bibliographic data, and (3) the date of filing of this Authorization. See 37 CFR 1.14(h)(1).

B. Search Results from U.S. Application to EPO - Unless box B in subsection 2 (opt-out of authorization) is checked, the undersigned hereby **grants the USPTO authority** to provide the EPO access to the bibliographic data and search results from the instant patent application when a European patent application claiming priority to the instant patent application is filed. See 37 CFR 1.14(h)(2).

The applicant is reminded that the EPO's Rule 141(1) EPC (European Patent Convention) requires applicants to submit a copy of search results from the instant application without delay in a European patent application that claims priority to the instant application.

2. Opt-Out of Authorizations to Permit Access by a Foreign Intellectual Property Office(s)

☐ A. Applicant **DOES NOT** authorize the USPTO to permit a participating foreign IP office access to the instant application-as-filed. If this box is checked, the USPTO will not be providing a participating foreign IP office with any documents and information identified in subsection 1A above.

☐ B. Applicant **DOES NOT** authorize the USPTO to transmit to the EPO any search results from the instant patent application. If this box is checked, the USPTO will not be providing the EPO with search results from the instant application.

NOTE: Once the application has published or is otherwise publicly available, the USPTO may provide access to the application in accordance with 37 CFR 1.14.

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Application Data Sheet 37 CFR 1.76	Attorney Docket Number	250303-1021
	Application Number	
Title of Invention	ELECTRONIC DEVICE FOR USE IN MOTION DETECTION AND METHOD FOR OBTAINING RESULTANT DEVIATION THEREOF	

Applicant Information:

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

Applicant 1 — Remove

If the applicant is the inventor (or the remaining joint inventor or inventors under 37 CFR 1.45), this section should not be completed. The information to be provided in this section is the name and address of the legal representative who is the applicant under 37 CFR 1.43; or the name and address of the assignee, person to whom the inventor is under an obligation to assign the invention, or person who otherwise shows sufficient proprietary interest in the matter who is the applicant under 37 CFR 1.46. If the applicant is an applicant under 37 CFR 1.46 (assignee, person to whom the inventor is obligated to assign, or person who otherwise shows sufficient proprietary interest) together with one or more joint inventors, then the joint inventor or inventors who are also the applicant should be identified in this section.

Clear

● Assignee	Legal Representative under 35 U.S.C. 117	Joint Inventor
Person to whom the inventor is obligated to assign.	Person who shows sufficient proprietary interest	

If applicant is the legal representative, indicate the authority to file the patent application, the inventor is:

Name of the Deceased or Legally Incapacitated Inventor:

If the Applicant is an Organization check here. ☒

Organization Name	CM HK LIMITED		
Mailing Address Information For Applicant:			
Address 1	RM 2401 24/F 101 KING'S RD		
Address 2			
City	FORTRESS HILL	**State/Province**	
Country	HK	Postal Code	
Phone Number		Fax Number	
Email Address			

Additional Applicant Data may be generated within this form by selecting the Add button. Add

Assignee Information including Non-Applicant Assignee Information:

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

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Approved for use through 04/30/2017. OMB 0651-0032
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Application Data Sheet 37 CFR 1.76	Attorney Docket Number	250303-1021
	Application Number	
Title of Invention	ELECTRONIC DEVICE FOR USE IN MOTION DETECTION AND METHOD FOR OBTAINING RESULTANT DEVIATION THEREOF	

Assignee 1

Complete this section if assignee information, including non-applicant assignee information, is desired to be included on the patent application publication. An assignee-applicant identified in the "Applicant Information" section will appear on the patent application publication as an applicant. For an assignee-applicant, complete this section only if identification as an assignee is also desired on the patent application publication.

Remove

If the Assignee or Non-Applicant Assignee is an Organization check here. ☐

Prefix	**Given Name**	Middle Name	**Family Name**	Suffix

Mailing Address Information For Assignee including Non-Applicant Assignee:

Address 1			
Address 2			
City		**State/Province**	
Country i		Postal Code	
Phone Number		Fax Number	
Email Address			

Additional Assignee or Non-Applicant Assignee Data may be generated within this form by selecting the Add button. Add

Signature:

Remove

NOTE: This Application Data Sheet must be signed in accordance with 37 CFR 1.33(b). **However, if this Application Data Sheet is submitted with the INITIAL filing of the application and either box A or B is not checked in subsection 2 of the "Authorization or Opt-Out of Authorization to Permit Access" section, then this form must also be signed in accordance with 37 CFR 1.14(c).**

This Application Data Sheet **must** be signed by a patent practitioner if one or more of the applicants is a **juristic entity** (e.g., corporation or association). If the applicant is two or more joint inventors, this form must be signed by a patent practitioner, **all** joint inventors who are the applicant, or one or more joint inventor-applicants who have been given power of attorney (e.g., see USPTO Form PTO/AIA/81) on behalf of **all** joint inventor-applicants.

See 37 CFR 1.4(d) for the manner of making signatures and certifications.

Signature	/M.PaulQualey,Jr./			Date (YYYY-MM-DD)	2017-06-02
First Name	M. Paul	Last Name	Qualey, Jr.	Registration Number	43,024

Additional Signature may be generated within this form by selecting the Add button. Add

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U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE
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Application Data Sheet 37 CFR 1.76	Attorney Docket Number	250303-1021
	Application Number	
Title of Invention	ELECTRONIC DEVICE FOR USE IN MOTION DETECTION AND METHOD FOR OBTAINING RESULTANT DEVIATION THEREOF	

This collection of information is required by 37 CFR 1.76. 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 23 minutes to complete, including gathering, preparing, and submitting the completed application data sheet form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. **SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.**

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 CooperationTreaty.

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

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

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

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

ELECTRONIC DEVICE FOR USE IN MOTION DETECTION AND METHOD FOR OBTAINING RESULTANT DEVIATION THEREOF

CROSS-REFERENCE TO RELATED APPLICATION

This application is a continuation application, which claims the benefit of and priority to U.S. application Ser. No. 13/072,794, filed on March 28, 2011, which is a continuation in part of and claims the priority benefit of U.S. application serial no. 12/943,934, filed on November 11, 2010, now patented as U.S. Patent No. 8,441,438, which claims the priority benefit of U.S. application serial no. 61/292,558, filed on January 06, 2010. The entirety of each of the above-mentioned patent applications is hereby incorporated by reference herein and made a part of this specification.

BACKGROUND OF THE INVENTION

Field of the Invention

[0001] The present invention generally relates to an electronic device, more particularly to an electronic device for use in computers, motion detection or navigation utilizing a motion sensor module and method of compensating signals of the motion sensor module subject to movements and rotations of said electronic device. The present invention utilizes a nine-axis motion sensor module with an enhanced comparison model to calculate and compensate accumulated errors associated with the motion sensor module and to obtain actual resulting deviation angles in spatial reference frame and under dynamic environments.

Description of the Related Art

[0002] Fig. 1 is a schematic diagram showing a user using a portable electronic device 110, such as a 3D pointing device or computer mouse, for detecting motions of the device and translating the detected motions to a cursor display such as a cursor pointing on the screen 122 of a 2D display device 120. If the pointing device 110 emits a light beam, the corresponding point would be the location where the light beam hits the screen 122. For example, the pointing device 110 may be a mouse of a computer or a pad of a video game console. The display device 120 may be a part of the computer or the video game console. There are two reference frames, such as the spatial pointer reference frame and the display frame, associated with the pointing device 110 and the display device 120, respectively. The first reference frame or spatial pointer reference frame associated with the pointing device 110 is defined by the coordinate axes X_P, Y_P and Z_P as shown in Fig. 1. The second reference frame or display frame associated with the display device 120 is defined by the coordinate axes X_D, Y_D and Z_D as shown in Fig. 1. The screen 122 of the display device 120 is a subset of the X_DY_D plane of the reference frame $X_DY_DZ_D$ associated with the display device 120. Therefore, the X_DY_D plane is also known as the display plane associated with the display device 120.

[0003] A user may perform control actions and movements utilizing the pointing device for certain purposes including entertainment such as playing a video game, on the display device 120 through the aforementioned pointer on the screen 122. For proper interaction with the use of the pointing device, when the user moves the pointing device 110, the pointer on the screen 122 is expected to move along with the orientation, direction and distance travelled by the pointing

device 110 and the display 120 shall display such movement of the pointer to a new location on the screen 122 of the display 120. The orientation of the pointing device 110 may be represented by three deviation angles of the 3D pointing device 110 with respect to the reference frame $X_PY_PZ_P$, namely, the yaw angle 111, the pitch angle 112 and the roll angle 113. The yaw, pitch and roll angles 111, 112, 113 may be best understood in relation to the universal standard definition of spatial angles related to commercial vehicles or transportation such as ships and airplanes. Conventionally, the yaw angle 111 may represent the rotation of the pointing device 110 about the Z_P axis; the pitch angle 112 may represent the rotation of the pointing device 110 about the Y_P axis; the roll angle 113 may represent the rotation of the pointing device 110 about the X_P axis.

[0004] In a known related art as shown in Fig. 1, when the yaw angle 111 of the pointing device 110 changes, the aforementioned pointer on the screen 122 must move horizontally or in a horizontal direction with reference to the ground in response to the change of the yaw angle 111. Fig. 2 shows what happens when the user rotates the pointing device 110 counterclockwise by a degree such as a 90-degree about the X_P axis. In another known related art as shown in Fig. 2, when the yaw angle 111 changes, the aforementioned pointer on the screen 122 is expected to move vertically in response. The change of the yaw angle 111 can be detected by a gyro-sensor which detects the angular velocity ω_x of the pointing device 110 about the X_P axis. Fig. 1 and Fig. 2 show that the same change of the yaw angle 111 may be mapped to different movements of the point on the screen 122. Therefore, a proper compensation mechanism for the orientation of the pointing device 110 is required such that corresponding mapping of the pointer on the screen 122 of the display 120 may be obtained correctly and desirably. The term compensation

of the prior arts by Liberty (US Patent No. 7,158,118, US Patent No. 7,262,760 and US Patent No. 7,414,611) refers to the correction and compensation of signals subject to gravity effects or extra rotations about the axis related to "roll". The term of "comparison" of the present invention may generally refer to the calculating and obtaining of the actual deviation angles of the 3D pointing device 110 with respect to the first reference frame or spatial pointing frame $X_PY_PZ_P$ utilizing signals generated by motion sensors while reducing or eliminating noises associated with said motion sensors; whereas the term mapping may refer to the calculating and translating of said deviation angles in the spatial pointing frame $X_PY_PZ_P$ onto the aforementioned pointer on the display plane associated with the 2D display device 120 of a second reference frame or display frame $X_DY_DZ_D$.

[0005] It is known that a pointing device utilizing 5-axis motion sensors, namely, Ax, Ay, Az, ω_Y and ω_Z may be compensated. For example, US Patent No. 7,158,118 by Liberty, US Patent 7,262,760 by Liberty and US 7,414,611 by Liberty provide such pointing device having a 5-axis motion sensor and discloses a compensation using two gyro-sensors ω_Y and ω_Z to detect rotation about the Yp and Zp axes, and accelerometers Ax, Ay and Az to detect the acceleration of the pointing device along the three axes of the reference frame $X_PY_PZ_P$. The pointing device by Liberty utilizing a 5-axis motion sensor may not output deviation angles of the pointing device in, for example, a 3D reference frame; in other words, due to due to the limitation of the 5-axis motion sensor of accelerometers and gyro-sensors utilized therein, the pointing device by Liberty cannot output deviation angles readily in 3D reference frame but rather a 2D reference frame only and the output of such device having 5-axis motion sensors is a planar pattern in 2D reference frame only. In addition, it has been found that the pointing device and compensation

disclosed therein cannot accurately or properly calculate or obtain movements, angles and directions of the pointing device while being subject to undesirable interferences, external or internal, in the dynamic environment during the obtaining of the signals generated by the motion sensors, in particular, during unexpected drifting movements and/or accelerations along with the direction of gravity. In other words, it has been found that dynamic actions or extra accelerations including additional accelerations, in particular the one acted upon the direction substantially parallel to or along with the gravity imposed on the pointing device with the compensation methods provided by Liberty, said pointing device by Liberty cannot properly or accurately output the actual yaw, pitch and roll angles in the spatial reference frame $X_PY_PZ_P$ and following which, consequently, the mapping of the spatial angles onto any 2D display reference frame such as $X_DY_DZ_D$ may be greatly affected and erred. To be more specific, as the 5-axis compensation by Liberty cannot detect or compensate rotation about the X_P axis directly or accurately, the rotation about the X_P axis has to be derived from the gravitational acceleration detected by the accelerometer. Furthermore, the reading of the accelerometer may be accurate only when the pointing device is static since due to the limitation on known accelerometers that these sensors may not distinguish the gravitational acceleration from the acceleration of the forces including centrifugal forces or other types of additional accelerations imposed or exerted by the user.

[0006] Furthermore, it has been found that known prior arts may only be able to output a "relative" movement pattern in a 2D reference frame based on the result calculated from the signals of motion sensors. For example, the abovementioned prior arts by Liberty may only output a 2D movement pattern in a relative manner and a pointer on a display screen to show such corresponding 2D relative movement pattern. To be more specific, the pointer moves from

a first location to a second new location relative to said first location only. Such relative movement from the previous location to the next location with respect to time cannot accurately determine and/or output the next location, particularly in situations where the previous location may have been an erred location or have been faultily determined as an incorrect reference point for the next location that is to be calculated therefrom and obtained based on their relative relationship adapted. One illustration of such defect of known prior arts adapting a relative relationship in obtaining a movement pattern may be clearly illustrated by an example showing the faultily outputted movements of a pointer intended to move out of a boundary or an edge of display screen. It has been found that as the pointer of known prior arts reaches the edge of a display and continues to move out of the boundary or edge at a certain extra extent beyond said boundary, the pointer fails to demonstrate a correct or "absolute" pattern as it moves to a new location either within the display or remaining outside of the boundary; in other words, instead of returning to a new location by taking into account said certain extra extend beyond the boundary made earlier in an "absolute" manner, the pointer of known arts discards such virtual distance of the extra extend beyond the boundary already made and an erred next position is faultily outputted due to the relative relationship adapted and utilized by the pointer. may be never calculated or processed due to the faultily obtained location at the edge or boundary of the display as well as the relative relationship adapted to obtain its next location therefrom.

[0007] Therefore, it is clear that an improved device for use in for example motion detection, computers or navigation with enhanced calculating or comparison method capable of accurately obtaining and calculating actual deviation angles in the spatial pointer frame is needed. For applications of navigations or computers including portable communication devices integrated

with displays therein, the electronic device may too include the mapping of such actual angles onto a cursor, pointer or position information on the display frame in dynamic environments and conditions including undesirable external interferences. In addition, as the trend of 3D technology advances and is applicable to various fields including displays, interactive systems and navigation, there is a significant need for an electronic device, including for example a motion detector, a 3D pointing device, a navigation equipment, or a communication device integrated with motion sensors therein, capable of accurately outputting a deviation of such device readily useful in a 3D or spatial reference frame. Furthermore, there is a need to provide an enhanced comparison method and/or model applicable to the processing of signals of motion sensors such that errors and/or noises associated with such signals or fusion of signals from the motions sensors may be corrected or eliminated. In addition, according to the field of application, such output of deviation in 3D reference frame may too be further mapped or translated to a pattern useful in a 2D reference frame.

SUMMARY OF THE INVENTION

[0008] According to one aspect of an exemplary embodiment of the present invention, an electronic device utilizing a nine-axis motion sensor module for use in for example computers, motion detection or navigation is provided. The electronic device comprises an accelerometer to measure or detect axial accelerations Ax, Ay, Az, a magnetometer to measure or detect magnetism Mx, My, Mz and a rotation sensor to measure or detect angular velocities ω_x, ω_y, ω_z such that resulting deviation including resultant angles comprising yaw, pitch and roll angles in a spatial pointer frame of the electronic device subject to movements and rotations in dynamic environments may be obtained and such that said resulting deviation including said resultant

angles may be obtained and outputted in an absolute manner reflecting or associating with the actual movements and rotations of the electronic device of the present invention in said spatial pointer reference frame and preferably excluding undesirable external interferences in the dynamic environments.

[0009] According to another aspect of the present invention, the present invention provides an enhanced comparison method and/or model to eliminate the accumulated errors as well as noises over time associated with signals generated by a combination of motion sensors, including the ones generated by accelerometers A_x, A_y, A_z, the ones generated by magnetometers M_x, M_y, M_z and the ones generated by gyroscopes ω_x, ω_y, ω_z in dynamic environments. In other words, accumulated errors associated with a fusion of signals from a motions sensor module comprising a plurality of motion sensors to detect movements on and rotations about different axes of a reference frame may be eliminated or corrected.

[0010] According to still another aspect of the present invention, the present invention provides an enhanced comparison method to correctly calculating and outputting a resulting deviation comprising a set of resultant angles including yaw, pitch and roll angles in a spatial pointer frame, preferably about each of three orthogonal coordinate axes of the spatial pointer reference frame, by comparing signals of rotation sensor related to angular velocities or rates with the ones of accelerometer related to axial accelerations and the ones of magnetometer related to magnetism such that these angles may be accurately outputted and obtained, which may too be further mapping to another reference frame different from said spatial pointer frame.

[0011] In the event of interferences including external interferences introduced by either the device user or the surrounding environment, such as external electromagnetic fields, according to still another aspect of the present invention, the present invention provides a unique update program comprising a data association model to intelligently process signals received from a motion sensor module to output a resultant deviation preferably in 3D reference frame such that the adverse effects caused by the interferences may be advantageously reduced or compensated.

[0012] According to still another aspect of the present invention, the present invention further provides a mapping of the abovementioned resultant angles, preferably about each of three orthogonal coordinate axes of the spatial pointer reference frame, including yaw, pitch and roll angles in a spatial pointer reference frame onto a display frame either external to the device of the present invention or integrated therein such that a movement pattern in a display frame different from the spatial pointer reference frame may be obtained according to the mapping or translation of the resultant angles of the resultant deviation onto said movement pattern.

[0013] According to another example embodiment of the present invention, an electronic device capable of generating 3D deviation angles and for use in for example computers, motion detection or navigation is provided. The electronic device may utilize a nine-axis motion sensor module with an enhanced comparison method or model for eliminating accumulated errors of said nine-axis motion sensor module to obtain deviation angles corresponding to movements and rotations of said electronic device in a spatial pointer reference frame. The comparison method or model may be advantageously provided by comparing signals from the abovementioned nine-axis motion sensor module capable of detecting rotation rates or angular velocities of the

electronic device about all of the X_P, Y_P and Z_P axes as well as axial accelerations and ambient magnetism including such as earth's magnetic field or that of other planets of the electronic device along all of the X_P, Y_P and Z_P axes such that deviation angles of the resultant deviation of the electronic device of the present invention may be preferably obtained or outputted in an absolute manner. In other words, the present invention is capable of accurately outputting the abovementioned deviation angles including yaw, pitch and roll angles in a 3D spatial pointer reference frame of the 3D pointing device to eliminate or reduce accumulated errors and noises generated over time in a dynamic environment including conditions such as being subject to a combination of continuous movements, rotations, external gravity forces, magnetic field and additional extra accelerations in multiple directions or movement and rotations that are continuously nonlinear with respect to time; and furthermore, based on the deviation angles being compensated and accurately outputted in 3D spatial reference frame may be further mapped onto or translated into another reference frame such as the abovementioned display frame, for example a reference in two-dimension (2D).

[0014] According to another example embodiment of the present invention, a 3D pointing device utilizing a nine-axis motion sensor module is provided; wherein the nine-axis motion sensor module of the 3D pointing device comprises at least one gyroscope, at least one accelerometer and at least one magnetometer. In one preferred embodiment of the present invention, the nine-axis motion sensor module comprises a rotation sensor capable of detecting and generating angular velocities of ω_x, ω_y, ω_z, an accelerometer capable of detecting and generating axial accelerations of Ax, Ay, Az, and a magnetometer capable of detecting and generating magnetism of Mx, My, Mz. It can be understood that in another embodiment, the

abovementioned rotation sensor may comprise three gyroscopes corresponding to each of the said angular velocities of ω_x, ω_y, ω_z in a 3D spatial reference frame of the 3D pointing device; whereas the abovementioned accelerometer may comprise three accelerometers corresponding to each of the said axial accelerations Ax, Ay, Az in a 3D spatial reference frame of the 3D pointing device; and whereas the abovementioned magnetometer may comprise three magnetic sensors such as magneto-impedance (MI) sensors or magneto-resistive (MR) sensors corresponding to each of the said magnetism Mx, My, Mz in a 3D spatial reference frame of the electronic device. The rotation sensor detects the rotation of the 3D pointing device with respect to a reference frame associated with the 3D pointing device and provides a rotation rate or angular velocity output. The angular velocity output includes three components corresponding to the rotation rate or angular velocities ω_x, ω_y, ω_z of the 3D pointing device about the first axis, the second axis and the third axis of the reference frame, namely, Xp, Yp and Zp of the 3D spatial frame. The accelerometer detects the axial accelerations of the 3D pointing device with respect to the spatial reference frame such as a 3D-pointer reference frame and provides an acceleration output. The acceleration output includes three components corresponding to the accelerations, Ax, Az, Ay of the 3D pointing device along the first axis, the second axis and the third axis of the reference frame, namely, Xp, Yp and Zp of the 3D spatial reference frame. The magnetometer detects the magnetism of the electronic device with respect to the spatial reference frame such as a 3D reference frame and provides an magnetism output. The magnetism output includes three components corresponding to the magnetism, Mx, My, Mz of the 3D pointing device along the first axis, the second axis and the third axis of the reference frame, namely, Xp, Yp and Zp of the 3D spatial frame. It can, however, be understood that the axes of Xp, Yp and Zp of the 3D spatial reference frame may too be represented simply by the denotation of X, Y and Z.

[0015] According to another example embodiment of the present invention, a method for compensating accumulated errors of signals of the abovementioned nine-axis motion sensor module in dynamic environments associated in a spatial reference frame is provided. In one embodiment, the method may be performed or handled by a hardware processor. The processor is capable of compensating the accumulated errors associated with the resultant deviation in relation to the signals of the abovementioned nine-axis motion sensor module of the 3D pointing device subject to movements and rotations in a spatial reference frame and in a dynamic environment by performing a data comparison to compare signals of rotation sensor related to angular velocities with the ones of accelerometer related to axial accelerations and the ones of magnetometer related to magnetism such that the resultant deviation corresponding to the movements and rotations of the 3D pointing device in the 3D spatial reference frame may be obtained accurately over time in the dynamic environments.

[0016] According to another embodiment of the present invention, a method for obtaining a resulting deviation including resultant angles in a spatial reference frame of a three-dimensional (3D) pointing device utilizing a nine-axis motion sensor module therein and subject to movements and rotations in dynamic environments in said spatial reference frame is provided. Said method comprises the steps of: obtaining a previous state associated with previous angular velocities ω_x, ω_y, ω_z gained from the motion sensor signals of the nine-axis motion sensor module at a previous time T-1; obtaining a current state of the nine-axis motion sensor module by obtaining measured angular velocities ω_x, ω_y, ω_z gained from the motion sensor signals at a current time T; obtaining a measured state of the nine-axis motion sensor module by obtaining

measured axial accelerations Ax, Ay, Az and measured magnetism M_x, M_y, M_z gained from the motion sensor signals at the current time T and calculating predicted axial accelerations Ax', Ay', Az' and predicted magnetism M_x', M_y', M_z' based on the measured angular velocities ω_x, ω_y, ω_z of the current state; obtaining an updated state of the nine-axis motion sensor module by comparing the current state with the measured state of the nine-axis motion sensor module; and calculating and converting the updated state of the nine-axis motion sensor module to said resulting deviation comprising said resultant angles in said spatial reference frame of the 3D pointing device.

[0017] According to another aspect of the present invention, a method for mapping deviation angles associated with movements and rotations of a 3D pointing device in a spatial reference frame onto a display frame of a display having a predetermined screen size is provided. In one embodiment, the method for mapping or translating deviation angles including yaw, pitch and roll angles in a spatial reference frame to an pointing object, such as a pointer, having movements in a display frame, preferably a 2D reference frame, comprises the steps of obtaining boundary information of the display frame by calculating a predefined sensitivity associated with the display frame and performing angle and distance translation in the display frame based on said deviation angles and boundary information.

[0018] According to another embodiment of the present invention, a method for obtaining a resulting deviation including resultant angles in a spatial reference frame of a three-dimensional pointing device utilizing a nine-axis motion sensor module therein and subject to movements and rotations in dynamic environments in said spatial reference frame is provided. Said method

comprises the steps of: obtaining a previous state of the nine-axis motion sensor module; wherein the previous state includes an initial-value set associated with at least previous angular velocities gained from the motion sensor signals of the nine-axis motion sensor module at a previous time T-1; obtaining a current state of the nine-axis motion sensor module by obtaining measured angular velocities ω_x, ω_y, ω_z gained from the motion sensor signals of the nine-axis motion sensor module at a current time T; obtaining a measured state of the nine-axis motion sensor module by obtaining measured axial accelerations Ax, Ay, Az gained from the motion sensor signals of the nine-axis motion sensor module at the current time T and calculating predicted axial accelerations Ax', Ay', Az' based on the measured angular velocities ωx, ωy, ωz of the current state of the nine-axis motion sensor module; obtaining a first updated state of the nine-axis motion sensor module by comparing the current state with the measured state of the nine-axis motion sensor module; obtaining the measured state of the nine-axis motion sensor module by obtaining and calculating a measured yaw angle gained from the motion sensor signals of the nine-axis motion sensor module at the current time T and calculating a predicted yaw angle based on the first updated state of the nine-axis motion sensor module; obtaining a second updated state of the nine-axis motion sensor module by comparing the current state with the measured state of the nine-axis motion sensor module; and calculating and converting the second updated state of the nine-axis motion sensor module to said resulting deviation comprising said resultant angles in said spatial reference frame of the electronic device.

BRIEF DESCRIPTION OF THE DRAWINGS

[0019] The accompanying drawings are included to provide a further understanding of the invention, and are incorporated herein for illustrative purposes only. The drawings illustrate

embodiments of the invention and, together with the description, serve to only illustrate the principles of the invention.

[0020] FIG. 1 shows a known related art having a 5-axis motion sensor in 2D reference frame.

[0021] FIG. 2 shows the known related art having a 5-axis motion sensor as shown in FIG.1 being rotated or rolled about Xp axis and is subject to further dynamic interactions or environment.

[0022] FIG. 3 is an exploded diagram showing an electronic device of the present invention, such as a pointing device, utilizing a nine-axis motion sensor module according to one embodiment of the present invention.

[0023] FIG. 4 is a schematic block diagram illustrating hardware components of an electronic device according to one embodiment of the present invention.

[0024] FIG. 5 is a schematic diagram showing another embodiment of an electronic device of the present invention, such as a pointing device, utilizing a nine-axis motion sensor module as well as an external processor.

[0025] FIG. 6 is an exploded diagram showing still another embodiment of an electronic device of the present invention, such as a smartphone or navigation equipment, utilizing a nine-axis motion sensor module according to anther embodiment of the present invention.

[0026] FIG. 7 is a flow chart illustrating a method for obtaining a resultant deviation of an electronic device of the present invention subject to movements and rotations in a spatial reference frame.

[0027] FIG. 8 shows another exemplary flow chart illustrating a method for obtaining resultant deviation including mapping of said deviation to a display of an electronic device according to another embodiment of the present invention.

[0028] FIG. 9 is a schematic diagram showing the mapping of the resultant angles of the resultant deviation according to an embodiment of the present invention.

[0029] FIG. 10 is an exemplary flow chart illustrating another embodiment of a method for obtaining a resultant deviation of an electronic device of the present invention.

[0030] FIG. 11 shows an exemplary flow chart illustrating another embodiment of a method for obtaining a resultant deviation including mapping of such deviation to a display of an electronic device of the present invention.

[0031] FIG. 12 shows an exemplary flow chart illustrating a method for obtaining resultant deviation of an electronic device according to still another embodiment of the present invention.

DESCRIPTION OF PREFERRED EMBODIMENTS

[0032] Detailed descriptions of preferred embodiments of the present invention recited herein are provided for illustrative purposes only; examples of which are too illustrated in the accompanying drawings. In addition, similar reference numbers in the drawings and the description may too refer to similar parts or components.

[0033] FIG. 3 is an exploded diagram showing an electronic device 300 according to one embodiment of the present invention, such as a pointing device. The electronic device 300 is subject to movements and rotations in dynamic environments in a spatial reference frame such as a 3D reference frame. The spatial reference frame is analogous to the reference frame $X_PY_PZ_P$ also shown in Fig. 1 and Fig. 2. The movements and rotations of the electronic device 300, such as a pointing device, in the aforementioned dynamic environments in the spatial reference frame may be continuously nonlinear with respect to time. The term of "dynamic" recited herein may refer to moving or subject to motions in general.

[0034] The electronic device 300 includes a top cover 310, a printed circuit board (PCB) 340, a rotation sensor 342, an accelerometer 344, a magnetometer 345, a data transmitting unit 346, a computing processor 348, a bottom cover 320, and a battery pack 322. The top cover 310 may include a few control buttons 312 for a user to issue predefined commands for remote control. In one embodiment, the housing 330 may comprise the top cover 310 and the bottom cover 320. The housing 330 may move and rotate in the spatial reference frame according to user manipulation or any external forces in any direction and/or under the abovementioned dynamic environments. As shown in the FIG.3, in one embodiment, the rotation sensor 342, the

accelerometer 344, the magnetometer 345, the data transmitting unit 346, and the computing processor 348 may be all attached to the PCB 340. The PCB 340 is enclosed by the housing 330. The PCB 340 includes at least one substrate having a longitudinal side configured to be substantially parallel to the longitudinal surface of the housing 330. An additional battery pack 322 provides electrical power for the electronic device 300.

[0035] Furthermore, in one embodiment, the abovementioned dynamic environments, in which the electronic device 300 of the present invention may be present or subject to, may include undesirable external interferences to the electronic device 300 of the present invention. In one example, the undesirable external interferences may refer to or include undesirable axial accelerations caused by undesirable external forces other than a force of gravity. In another example, the undesirable external interferences may also refer to or include undesirable magnetism caused by undesirable electromagnetic fields.

[0036] FIG. 4 is a schematic block diagram illustrating hardware components of the electronic device 300. The electronic device 300 includes a nine-axis motion sensor module 302 and a processing and transmitting module 304. The nine-axis motion sensor module 302 includes the rotation sensor 342, the accelerometer 344 and the magnetometer 345. The processing and transmitting module 304 includes the data transmitting unit 346 and the computing processor 348.

[0037] The term "nine-axis" recited herein may refer to and generally include the three angular velocities ω_x, ω_y, ω_z, the three axial accelerations Ax, Ay, Az, and the three magnetism

Mx, My, Mz. The rotation sensor 342 of the nine-motion sensor module 302 detects and generates the first signal set including angular velocities ω_x, ω_y, ω_z associated with the movements and rotations of the electronic device 300 about each of three orthogonal coordinate axes $X_PY_PZ_P$ of the spatial reference frame. The angular velocities ω_x, ω_y and ω_z are corresponding to the coordinate axes X_P, Y_P and Z_P respectively. The accelerometer 344 detects and generates the second signal set including axial accelerations Ax, Ay, Az associated with the movements and rotations of the electronic device 300 along each of the three orthogonal coordinate axes $X_PY_PZ_P$ of the spatial reference frame. The axial accelerations Ax, Ay and Az are corresponding to the coordinate axes X_P, Y_P and Z_P respectively. The magnetometer 345 of the nine-motion sensor module 302 detects and generates the third signal set including magnetism Mx, My, Mz associated with the movements and rotations of the electronic device 300 along each of the three orthogonal coordinate axes $X_PY_PZ_P$ of the spatial reference frame. The magnetism Mx, My and Mz represent the strength and/or direction of ambient magnetic field (such as the magnetic field of the Earth) of the electronic device 300. The magnetism Mx, My and Mz are corresponding to the coordinate axes X_P, Y_P and Z_P respectively. It too can be understood that the abovementioned nine axes of $X_pY_pZ_p$ may not need to be orthogonal in a specific orientation and they may be rotated in different orientations; the present invention discloses such coordinate system for illustrative purposes only and any coordinates in different orientation and/or denotations may too be possible.

[0038] Furthermore, in one embodiment of the present invention, the motion sensor module or nine-axis motion sensor module 302 of the electronic device 300 may refer to a Micro-Electro-Mechanical-System (MEMS) type of sensor. In an explanatory example, the

abovementioned rotation sensor 342 of the nine-axis motion sensor module 302 may further comprise at least one resonating mass such that a movement of said at least one resonating mass along an axis of said spatial reference frame may be detected and measured by said rotation sensor using the Coriolis acceleration effect to generate said first signal set comprising angular velocities ωx, ωy, ωz in said spatial reference frame. It can be understood that for a three-axis rotation sensor of a MEMS type sensor, there may be positioned three resonating masses along each of X, Y and Z axes of the spatial reference frame to generate and obtain movements or displacements of the three resonating masses thereof. It can too be understood that the nine-axis motion sensor 302 of the present invention may also include a three-axis accelerometer, a three-axis rotation sensor and a three-axis magnetometer in a MEMS structure.

[0039] The data transmitting unit 346 is electrically connected to the nine-axis motion sensor module 302 for transmitting the first, second and third signal sets. The data transmitting unit 346 transmits the first, second and third signal sets of the nine-axis motion sensor module 302 to the computing processor 348 preferably via electronic connections configured on the PCB 340. The computing processor 348 receives and calculates the first, second and third signal sets from the data transmitting unit 346. The computing processor 348 further communicates with the nine-axis motion sensor module 302 to calculate the resulting deviation of the electronic device 300 including three resultant angles preferably about each of the three axes of the spatial reference frame. The resultant angles include the yaw angle 111, the pitch angle 112 and the roll angle 113 as shown in Fig. 1 and Fig. 2. In order to calculate the resulting deviation, the computing processor 348 may utilize a comparison or algorithm to eliminate accumulated errors of the first, second and/or third signal sets of the nine-axis motion sensor module 302, whereby

the resultant angles in the spatial reference frame, preferably about each of three orthogonal coordinate axes of the spatial reference frame, of the resulting deviation of the nine-axis motion sensor module 302 of the electronic device 300 is obtained under the aforementioned dynamic environments excluding the abovementioned undesirable external interferences and such that it is preferably obtained and outputted in an absolute manner reflecting or associating with the actual movements and rotations of the electronic device 300, including such as a pointing device, of the present invention in said spatial reference frame. In addition, said comparison utilized by the computing processor 348 may further comprise an update program to obtain an updated state of the nine-axis motion sensor module based on a previous state associated with a first signal set in relation to the angular velocities ω_x, ω_y, ω_z and a measured state associated with both said second and third signal sets in relation to the axial accelerations Ax, Ay, Az as well as magnetism Mx, My, Mz. The abovementioned measured state may include a measurement of said second signal set or measured Ax, Ay, Az and a predicted measurement of Ax', Ay' and Az' obtained based on or calculated from a current state of the motion sensor module 302. In addition, the abovementioned measured state may too include a measurement of said third signal set or measured Mx, My, Mz and a predicted measurement of Mx', My' and Mz' obtained based on or calculated from the current state of the motion sensor module 302. Details of different "states" of the nine-axis motion sensor module 302 of the electronic device 300 of the present invention are provided in the later content.

[0040] In one embodiment, the computing processor 348 of the processing and transmitting module 304 may further include a mapping program for translating the resultant angles of the resulting deviation in the spatial reference frame to a movement pattern in a display reference

frame different from the spatial reference frame. The display reference frame is analogous to the reference frame $X_DY_DZ_D$ in Fig. 1 and Fig. 2. The movement pattern may be displayed on a screen of a 2D display device similar to the display device 120 in Fig. 1 and Fig. 2. The mapping program translates the resultant angles, preferably about each of the three orthogonal coordinate axes of the spatial reference frame to the movement pattern according to a sensitivity input correlated to the display reference frame.

[0041] FIG. 5 is a schematic diagram showing an electronic device 500 utilizing a nine-axis motion sensor module according to anther embodiment of the present invention in a 3D spatial reference frame. As shown in FIG. 5, the electronic device 500 may comprise two parts 560 and 570 in data communication with each other. In one embodiment, the first part 560 includes a top cover (not shown), a PCB 540, a nine-axis motion sensor module 502 comprising a rotation sensor 542, an accelerometer 544 and a magnetometer 545, a data transmitting unit 546, a bottom cover 520, and a battery pack 522. The data transmitting unit 546 transmits the first signal set (ω_x, ω_y, ω_z) generated by the rotation sensor 542 of the nine-motion sensor module 502 and the second signal set (Ax, Ay, Az) generated by the accelerometer 544 as well as the third signal set (Mx, My, Mz) generated by the magnetometer 545 of the nine-motion sensor module 502 to the data receiving unit 552 of the second part 570 via wireless communication or connection including wireless local area network (WLAN) based on IEEE 802.11 standards or Bluetooth™. It can be understood that in another embodiment, wired communication or connection via a physical cable or electrical wires connecting the first part 560 and the second part 570 may too be possible. In one embodiment of the present invention, the motion sensor module or nine-axis motion sensor module 502 of the electronic device 500 may refer to a MEMS type of sensor. In

an explanatory example, the abovementioned rotation sensor 542 of the nine-axis motion sensor module 502 may further comprise at least one resonating mass such that a movement of said at least one resonating mass along an axis of said spatial reference frame may be detected and measured by said rotation sensor using the Coriolis acceleration effect to generate said first signal set comprising angular velocities ωx, ωy, ωz in said spatial reference frame. It can be understood that for a three-axis rotation sensor of a MEMS type sensor, there may be positioned three resonating masses along each of X, Y and Z axes of the spatial reference frame to generate and obtain movements or displacements of the three resonating masses thereof. It can too be understood that the nine-axis motion sensor 502 of the present invention may also include a three-axis accelerometer, a three-axis rotation sensor and a three-axis magnetometer in a MEMS structure.

[0042] In one embodiment, the second part 570 may be an external processing device to be adapted to another electronic computing apparatus or system such as a standalone personal computer or server 580; for instance, the second part 570 may be coupled or adapted to an laptop computer via a standard interface, such as the universal serial bus (USB) interface depicted as shown in Fig. 5. The first part 560 and the second part 570 communicate via the data transmitting unit 546 and the data receiving unit 552. As previously mentioned, the data transmitting unit 546 and the data receiving unit 552 may communicate through wireless connection or wired connection. In other words, in terms of hardware configuration and data transmission, in one embodiment of the present invention, the nine-axis motion sensor module 502 comprising the rotation sensor 542, the accelerometer 544 and the magnetometer 545 may be disposed distally from the processing unit or computing processor 554; the signals from the

nine-axis motion sensor module 502 may then be transmitted via the data transmitting units 546, 552 to the computing processor 554 via wired or wireless communication including for example IEEE 802.11 standards or Bluetooth™.

[0043] The second part 570 of the electronic device 500 according to one embodiment of the present invention comprises the data transmitting unit 552 and the processor 554. The data transmitting unit 552 of the second part 570 may be in data communication with the other data transmitting unit 546 disposed distally therefrom in the first part 560 as previously mentioned. The data transmitting unit 552 in the second part 570 receives the first, second and third signal sets from the data transmitting unit 546 in the first part 560 and transmits the first, second and third signal sets to the computing processor 554. In one embodiment, the computing processor 554 performs the aforementioned calculation as well as comparison of signals. In one embodiment, said comparison utilized by the computing processor 554 may further comprise an update program to obtain an updated state based on or from a previous state associated with said first signal set and a measured state associated with said second and third signal sets. The measured state may further include a measurement of said second and third signal sets and predicted measurements obtained based on the first signal set or based on a current state of the motion sensor module 502. The computing processor 554 is external to the housing of the 3D pointing device as depicted in Fig. 5. In one embodiment, the computing processor 554 also performs mapping by translating the resultant angles of the resulting deviation of the electronic device in the spatial pointer reference frame, preferably about each of three orthogonal coordinate axes of the spatial reference frame, to a movement pattern in a display reference frame associated with the notebook computer 580. The movement pattern may be displayed on

the screen 582 of the notebook computer 580.

[0044] FIG. 6 is an exploded diagram showing a portable electronic device 600, such as for example a 3D pointing device, utilizing a nine-axis motion sensor module according to anther embodiment of the present invention in a 3D spatial reference frame. The portable electronic device 600 may further comprises a built-in display 682; examples of the portable electronic device 600 as an explanatory embodiment of the present invention may include such as smartphone, tablet PC or navigation equipment. In other words, the abovementioned display reference frame associated with a display may need not to be external to the spatial reference frame in terms of the hardware configuration of the present invention. In one embodiment, the electronic device 600 comprises a bottom cover 620, a PCB 640, a battery pack 622, a rotation sensor 642, an accelerometer 644, a magnetometer 645, a data transmitting unit 646, a computing processor 648, a display 682, and a top cover 610. Likewise, in one embodiment, the housing 630 may comprise the top and bottom covers 610, 620. A built-in display 682 may too be integrated on the housing 630; the nine-axis motion sensor module 602 may comprise the rotation sensor 642, the accelerometer 644 and the magnetometer 645. The data transmitting unit 646 and the computing processor 648 may also be integrated as a processing and transmitting module 604 of the electronic device 600. In one embodiment of the present invention, the motion sensor module or nine-axis motion sensor module 602 of the portable electronic device 600 may refer to a MEMS type of sensor. In an explanatory example, the abovementioned rotation sensor 642 of the nine-axis motion sensor module 602 may further comprise at least one resonating mass such that a movement of said at least one resonating mass along an axis of said spatial reference frame may be detected and measured by said rotation sensor using the Coriolis

acceleration effect to generate said first signal set comprising angular velocities ωx, ωy, ωz in said spatial reference frame. It can be understood that for a three-axis rotation sensor of a MEMS type sensor, there may be positioned three resonating masses along each of X, Y and Z axes of the spatial reference frame to generate and obtain movements or displacements of the three resonating masses thereof. It can too be understood that the nine-axis motion sensor 602 of the present invention may also include a three-axis accelerometer, a three-axis rotation sensor and a three-axis magnetometer in a MEMS structure.

[0045] The computing processor 648 of the processing and transmitting module 604 may too perform the mapping of resultant deviation from or in said spatial reference frame or 3D reference frame to a display reference frame such as a 2D reference frame by translating the resultant angles of the resulting deviation of the electronic device 600 in the spatial reference frame, preferably about each of three orthogonal coordinate axes of the spatial reference frame to a movement pattern in a display reference frame associated with the electronic device 600 itself. The display 682 displays the aforementioned movement pattern. The top cover 610 includes a transparent area 614 for the user to see the display 682.

[0046] FIG. 7 is an explanatory flow chart illustrating a method for obtaining and/or outputting a resultant deviation including deviation angles in a spatial reference frame of an electronic device, including such as a pointing device, navigation equipment or smartphone, having movements and rotations in a 3D spatial reference frame and in dynamic environments according to an embodiment of the present invention. The method in Fig. 7 may be a program such as an algorithm or a comparison model to be embedded or performed by the processing unit

or computing processor 348, 554, 648 of the processing and transmitting module according to different embodiments of the present invention recited herein for illustrative purposes.

[0047] Accordingly, in one embodiment of the present invention, a method for obtaining a resultant deviation including deviation angles in a spatial reference frame of an electronic device utilizing a nine-axis motion sensor module therein in dynamic environments and preferably excluding undesirable external interferences thereof is provided. As the electronic device may be subject to movements and rotations in the dynamic environments, undesirable interferences may cause the measurements, calculations or outputs of the motion sensor module thereof to be errorsome. In one embodiment, said method may comprise the following steps. First of all, as shown in FIG.7, different states including "previous state", "current state", "measured state" and "update state" of the nine-axis motion sensor module may be provided to represent a step or a set of steps utilized by the method for obtaining the resulting deviation in 3D reference frame, and preferably in the abovementioned "absolute" manner. In one exemplary embodiment, the method comprises the steps of obtaining a previous state of the nine-axis motion sensor module (such as steps 705, 710); and wherein the previous state may too include an initial-value set predetermined to initialize said previous state of the nine-axis motion sensor module at a beginning of the method. The initial-value set may preferably be utilized at said beginning of the method or a start of the method where a previous state is not available to be obtained from an updated state (to be recited hereafter). In another embodiment where previous state may be obtained or updated from an updated state, said previous state may be a first quaternion inducing values associated with at least previous angular velocities ω_x, ω_y, ω_z gained from the motion sensor signals of the nine-axis motion sensor module at a previous time T-1. A current state of

the nine-axis motion sensor module may then be subsequently obtained by obtaining measured angular velocities ω_x, ω_y, ω_z gained from the motion sensor signals of the nine-axis motion sensor module at a current time T (such as steps 715, 720). A measured state of the nine-axis motion sensor module may then be obtained by obtaining measured axial accelerations Ax, Ay, Az gained from the motion sensor signals of the nine-axis motion sensor module at the current time T (such as step 725). Furthermore, the step of calculating predicted axial accelerations Ax', Ay', Az' based on the measured angular velocities ω_x, ω_y, ω_z of the current state of the nine-axis motion sensor module (such as step 730); obtaining an updated state of the nine-axis motion sensor module by comparing the current state with the measured state of the nine-axis motion sensor module (such as step 735); and calculating and converting the updated state of the nine-axis motion sensor module to said resulting deviation comprising said resultant angles in said spatial reference frame of the electronic device (745) may then be performed and obtained; and whereby the resultant deviation comprising deviation angles associated with the updated state of the nine-axis motion module may be obtained excluding said undesirable external interferences in the dynamic environments. In order to provide a continuous loop such as performed in a looped manner, the result of the updated state of the nine-axis motion sensor module may preferably be outputted to the previous state; in one embodiment, the updated state may be a quaternion, namely third quaternion as shown in the figure, such that it may be directly outputted to the abovementioned previous state of another quaternion, namely the abovementioned first quaternion and as shown in the figure (such as step 740).

[0048] In addition, it can be understood that the abovementioned comparison utilized by the processing and transmitting module and comprising the update program may too make reference

to said different states of the nine-axis motion sensor module as shown in FIGs 7 and 8. As mentioned previously, the update program may be utilized by the processor to obtain the updated state of the nine-axis motion sensor module based on the previous state associated with a first signal set in relation to the angular velocities ω_x, ω_y, ω_z and the measured state associated with said second signal set in relation to the axial accelerations Ax, Ay, Az. The abovementioned measured state may include a measurement of said second signal set or measured Ax, Ay, Az and a predicted measurement of Ax', Ay' and Az' obtained based on or calculated from the first signal set. Details of each of the abovementioned states of the nine-axis motion sensor module and the related steps of the method for obtaining the resultant deviation of the electronic device in 3D reference frame are as follows.

[0049] Referring to FIG. 7 again, the method for obtaining a resultant deviation including resultant angles in a spatial reference frame of electronic device utilizing a nine-axis motion sensor module according to one embodiment of the present invention may begin at the obtaining of a previous state of the nine-axis motion sensor module. In one embedment, the previous state of the nine-axis motion sensor module may preferably be in a form of a first quaternion, and the first quaternion may be preferably initialized (step 705) at a very beginning of the process or method and as part of the obtaining of the previous state thereof. In other words, according to one embodiment of the present invention, the signals of the nine-axis motion sensor are preferably to be initialized according to a predetermined value set or quaternion including such as zeros and in particular, the signal or value associated with the yaw angle in terms of a quaternion value. The four elements of the first quaternion may be initialized with predetermined initial values. Alternatively, the first quaternion may be initialized or replaced by another signal

sets generated by the rotation sensor and the accelerometer at a next time frame such that the method as shown in Fig. 7 is a continuous loop between a previous time frame T-1 and a present time frame T; details on the replacement of the first quaternion at T-1 with the later outputted quaternion at T is to be provided in the later content. It can be understood that one may make reference to Euler Angles for definition on quaternion. Similarly, it can be easily comprehended that the abovementioned previous time T-1 and present time T may too be substitute by a present time T and a next time T+1 respectively and shall too fall within the scope and spirit of the present invention.

[0050] In addition, the abovementioned dynamic environments may include undesirable external interferences to the present invention as mentioned previously. For instance, the undesirable external interferences nay refer to or include undesirable axial accelerations caused by undesirable external forces other than a force of gravity and they may too include or refer to include undesirable magnetism caused by undesirable electromagnetic fields. In a preferred embodiment of the present invention, one of the technical effects of the perform of the method as shown in FIG. 7 include that the abovementioned updated state of the nine-axis motion sensor module to said resulting deviation comprising said resultant angles in said spatial reference frame of the electronic device (step 745) may be preferably obtained excluding undesirable interferences in the dynamic environments, such as decoupling of undesirable external forces from the force of gravity to exclude undesirable axial accelerations and exclusion of undesirable external magnetism caused or induced by undesirable electromagnetic fields in the dynamic environments.

[0051] The method illustrated in Fig. 7 may be performed in consecutive time frames. According to one embodiment of the present invention, steps 710-745 may be performed in a looped manner by such as a data processing unit of an electronic device of the present invention. In another embodiment, multiple steps may be performed simultaneously, such as the obtaining of signals from the nine-axis motion sensor module may be performed simultaneously instead of one after another. It can therefore be understood that the steps recited herein are for illustrative purposes only and any other sequential orders or simultaneous steps are possible and shall too be considered to be within the scope of the present invention. The first quaternion with respect to the previous time T is obtained as shown in the figure as step 710. When step 710 is performed, the first quaternion initialized in step 705 is obtained. Otherwise, the first quaternion used in the present time T is generated in the previous time T-1. In other words, the step 710 may generally refer to or represented by the abovementioned "previous state" of the nine-axis motion sensor module; according to another embodiment, the previous state may refer to the steps of 705 and 710.

[0052] The next may be to obtain the first signal set generated by the rotation sensor, which includes the measured angular velocities ω_x, ω_y and ω_z as shown in step 715 according to an exemplary embodiment of the present invention. In step 720, the second quaternion with respect to a present time T is calculated and obtained based on the angular velocities ω_x, ω_y and ω_z. The step 715 and 720 may generally refer to or may be represented by the abovementioned "current state" of the nine-axis motion sensor module. In one embodiment, the computing processor may use a data conversion utility including such as an algorithm to convert the angular velocities ω_x, ω_y , ω_z and first quaternion into the second quaternion. This data conversion utility may be a

program or instruction represented by the following equation (1).

$$\begin{bmatrix} \dot{q}_0 \\ \dot{q}_1 \\ \dot{q}_2 \\ \dot{q}_3 \end{bmatrix} = \frac{1}{2} \begin{bmatrix} 0 & -\omega_x & -\omega_y & -\omega_z \\ \omega_x & 0 & \omega_z & -\omega_y \\ \omega_y & -\omega_z & 0 & \omega_x \\ \omega_z & \omega_y & -\omega_x & 0 \end{bmatrix} \begin{bmatrix} q_0 \\ q_1 \\ q_2 \\ q_3 \end{bmatrix} \quad \text{..... (1)}$$

Equation (1) is a differential equation. The quaternion on the left side of the equal sign is the first order derivative with respect to time of the quaternion (q_0, q_1, q_2, q_3) on the right side of the equal sign. The data conversion utility uses the first quaternion as the initial values for the differential equation (1) and calculates the solution of the differential equation (1). The second quaternion may be represented by a solution of the differential equation (1).

[0053] As shown in the figure, the "measured state" of the nine-axis motion sensor module according to one embodiment of the present invention may generally refer or may be represented by steps 725 and 730. In step 725, the second signal set generated by the accelerometer may be obtained, which includes measured axial accelerations Ax, Ay and Az; or Ax, Ay and Az may refer to the measurement of the axial accelerations obtained. In order to obtain said measured state of the nine-axis motion sensor of the present invention, according to one embodiment, predicted axial accelerations Ax', Ay' and Az' may too be calculated and obtained based on the abovementioned current state of the nine-axis motion sensor module or the second quaternion as shown in step 730. In other words, two sets of axial accelerations may be obtained for the measured state of the nine-axis motion sensor module; one may be the measured axial accelerations Ax, Ay, Az in step 725 and the other may be the predicted axial accelerations Ax', Ay', Az' in step 730 calculated based on the abovementioned current state or second quaternion

in relation to the measured angular velocities thereof. Furthermore, in one embodiment, the computing processor may use a data conversion utility to convert quaternion into the predicted axial accelerations Ax', Ay' and Az'. This data conversion utility may be a software program represented by the following equations (2), (3) and (4).

$$2(q_1q_3 - q_0q_2) = Ax' \quad \text{..... (2)}$$

$$2(q_2q_3 + q_0q_1) = Ay' \quad \text{..... (3)}$$

$$q_0^2 - q_1^2 - q_2^2 + q_3^2 = Az' \quad \text{..... (4)}$$

The computing processor calculates the solution (Ax', Ay', Az') of the equations (2), (3) and (4).

[0054] According to an exemplary embodiment of the method for obtaining a resultant deviation including deviation angles in a spatial reference frame of an electronic device, including such as a 3D pointing device, a portable electronic device, a navigation equipment or a smartphone, utilizing a nine-axis motion sensor module, it may be preferable to compare the current state of the nine-axis motion sensor module with the measured state thereof with respect to the present time frame T by utilizing a comparison model. In other words, in one embodiment as shown in step 735, it is preferable to compare the second quaternion in relation to the measured angular velocities of the current state at present time T with the measured axial accelerations Ax, Ay, Az as well as the predicted axial accelerations Ax', Ay', Az' also at present time T. Following which, a result may be advantageously obtained as an updated state of the nine-axis motion sensor module, excluding the abovementioned undesirable external interferences of the dynamic environments. In an explanatory example, the updated state may generally refer to the update of the current state of the nine-axis motion sensor module at preset

time T. Instructions including equations related to the abovementioned current state, measured state and updated state may be illustrated in the following.

[0055] According to an exemplary embodiment of the comparison model utilized by the present invention in relation to step 735 as shown in the figure, the current state correlated to the abovementioned second quaternion and in relation to the angular velocities of gyroscope(s) may be obtained based on an exemplary equation of:

$$x(t \mid t-1) = f(x_{t-1}, u_t) \quad \text{..... (5)}$$

Preferably, a first probability (state transition probability) associated with the said current state may be further obtained based on an exemplary equation of:

$$P(x_t \mid x_{t-1}, u_t) = F_x P(x_{t-1} \mid x_{t-1}) F_x^T + F_u P(u_{t-1} \mid u_{t-1}) F_u^T + Q_t$$

$$F_x = \frac{\partial f(x_{t-1}, u_t)}{\partial x_{t-1}} \quad \text{..... (6)}$$

$$F_u = \frac{\partial f(x_{t-1}, u_t)}{\partial u_t} \quad \text{..... (7)}$$

wherein Q_t = addtional motion model noise

Likewise, the measured state correlated to the abovementioned predicted axial accelerations and in relation to the axial accelerations of accelerometers and current state may be obtained based on an exemplary equation of:

$$z_t(t \mid t-1) = h(x(t \mid t-1)) \quad \text{..... (8)}$$

Preferably, a second probability (measurement probability) associated with the measured state may be further obtained based on an exemplary equation of:

$$P(z_t \mid x_t) = H_x P(x_t \mid x_{t-1}) H_x^T + R_t \quad \text{..... (9)}$$

$$H_x = \frac{\partial h(x(t \mid t-1))}{\partial x(t \mid t-1)} \quad \text{..... (10)}$$

wherein R_t = measurement model noise

As an illustrative example, the abovementioned first and second probabilities may be further utilized to obtain the updated state of the nine-axis motion sensor module based on an exemplary method of data association of an exemplary equation of:

$$D_t = \{[z_t - h(x(t \mid t-1))]P(z_t \mid x_t)[z_t - h(x(t \mid t-1))]^{-1}\}^{1/2} \quad \text{..... (11)}$$

In one embodiment, the result of the updated state of the nine-axis motion sensor module, preferably involving comparison or data association represented by the equations, may be a third quaternion as shown in the figure. Furthermore, the result may then be further outputted and utilized to obtain a resultant deviation, excluding undesirable interferences of the dynamic environments under which the present invention is subject to, but including deviation angles in a spatial reference frame in the following steps as shown in the figure. In a preferred embodiment of the present invention, said undesirable external interferences may further comprise or refer to undesirable axial accelerations caused by undesirable external forces other than a force of gravity; in another preferred embodiment, said undesirable external interferences may further comprise or refer to undesirable magnetism caused by undesirable electromagnetic fields. In other words, the method and algorithm provided by the present invention may preferably generate or provide an output of the resultant deviation of the nine-axis motion sensor module excluding the abovementioned undesirable interferences. In one example, external forces exerted to cause axial accelerations of a nine-axis motion sensor of an electronic device of the present invention may be decoupled or separated from a force of gravity; and in another example, the undesirable magnetism caused by such as electromagnetic fields external or internal to an electronic device

the present invention may be excluded. It can be understood that the examples of current state, measured state, state update, data association and probabilities of the comparison model and method of the present invention recited herein are provided for illustrative purposes only.

[0056] As mentioned previously, it may be preferable to output the result of the updated state, preferably in a form of third quaternion, to the previous state of the nine-axis motion sensor module as shown in step 740 in FIG.7. In a preferred embodiment, the updated state may further comprise a first data association model; and wherein the abovementioned and related data association model may be provided for comparing the measured state associated with said second signal set with a predicted measurement obtained from said current state. In other words, in one embodiment, the first quaternion may be replaced by the abovementioned third quaternion or substitute directly any previous values of first quaternion in the previous time T for further process in a loop. In other words, the third quaternion with respect to the present time T becomes the first quaternion with respect to the next time such as T+1; or, the third quaternion at previous time frame T-1 outputted may now be the first quaternion at present time frame T.

[0057] In step 745, the updated state of the nine-axis motion sensor module of the present invention may be further calculated and converted to the resultant deviation including deviation angles associated with the spatial reference frame, wherein the deviation angles includes the yaw angle, pitch angle and roll angle of the electronic device associated with the spatial reference frame, preferably about each of three orthogonal coordinate axes of the spatial reference frame; and whereby the resultant deviation comprising deviation angles associated with the updated state of the nine-axis motion module may be preferably obtained excluding said undesirable

external interferences in the dynamic environments. In an explanatory example, said undesirable external interferences may refer to or further comprise undesirable axial accelerations caused by undesirable external forces other than a force of gravity. In another explanatory example, said undesirable external interferences may refer to or further comprise undesirable magnetism caused by undesirable electromagnetic fields. In one embodiment, the computing processor may use a data conversion utility to convert the third quaternion of the updated state of the nine-axis motion sensor module into the yaw, pitch and roll angles thereof. This data conversion utility may be a program or instruction represented by the following equations (12), (13) and (14).

$$yaw = \arctan\left(\frac{2(q_0q_3 + q_1q_2)}{q_0^2 + q_1^2 - q_2^2 - q_3^2}\right) \quad \text{..... (12)}$$

$$pitch = \arcsin(2(q_0q_2 - q_3q_1)) \quad \text{..... (13)}$$

$$roll = \arctan\left(\frac{2(q_0q_1 + q_2q_3)}{q_0^2 - q_1^2 - q_2^2 + q_3^2}\right) \quad \text{..... (14)}$$

The variables q_0, q_1, q_2 and q_3 in equations (12), (13) and (14) are the four elements of the third quaternion.

[0058] For a looped method continuous with respect to time, in one embodiment of the present invention, the method utilized by for example the computing processor communicated with the nine-axis motion sensor module may return to step 710 to perform the comparison process or method with respect to the next time T+1. In addition, the abovementioned resultant deviation including deviation angles comprising yaw, pitch and roll angles in the spatial reference frame converted from the third quaternion is preferably obtained and outputted in an

absolute manner reflecting or associating with the actual movements and rotations of the electronic device of the present invention in said spatial reference frame. It can be understood that said actual movements and rotations of the electronic device of the present invention in the spatial reference frame or 3D reference frame may refer to real-time movements and rotations associated with vectors having both magnitudes and directions along or about orthogonal axes in the spatial reference frame under the dynamic environments.

[0059] FIG. 8 shows a flow chart illustrating a method of mapping resultant deviation angles of an electronic device having movements and rotations in a 3D spatial reference frame and in a dynamic environment onto a display reference frame according to another embodiment of the present invention. FIG. 9 is a schematic diagram showing the aforementioned mapping of the resultant angles of the resultant deviation of an electronic device according to this embodiment. For illustrative purposes, the difference between FIG. 7 and Fig. 8 may be represented by the additional mapping step 750 as shown in FIG. 8. Steps 705-745 in Fig. 8 are the same as their counterparts in Fig. 7, which perform the comparison process for the 3D pointing device. Step 750 performs the mapping process for the electronic device. The computing processor may include a mapping program that performs the mapping step 750. At step 750, the processing and transmitting module may obtain display data including for example, display screen size such as boundary information, and translates the deviation angles of the resultant deviation associated with the spatial reference frame, preferably about each of three orthogonal coordinate axes of the spatial reference frame, to a movement pattern in a mapping area in a display reference frame based on a sensitivity input correlated to the display reference frame. It can be understood that the abovementioned display data may too include or refer to the type of display such as LED,

LCD, touch panel or 3D display as well as frequency rate of display such as 120Hz or 240Hz. In one embodiment, the display reference frame associated with the display to be mapped may be a 2D display reference frame; in another embodiment, the display reference frame may be a 3D display reference frame of a 3D display.

[0060] The aforementioned display data may further include a sensitivity input. The aforementioned sensitivity input is a parameter which may be inputted and adjusted by a user through control buttons attached on the housing of the electronic device. The sensitivity input may represent the sensitivity of the display device with respect to the movement of the electronic device. For details of the mapping process, please refer to Fig. 9. In one embodiment, the sensitivity input is a parameter representing the relationship between the display to be mapped with deviation to a movement pattern in 2D display reference frame and the electronic device of the present invention outputted with said deviation including yaw, pitch and roll angles in 3D reference frame; wherein the relationship may be a distance relationship. In another embodiment, the sensitivity input may be a display screen size including boundary information predetermined by a user; wherein the boundary information may be obtained based on a user input or manual input data from the user. In still another embodiment, the sensitivity input may be predefined or preset in the mapping program such that the parameter of the sensitivity input is a preset value for either increase or decrease the movement patterns including distance or number of pixels to be moved or mapped from said resultant deviation of the electronic device of the present invention.

[0061] Fig. 9 is a bird's-eye view of an electronic device 930 according to one embodiment of

the present invention directed to a display screen 910 of a display device. The display screen has a central point 922, a target point 924 and a boundary point 926. The central point 922 is the geometric center of the display screen 910. The target point 924 is the position that the electronic device 930 is aiming at. The boundary point 926 is a point on the right boundary of the display screen 910. The points 922, 924, 926 and the electronic device 930 are on a common plane parallel to both the X_D axis and the Z_D axis of the display reference frame $X_DY_DZ_D$. Virtual beams 942, 944 and 946 are imaginary light beams from the electronic device 930 to the central point 922, the target point 924 and the boundary point 926, respectively. The distance P is the distance between the central point 922 and the target point 924, while the distance P_{max} is the distance between the central point 922 and the boundary point 926. The distance d is the distance between the central point 922 and the electronic device 930. The aforementioned yaw angle of the resultant deviation of the electronic device 930 of the present invention is the angle θ between the virtual beams 942 and 944, while the angle θ_{max} is the angle between the virtual beams 942 and 946. The aforementioned mapping area is a plane including the display surface of the display screen 910 in the display reference frame. The display surface of the display screen 910 is a subset of the mapping area.

[0062] In this embodiment, the aforementioned sensitivity input is provided by the user of the electronic device 930. The sensitivity β is defined by the following equation (15).

$$\beta = \frac{P_{\max}}{\theta_{\max}} \quad \text{..... (15)}$$

The variable β in equation (16) is the sensitivity input defined by user.

The following equation (16) may be derived from equation (15) and geometry.

$$d = \frac{P_{\max}}{\tan\left(\frac{P_{\max}}{\beta}\right)} \quad \text{.....(16)}$$

The following equation (17) may be derived from equations (16).

$$P = f(\theta) = d \times \tan\theta = \frac{P_{\max} \times \tan\theta}{\tan\left(\frac{P_{\max}}{\beta}\right)} \quad \text{.....(17)}$$

[0063] In equation (17), the distance P_{max} may be obtained from the width of the display screen of the display data obtained at step 750; the angle θ is the yaw angle obtained at step 745; the sensitivity input β is provided by the user. Therefore, the computing processor of the electronic device 930 can calculate the distance P according to equation (17). Next, the computing processor can easily obtain the horizontal coordinate of the target point 924 on the display screen 910 according to the distance P and the width of the display screen 910. In addition, the computing processor can easily obtains the vertical coordinate of the target point 924 on the display screen 910 according to the pitch angle in a similar way.

[0064] The mapping process performed at step 750 may be exemplified by the process of translating the yaw angle and the pitch angle of the resultant angles to the 2D coordinates of the target point 924 on the display screen 910 discussed above. Now the computing processor has the coordinates of the target point 924 of the present time frame. The computing processor subtracts the coordinates of the target point 924 of the previous time frame from the coordinates of the target point 924 of the present time frame. The result of the subtraction is the horizontal

offset and the vertical offset of the target point 924 in the present time frame. The horizontal and vertical offsets may be transmitted to the display device so that the display device can track the position of the target point 924. The display device may display a cursor or some video effect on the display screen 910 to highlight the position of the target point 924. The cursor or video effect may exhibit a movement pattern on the display screen 910 when the user moves the electronic device 930 of the present invention.

[0065] Likewise, according to another embodiment of the present invention, the comparison method of the present invention may be a lopped method. For a looped method continuous with respect to time, in one embodiment, the method utilized by for example the computing processor communicating with the nine-axis motion sensor module may return to step 710 to perform the comparison process or method with respect to the next time T+1, following which the comparison and mapping process with respect to the next time frame may then be performed.

[0066] FIG. 10 shows another embodiment of the comparison method of the present invention. The flow chart illustrates a method of obtaining resultant deviation including deviation angles in a spatial reference frame of an electronic device utilizing a nine-axis motion sensor module therein and subject to movements and rotations in dynamic environments in the spatial reference frame and mapping resultant deviation of the electronic device of the present invention having movements and rotations in a 3D spatial reference frame and in a dynamic environment onto a display reference frame according to another embodiment of the present invention; and whereby the resultant deviation comprising deviation angles associated an output or state such as an updated state (details below) of the nine-axis motion module may be preferably obtained

excluding said undesirable external interferences in the dynamic environments. In an explanatory example, said undesirable external interferences may refer to or further comprise undesirable axial accelerations caused by undesirable external forces other than a force of gravity. In another explanatory example, said undesirable external interferences may refer to or further comprise undesirable magnetism caused by undesirable electromagnetic fields. The steps 1005-1030 in Fig. 10 may make reference to the ones shown in another embodiment of the present invention as shown in Fig. 7.

[0067] For an electronic device, including such as a pointing device, a navigation equipment, a smartphone or other portable electronic apparatus, utilizing a nine-axis motion sensor module, the signals of the magnetometer of the motion sensor module may be preferably be used to facilitate the obtaining of the resultant deviation including deviation angles in 3D reference and preferably in an absolute manner. The third signal set generated by the magnetometer may be obtained as shown in step 1035 in FIG. 10, which includes measured magnetism Mx, My and Mz. In one embodiment, the Mx, My and Mz may refer to the measurement of the magnetism obtained. In order to obtain said measured state of the nine-axis motion sensor, according to one embodiment of the present invention, predicted magnetism Mx', My' and Mz' may too be calculated and obtained based on the abovementioned current state of the nine-axis motion sensor module or the second quaternion as shown in step 1040. In other words, two sets of magnetism may be obtained for the measured state of the nine-axis motion sensor module; one may be the measured magnetism Mx, My, Mz in step 1035 and the other may be the predicted magnetism Mx', My', Mz' in step 1040 calculated based on the abovementioned current state or second quaternion in relation to the measured angular velocities thereof. Furthermore, in one

embodiment, the computing processor may use a data conversion utility to convert the current state or second quaternion into predicted magnetism Mx',My' and Mz' and vice versa. This data conversion utility may be a software program represented by the following equations (18), (19) and (20).

$$(q_0^{\ 2} + q_1^{\ 2} - q_2^{\ 2} - q_3^{\ 2})\cos\lambda + 2(q_1q_3 - q_0q_2)\sin\lambda = Mx' \quad \text{..... (18)}$$

$$2(q_1q_2 - q_0q_3)\cos\lambda + 2(q_2q_3 + q_0q_1)\sin\lambda = My' \quad \text{..... (19)}$$

$$2(q_1q_3 + q_0q_2)\cos\lambda + (q_0^2 - q_1^2 - q_2^2 + q_3^2)\sin\lambda = Mz' \quad \text{..... (20)}$$

The variable λ in equations (18), (19) and (20) is the dip angle between the direction of the ambient magnetic field measured by the magnetometer and a horizontal plane in the spatial reference frame. The dip angle λ may be measured or calculated through an initial calibration process of the electronic device of the present invention and then be used as a parameter. The computing processor calculates the solution (Mx',My',Mz') of the equations (18), (19) and (20).

[0068] According to an exemplary embodiment of the method for obtaining a resultant deviation including deviation angles in a spatial reference frame of an electronic device, including such as a pointing device, a navigation equipment, a smartphone or other portable electronic apparatus, utilizing a nine-axis motion sensor module, it may be preferable to compare the current state of the nine-axis motion sensor module with the measured state thereof with respect to the present time frame T by utilizing a comparison model. In other words, in one embodiment as shown in step 1045, it is preferable to compare the second quaternion in relation to the measured angular velocities of the current state at present time T with the measured axial accelerations Ax, Ay, Az, the predicted axial accelerations Ax', Ay', Az', the measured

magnetism Mx, My, Mz, and the predicted magnetism Mx', My', Mz' also at present time T. Following which, a result may be obtained as an updated state of the nine-axis motion sensor module. In general and in an explanatory example of the present invention, the updated state may generally refer to the update of the previous state of the nine-axis motion sensor module at a previous time T-1 with reference to the current state and/or measured state thereof. The comparison model in step 1045 utilizes the measured axial accelerations Ax, Ay, Az and measured magnetism Mx, My, Mz, as well as the predicted axial accelerations Ax', Ay', Az' and the predicted magnetism Mx', My', Mz'.

[0069] In one embodiment, the result of the updated state of the nine-axis motion sensor module, preferably involving comparison or data association represented by the equations associated to the comparison model, may be a third quaternion as shown in the figure. Furthermore, as shown in steps 1050~1060, the result may then be further outputted and utilized to obtain a resultant deviation including deviation angles in a spatial reference frame in the steps as shown in the figure. It can be understood that the examples of current state, measured state, state update, data association and probabilities of the comparison model and method of the present invention are provided for illustrative purposes only.

[0070] FIG. 11 shows a further exemplary embodiment of the comparison method of the present invention. The flow chart illustrates a method of obtaining resulting deviation including resultant angles in a spatial reference frame of an electronic device, including such as a pointing device, a navigation equipment, a smartphone or other portable electronic device, utilizing a nine-axis motion sensor module therein and subject to movements and rotations in dynamic

environments in the spatial reference frame and mapping resultant deviation angles of said electronic device having movements and rotations in the 3D spatial reference frame and in a dynamic environment onto a display reference frame according to another embodiment of the present invention. Likewise, steps 1105~1130 may include obtaining a previous state and a current state of the motion sensor module as well as a measured state related to the axial accelerations of the motion sensor module. Additionally, in step 1135, it may be preferable to compare the current state of the nine-axis motion sensor module with the measured state thereof with respect to the present time frame T by utilizing a comparison model. In other words, as shown in step 1135, it is preferable to compare the second quaternion in relation to the measured angular velocities of the current state at present time T with the measured axial accelerations Ax, Ay, Az as well as the predicted axial accelerations Ax', Ay', Az' also at present time T. Following which, a result may be obtained as the first updated state of the nine-axis motion sensor module. In an explanatory example, the first updated state may generally refer to the first update of the current state of the nine-axis motion sensor module at preset time T. Furthermore, one of the technical effects of the present invention may too be obtained or achieved. In step 1135, one of the advantages or effects by performing steps from1105~1135 may be that the first updated state or third quaternion as shown in FIG. 11 may be advantageously obtained excluding undesirable axial accelerations caused by for example undesirable external forces such as the ones decoupled from a force of gravity.

[0071] In one embodiment, the result of the first updated state of the nine-axis motion sensor module, preferably involving comparison or data association represented by the equations associated to the comparison model, may be a third quaternion as shown in the figure. In addition,

one of the technical effects of the present invention may include the exclusion of undesirable external interferences in the dynamic environment as previously mentioned; and wherein the undesirable external interferences may refer to or further include undesirable axial accelerations caused by undesirable external forces, preferably decoupled from a force of gravity, and/or undesirable magnetism caused by for example undesirable electromagnetic fields either adjacent to the motion sensor module. As shown in step 1140 of FIG. 11, the first updated state of the nine-axis motion sensor module of the present invention may be further calculated and converted to a temporary pitch angle and a temporary roll angle based on the third quaternion. The first updated state, as shown in the figure, may be advantageously obtained such that or whereby undesirable axial accelerations associated with said undesirable external interferences in the dynamic environments may be preferably excluded; in an explanatory example, the first updated state may be preferably obtained excluding the abovementioned undesirable axial accelerations caused by undesirable external forces, such as external forces decoupled from a force of gravity. The third signal set generated by the magnetometer may be obtained, which includes measured magnetism Mx, My and Mz. The measured state of the nine-axis motion sensor module may be obtained by obtaining and calculating a measured yaw angle gained from the motion sensor signals of the nine-axis motion sensor module at the current time T according to the following equation (21).

$$Ty = \frac{-My\cos(Tr) + Mz\sin(Tr)}{Mx\cos(Tp) + My\sin(Tp)\cos(Tr) + Mz\sin(Tp)\cos(Tr)} \quad \text{..... (21)}$$

In equation (21), Ty is the measured yaw angle, Tp is the temporary pitch angle and Tr is the temporary roll angle.

[0072] In order to obtain said measured state of the nine-axis motion sensor, according to one embodiment of the present invention, a predicted yaw angle may be calculated and obtained based on the abovementioned first updated state of the nine-axis motion sensor module or the third quaternion at present time T as shown in step 1145. In other words, the measured yaw angle in step 1140 and the predicted yaw angle in step 1145 may be obtained for the measured state of the nine-axis motion sensor module.

[0073] Furthermore, it may be preferable to compare the current state of the nine-axis motion sensor module with the measured state thereof with respect to the present time frame T by utilizing a comparison model. In other words, as shown in step 1150, it is preferable to compare the second quaternion in relation to the measured angular velocities of the current state at present time T with the measured axial accelerations Ax, Ay, Az, the predicted axial accelerations Ax', Ay', Az', the measured yaw angle and the predicted yaw angle also at present time T. Following which, a result may be obtained as the second updated state of the nine-axis motion sensor module. In an explanatory example, the second updated state may generally refer to the second update of the current state of the nine-axis motion sensor module at preset time T. The comparison model in step 1150 is very similar to the abovementioned comparison models. Related details are omitted here for brevity. In one embodiment, the result of the second updated state of the nine-axis motion sensor module may be a fourth quaternion as shown in the figure. Furthermore, the result may then be further outputted and utilized to obtain a resulting deviation including resultant angles in a spatial reference frame in the following steps as shown in the figure. In addition to the abovementioned technical effects of the present invention in which undesirable axial accelerations of undesirable external interferences in the dynamic environments

may be advantageously excluded as a result of the first updated state of the motion sensor module in step 1135, another technical effect or merit may too be obtained along with result of the second updated state of the motion sensor as shown in step 1150 of FIG. 11. One of the advantages or effects by performing steps such as from 1140~1150 may be that the second updated state or fourth quaternion as shown in FIG. 11 may be advantageously obtained excluding undesirable magnetism such as the ones caused by for example undesirable external or internal electromagnetic fields adjacent to the motion sensor module in the dynamic environments of the present invention.

[0074] It may be preferable to output the result of the second updated state, preferably in a form of the fourth quaternion, to the previous state of the nine-axis motion sensor module as shown in step 1155 in the figure. In other words, in one embodiment, the first quaternion may be replaced by the abovementioned fourth quaternion or substitute directly any previous values of first quaternion in the previous time T for further process in a loop. In other words, the fourth quaternion with respect to the present time T becomes the first quaternion with respect to the next time such as T+1; or, the fourth quaternion at previous time frame T-1 outputted may now be the first quaternion at present time frame T.

[0075] In step 1160, the second updated state of the nine-axis motion sensor module of the present invention may be further calculated and converted to the resulting deviation including resultant angles associated with the spatial reference frame, wherein the resultant angles includes the yaw angle, pitch angle and roll angle of the 3D pointing device associated with the spatial reference frame, preferably about each of three orthogonal coordinate axes of the spatial

reference frame. In addition, the second updated state, as shown in the figure, may be advantageously obtained such that or whereby undesirable magnetism associated with said undesirable external interferences in the dynamic environments may be preferably excluded; in an explanatory example, the second updated state may be preferably obtained excluding the abovementioned undesirable magnetism caused by for example undesirable electromagnetic fields, or magnetism other than the planetary geomagnetism, adjacent or of a magnitude influencing magnetometer of the motion sensor module. The resultant angles may be calculated according to equations (12), (13) and (14), wherein the variables q_0, q_1, q_2 and q_3 in equations (12), (13) and (14) are the four elements of the fourth quaternion. Furthermore, the resultant deviation in step 1160 may be advantageously obtained excluding undesirable interferences including such as the ones of undesirable axial accelerations caused by undesirable external forces decoupled from a force of gravity mentioned previously in step 1135 and the ones of undesirable magnetism caused by for example undesirable electromagnetic fields as mentioned previously in step 1150. Likewise, in step 1165 as shown in FIG. 11, the resultant deviation including deviation angles in 3D pointer reference may be further mapped to a display reference such as a 2D display reference of a display.

[0076] As illustrated by FIG.12, in one preferred embodiment, the first and second updated states may further comprise a first data association model and a second data association model respectively. The first data association model may be advantageously provided for comparing the first measured state associated with said second signal set with a first predicted measurement obtained from said current state; in addition, the second data association model may too be advantageously provided for comparing the second measured state associated with said third

signal set with a second predicted measurement obtained from said first updated state. Furthermore, in another preferred embodiment, the first and second updated states may further comprise a first data association model and a second data association model respectively; and wherein the first data association model may be advantageously provided for comparing the first measured state associated with said second signal set with a first predicted measurement obtained from said current state; and wherein the second data association model may be advantageously provided for comparing the second measured state associated with said third signal set with a second predicted measurement obtained from said current state. Details on the differences of the obtaining of said second predicted measurement based on either the first updated state or the current state of the motion sensor module depending upon a comparison result are further described in FIG. 12, as the routes presented or denoted by "Yes" and "No' shown therein.

[0077] FIG. 12 shows an exemplary flow chart of another embodiment of the present invention of a method for obtaining a resultant deviation comprising deviation angles of an electronic device, including such as a pointing device, navigation equipment, a smartphone or other portable electronic apparatus. Accordingly, the method for obtaining a resultant deviation including deviation angles in a spatial reference frame of an electronic device utilizing a nine-axis motion sensor module therein and subject to movements and rotations in dynamic environments in said spatial reference frame includes the following steps. As shown in the figure, at step 1210, a previous state of the nine-axis motion sensor module may be obtained; and wherein the previous state is associated with at least previous angular velocities gained from the motion sensor signals of the nine-axis motion sensor module at a previous time T-1. In another

embodiment, the previous state is associated with previous angular velocities, previous axial accelerations and previous magnetism gained from the motion sensor signals of the nine-axis motion sensor module at a previous time T-1. Next, at step 1220, it may be to obtain a current state of the nine-axis motion sensor module by obtaining measured angular velocities ω_x, ω_y, ω_z gained from the motion sensor signals of the nine-axis motion sensor module at a current time T. At step 1225, it may be to obtain a first measured state of the nine-axis motion sensor module by obtaining measured axial accelerations Ax, Ay, Az gained from the motion sensor signals of the nine-axis motion sensor module at the current time T. Following which and at step 1230 is calculating and obtaining a first predicted measurement of the nine-axis motion sensor module based on said current state thereof. At step 1235, a comparison may be performed to determine whether the signals related to the measured state including such as measured axial accelerations and/or measured magnetism are "good enough" to be used to compensate the current state of the motion sensor module and therefore an updated state thereof can be obtained.

[0078] According to the previously mentioned objectives of the present invention, it is preferable to provide an advantageous comparison or compensation method capable of outputting resultant deviation of a motion sensor module of a relatively high accuracy in the presence of external or internal interferences including such as electromagnetic fields generated by other electronic components adjacent to the motion sensor modules or of a magnitude strong enough to distort or affect the normal operations or signals of motion sensor module. Under such circumstances, a comparison utilizing data association may be advantageously provided or used to compare measured state of the motion sensor modules with an expected or predicted measurement thereof to determine the compensation for updating an updated state of the

previous state. In step 1235 as previously mentioned, the data association may also include a predetermined value preset or preselected in accordance with for example the performance of motion sensor module utilized, and such that the comparison result of the measured state and the predicted measurement may make reference to the data association and the predetermined value or range to determine the compensation needed to take place to update the state of the motion sensor module including such as the previous and/or current states thereof.

[0079] Accordingly, updated state(s) of the motion sensor module may be obtained based on the result of the data association(s). As shown in the figure, if the result of abovementioned comparison falls within the predetermined result of for example a predetermined value or range of the data association, then in one embodiment of the present invention, in step 1240, a first updated state of the nine-axis motion sensor module may be obtained based on a first comparison between said first predicted measurement and said first measured state of the nine-axis motion sensor module. Otherwise, if the result is not within the predetermined value of range of the data association, then the first updated state may not be performed or obtained. Such method of the use of data association and comparison may be particularly useful in the abovementioned scenario of external or internal "interferences" such as the ones caused by undesired electromagnetic fields. In the case where the result falls outside of expected range, or denoted by "No" as shown in FIG. 12, the next step would be to obtain another measured state or the second measured state of the motion sensor module to determine whether another data association may be utilized to obtain the second updated state. It can however be understood that the second updated state may be provided as an additional step to the method of the present invention. One may only perform the abovementioned steps and obtain a result of the first updated state based

on the measured state including the measured axial accelerations associated with the motion sensor module; in other words, either performing steps to obtain only the first updated state, steps to obtain only the second updated state, and/or steps to obtain both the first and second updated states as shown in the figure, shall all be considered to be within the scope of the present invention and within the spirit of the present invention. Furthermore and likewise, one of the technical effects of the present invention may too be obtained or achieved. In step 1240, one of the advantages or effects by performing steps from 1210~1240 may be that the first updated state as shown in FIG. 12 may be advantageously obtained excluding undesirable axial accelerations caused by for example undesirable external forces such as the ones decoupled from a force of gravity.

[0080] In another embodiment of the present invention or in the case where the abovementioned second updated state is to be obtained, one may further perform steps 1245 ~1260 as shown in FIG. 12. In step 1245, one may obtain a second measured state of the nine-axis motion sensor module by obtaining a measured yaw angle based on measured magnetism Mx, My, Mz gained from the motion sensor signals of the nine-axis motion sensor module at the current time T. Furthermore, as shown in step 1250, a second predicted measurement of the nine-axis motion sensor module may be calculated and obtained, following which a predicted yaw angle may too be obtained based on said first updated state thereof depending upon the result of the comparison such as the route denoted by "Yes" in FIG. 12. In another embodiment, the predicted yaw angle may be obtained based on said current state of the motion sensor module depending upon the result of the comparison such as a result or route of "No" denoted in FIG. 12. Once the measured state and the predicted measurements are obtained

and available, a second comparison may be performed to determine whether compensation may be carried out based on the result of the comparison and the second data association. As shown in step 1255, the second data association including a predetermined value or range may be performed to determine whether the comparison falls within said predetermined value or range. If the result falls within said value or range, then a second updated state may be obtained and compensation may too take place as shown in step 1260 with the denotation of "Yes". Otherwise, if the result is not within the predetermined value, then step 1265 shall be carried out, following the direction shown and denoted by "No" in the figure; and in other words, compensation may utilize the second predicted measurement of the motion sensor module thereof for updating instead of using the second measured state thereof. Likewise, in addition to the abovementioned technical effects of the present invention in which undesirable axial accelerations of undesirable external interferences in the dynamic environments may be advantageously excluded as a result of the first updated state of the motion sensor module in step 1240, another technical effect or merit may too be obtained along with result of the second updated state of the motion sensor as shown in step 1260 of FIG. 12. One of the advantages or effects by performing steps such as from 1245~1260 may be that the second updated state as shown in FIG. 12 may be advantageously obtained excluding undesirable magnetism such as the ones caused by for example undesirable external or internal electromagnetic fields adjacent to the motion sensor module in the dynamic environments of the present invention.

[0081] Following the above steps, in one embodiment of the present invention in which said comparison method may be provided in a continuous loop or a looped manner with respect to time, the result of the updated state at present time T may then be outputted to the previous state

at previous time T-1 and become another beginning of the loop for the abovementioned steps to carry out again. The terminology of time(s) T, T-1 or T+1 shall be clear and apparent and shall too fall within the scope and spirit of the present invention. For example, in step 1260 as shown in FIG. 12, the second updated state of the nine-axis motion sensor module may be obtained by, or may too include, the updating said first updated state thereof based on a second comparison between said second predicted measurement and said second measured state of the nine-axis motion sensor module; and in step 1265, the result of the second updated state thereof may be further outputted to the previous state in a looped manner with respect to time.

[0082] After step 1265, the resultant deviation including the deviation angles in the spatial reference frame, namely the yaw, pitch and roll angles, may be obtained in step 1270 in a similar way as those in steps 745, 1060 and 1160. Furthermore, the resultant deviation in step 1270 may be advantageously obtained excluding undesirable interferences including such as the ones of undesirable axial accelerations caused by undesirable external forces decoupled from a force of gravity mentioned previously in step 1240 and the ones of undesirable magnetism caused by for example undesirable electromagnetic fields as mentioned previously in step 1260.

[0083] As mentioned previously, in one embodiment of the present invention, the method for obtaining a resultant deviation of an electronic device utilizing a nine-axis motion sensor module, data associations may be provided to obtain a relatively accurate result under for example the existence of external or internal interferences to the sensor module. Accordingly, the abovementioned step of obtaining the first updated state of the nine-axis motion sensor module may further comprise performing a first data association to determine whether said first

comparison between said first predicted measurement and said first measured state thereof falls within a first predetermined value of the nine-axis motion sensor module; and wherein the step of obtaining the second updated state of the nine-axis motion sensor module may too further comprise performing a second data association to determine whether said second comparison between said second predicted measurement and said second measured state thereof falls within a second predetermined value of the nine-axis motion sensor module.

[0084] Likewise, in accordance to the abovementioned continuous loop of the method of the present invention with respect to time and in one embodiment, the method for obtaining a resultant deviation of an electronic device utilizing a nine-axis motion sensor module may further comprise outputting said second updated state of the nine-axis motion sensor module to said previous state thereof; and wherein said previous state of the nine-axis motion sensor module may be a first quaternion with respect to said previous time T-1; and wherein said current state of the nine-axis motion sensor module may be a second quaternion with respect to said current time T; and wherein said first and second updated states of the nine-axis motion sensor module may too be a third and a fourth quaternion with respect to said current time T respectively.

[0085] In summary, the present invention also provides a nine-axis comparison method that compares the detected signals generated by and converted from the rotation of the electronic device, utilizing a nine-axis motion sensor module, about all of the three axes with the detected signals generated by and converted from the acceleration of the device along all of the three axes. In one embodiment, The nine-axis comparison method may then output the resultant deviation

including yaw, pitch and roll angles in a spatial reference frame such as a 3D reference frame of the device. In another embodiment, the nine-axis comparison method may also include the mapping of the resultant deviation including yaw, pitch and roll angles in the spatial reference to a display reference frame such as a 2D display reference frame of a display screen of a display device. The nine-axis comparison method involving the comparison of different states of the motion sensor module and the utilization of data association of the present invention in order to output a resultant deviation having yaw, pitch and roll angles in for example 3D reference frame is novel and cannot be easily achieved by any know arts or their combinations thereof.

[0086] In view of the above, it is clear that such obtaining and outputting of deviation including 3D angles in a spatial reference frame in an "absolute" manner of the present invention is too novel, and the fact that the electronic device utilizing a motion sensor module therein having a novel comparison method and program of the present invention to obtain and output such deviation in "absolute" manner cannot be easily achieved by any known arts or their combination thereof. The term "absolute" associated with the resulting deviation including resultant angles such as yaw, pitch and roll in a spatial reference frame or 3D reference frame obtained and outputted by the device of the present invention may refer to the "actual" movements and rotations of the 3D pointer device of the present invention in said spatial reference frame. Moreover, the nine-axis comparison method of the present invention may accurately output said deviation including angles in 3D reference frame as noises associated with the nine-axis motion sensor module subject to movement and rotations in dynamic environments and accumulated over time may be effectively eliminated or compensated. Furthermore, the term "a", "an" or "one" recited herein as well as in the claims hereafter may refer to and include the

meaning of “at least one” or “more than one”. It can be understood that, as previously mentioned, the term of “dynamic” recited herein may refer to moving or subject to motions in general. It too can be understood that the term “excluding” recited herein to describe the exclusion of undesirable interferences is provided for illustrative purposes and shall not be limited to a certain or specific degree or magnitude of the effect of exclusion; any degree or magnitude associated thereto shall be considered to be within the spirit and scope of the present invention. It may be understood that the present invention may be applied to various scenarios and application fields including such as gaming, computers and navigation. It may too be understood that the scope of the present invention shall be determined by the accompanying claims and shall include variations of applications of the present invention as well as differences in the term definitions used or related to including such as pointing devices, navigation equipment, smartphone and/or electronic devices.

WHAT IS CLAIMED IS:

1. An electronic device subject to movements and rotations in dynamic environments, comprising:

a motion sensor module comprising a rotation sensor and an accelerometer, both of which are subjected to the movements and the rotations in the dynamic environments, the rotation sensor having sensor circuitry configured to generate a first signal set comprising measured angular velocities ωx, ωy, ωz, the accelerometer having accelerometer circuitry configured to generate a second signal set comprising measured axial accelerations Ax, Ay, Az; and

a computing processor having processor circuitry configured to calculate a resulting deviation comprising resultant angles in a spatial reference frame by:

providing a current state associated with the first signal set;

comparing a predicted measurement based on the first signal set to a measurement of the second signal set such that a comparison result is provided as a measured state; and

obtaining an update state based on the current state and the measured state.

2. The electronic device of claim 1, wherein:

the motion sensor module further comprises a magnetometer having magnetometer circuitry configured to generate a third signal set comprising measured magnetism Mx, My, Mz; and

in calculating the resulting deviation, the computing processor is further configured to compare the predicted measurement obtained based on the update state and the first signal set to a measurement of the third signal set.

3. The electronic device of claim 2, wherein the measured state correlates to a comparison result between the predicted measurement, and the measurement of the second signal set and the measurement of the third signal set.

4. The electronic device of claim 3, wherein, in calculating the resulting deviation, the computing processor is further configured to:

utilize a data association model to determine whether compensation is needed to obtain the update state based on the measured axial accelerations or the measured magnetisms; and

obtain the update state in response to determining that the compensation is needed.

5. The electronic device of claim 4, wherein, in calculating the resulting deviation, the computing processor is further configured to utilize the data association model to:

compare the measured state associated with at least the second signal set or the third signal set with a predicted measurement calculated and obtained from the current state and associated with at least the first signal set; and

determine whether compensation is needed to obtain the update state based on whether the comparison result is a predetermined value or within a predetermined range.

6. The electronic device of claim 3, wherein computing processor is further configured to:

calculate the measured state associated with the third signal set by obtaining measured yaw based on measured magnetism Mx, My, Mz; and

calculate predicted yaw associated with the predicted measurement, wherein the predicted measurement is calculated and obtained from the update state and associated with the first signal set.

7. The electronic device of claim 6, wherein the measured yaw is calculated and obtained based on the measured state associated with the third signal set, a temporary pitch value, and a temporary roll value, wherein the temporary pitch value and the temporary roll value are calculated and converted from the update state.

8. The electronic device of claim 6, wherein, in calculating the resulting deviation, the computing processor is further configured to:

obtain a first update state based on the current state associated with the first signal set and a first measured state, wherein the first measured state is correlated to the measurement of the second signal set and a first predicted measurement calculated and obtained from the current state and associated with the first signal set; and

obtain a second update state based on the first update state and a second measured state, wherein the second measured state is correlated to the measured yaw and a predicted yaw associated with a second predicted measurement, which is calculated and obtained from the current state or the first update state and associated with the first signal set, wherein the resultant angles are based on the second update state.

9. A method for determining movements and rotations in dynamic environments, comprising:

generating, with a rotation sensor having sensor circuitry, a first signal set comprising measured angular velocities ωx, ωy, ωz;

generating, with an accelerometer having accelerometer circuitry, a second signal set comprising measured axial accelerations Ax, Ay, Az; and

calculating, with a computing processor having processor circuitry, a resulting deviation comprising resultant angles in a spatial reference frame by:

providing a current state associated with the first signal set;

comparing a predicted measurement based on the first signal set and a measurement of the second signal set such that a comparison result is provided as a measured state; and

obtaining an updated state based on the current state and the measured state.

10. The method of claim 9, wherein:

the method further comprises generating, with a magnetometer having magnetometer circuitry, a third signal set comprising measured magnetism Mx, My, Mz; and

calculating the resulting deviation further comprises comparing the predicted measurement obtained based on the update state and the first signal set to a measurement of the third signal set.

11. The method of claim 10, wherein the measured state correlates to a comparison result between the predicted measurement, and the measurement of the second signal set and the measurement of the third signal set.

12. The method of claim 10, wherein calculating the resulting deviation further comprises:

utilizing a data association model to determine whether compensation is needed to obtain the update state based on the measured axial accelerations or the measured magnetisms; and

obtaining the update state in response to determining that the compensation is needed.

13. The method of claim 10, wherein utilizing the data association model further comprises:

comparing the measured state associated with at least the second signal set or the third signal set with a predicted measurement calculated and obtained from the current state and associated with at least the first signal set; and

determining whether compensation is needed to obtain the update state based on whether the comparison result is a predetermined value or within a predetermined range.

14. The method of claim 10, wherein calculating the resulting deviation further comprises:

calculating the measured state associated with the third signal set by obtaining measured yaw based on measured magnetism Mx, My, Mz; and

calculating predicted yaw associated with the predicted measurement, wherein the predicted measurement is calculated and obtained from the update state and associated with the first signal set.

15. The method of claim 14, wherein:

the measured yaw is calculated and obtained based on the measured state associated with the third signal set, a temporary pitch value, and a temporary roll value; and

the temporary pitch value and the temporary roll value are calculated and converted from the update state.

16. The method of claim 14, wherein calculating the resulting deviation further comprises:

obtaining a first update state based on the current state associated with the first signal set and a first measured state, wherein the first measured state is correlated to the measurement of the second signal set and a first predicted measurement calculated and obtained from the current state and associated with the first signal set; and

obtaining a second update state based on the first update state and a second measured state, wherein the second measured state is correlated to the measured yaw and a predicted yaw associated with a second predicted measurement, which is calculated and obtained from the current state or the first update state and associated with the first signal set, wherein the resultant angles are based on the second update state.

ABSTRACT OF THE DISCLOSURE

An electronic device utilizing a nine-axis motion sensor module, capable of accurately outputting a resultant deviation including deviation angles in a 3D reference frame is provided. The present invention provides a novel comparison and compensation to accurately obtain a resultant deviation including deviation angles of the electronic device under the presence of external and/or internal interferences including the ones caused by undesirable electromagnetic fields and the ones associated with undesirable external forces and axial accelerations. The output of the nine-axis motion sensor module of the present invention including a rotation sensor, an accelerometer and a magnetometer can be advantageously obtained and compensated with a comparison comparing different states of the motion sensor module such that an updated state associated with the output and the resultant deviation angles of the nine-axis motion sensor module are preferably obtained in an absolute manner with the undesirable external interferences being effectively excluded.

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DECLARATION (37 CFR 1.63) FOR UTILITY OR DESIGN APPLICATION USING AN APPLICATION DATA SHEET (37 CFR 1.76)

Title of Invention	ELECTRONIC DEVICE FOR USE IN MOTION DETECTION AND METHOD FOR OBTAINING RESULTANT DEVIATION THEREOF

As the below named inventor, I hereby declare that:

This declaration is directed to:

- [■] The attached application, or
- [ ] United States application or PCT international application number _____

filed on _____.

The above-identified application was made or authorized to be made by me.

I believe that I am the original inventor or an original joint inventor of a claimed invention in the application.

I hereby acknowledge that any willful false statement made in this declaration is punishable under 18 U.S.C. 1001 by fine or imprisonment of not more than five (5) years, or both.

WARNING:

Petitioner/applicant is cautioned to avoid submitting personal information in documents filed in a patent application that may contribute to identity theft. Personal information such as social security numbers, bank account numbers, or credit card numbers (other than a check or credit card authorization form PTO-2038 submitted for payment purposes) is never required by the USPTO to support a petition or an application. If this type of personal information is included in documents submitted to the USPTO, petitioners/applicants should consider redacting such personal information from the documents before submitting them to the USPTO. Petitioner/applicant is advised that the record of a patent application is available to the public after publication of the application (unless a non-publication request in compliance with 37 CFR 1.213(a) is made in the application) or issuance of a patent. Furthermore, the record from an abandoned application may also be available to the public if the application is referenced in a published application or an issued patent (see 37 CFR 1.14). Checks and credit card authorization forms PTO-2038 submitted for payment purposes are not retained in the application file and therefore are not publicly available.

LEGAL NAME OF INVENTOR

Inventor: Shun-Nan Liou Date (Optional): _____

Signature: _____

Note: An application data sheet (PTO/SB/14 or equivalent), including naming the entire inventive entity, must accompany this form or must have been previously filed. Use an additional PTO/AIA/01 form for each additional inventor.

This collection of information is required by 35 U.S.C. 115 and 37 CFR 1.63. 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 1 minute to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. **SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.**

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

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.

Doc code: Oath
Document Description: Oath or declaration filed

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SUBSTITUTE STATEMENT IN LIEU OF AN OATH OR DECLARATION FOR UTILITY OR DESIGN PATENT APPLICATION (35 U.S.C. 115(d) AND 37 CFR 1.64)

Title of Invention	ELECTRONIC DEVICE FOR USE IN MOTION DETECTION AND METHOD FOR OBTAINING RESULTANT DEVIATION THEREOF

This statement is directed to:

[■] The attached application,

OR

[ ] United States application or PCT international application number _____ filed on _____.

LEGAL NAME of inventor to whom this substitute statement applies:

(*E.g.*, Given Name (first and middle (if any)) and Family Name or Surname)

Zhou Ye

Residence (except for a deceased or legally incapacitated inventor):

City	State	Country
Taipei		TW

Mailing Address (except for a deceased or legally incapacitated inventor):

5F-2, No.12, Wenhu St., Neihu Dist.

City	State	Zip	Country
Taipei		11445	TW

I believe the above-named inventor or joint inventor to be the original inventor or an original joint inventor of a claimed invention in the application.

The above-identified application was made or authorized to be made by me.

I hereby acknowledge that any willful false statement made in this statement is punishable under 18 U.S.C. 1001 by fine or imprisonment of not more than five (5) years, or both.

Relationship to the inventor to whom this substitute statement applies:

- [ ] Legal Representative (for deceased or legally incapacitated inventor only),
- [ ] Assignee,
- [■] Person to whom the inventor is under an obligation to assign,
- [ ] Person who otherwise shows a sufficient proprietary interest in the matter (petition under 37 CFR 1.46 is required), or
- [ ] Joint inventor.

This collection of information is required by 35 U.S.C. 115 and 37 CFR 1.63. 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 1 minute to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. **SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.**

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SUBSTITUTE STATEMENT

Circumstances permitting execution of this substitute statement:

- ☐ Inventor is deceased.
- ☐ Inventor is under legal incapacity.
- ☒ Inventor cannot be found or reached after diligent effort, or
- ☐ Inventor has refused to execute the oath or declaration under 37 CFR 1.63.

If there are joint inventors, please check the appropriate box below:

- ☒ An application data sheet under 37 CFR 1.76 (PTO/AIA/14 or equivalent) naming the entire inventive entity has been or is currently submitted.

OR

- ☐ An application data sheet under 37 CFR 1.76 (PTO/AIA/14 or equivalent) has not been submitted. Thus, a Substitute Statement Supplemental Sheet (PTO/AIA/11 or equivalent) naming the entire inventive entity and providing inventor information is attached. See 37 CFR 1.64(b).

WARNING:

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PERSON EXECUTING THIS SUBSTITUTE STATEMENT:

Name: Shun-Nan Liou | Date (Optional):

Signature:

APPLICANT NAME AND TITLE OF PERSON EXECUTING THIS SUBSTITUTE STATEMENT:

If the applicant is a juristic entity, list the applicant name and the title of the signer:

Applicant Name: CM HK LIMITED

Title of Person Executing This Substitute Statement: CEO

The signer, whose title is supplied above, is authorized to act on behalf of the applicant.

Residence of the signer (unless provided in an application data sheet, PTO/AIA/14 or equivalent):

City | State | Country Hong Kong

Mailing Address of the signer (unless provided in an application data sheet, PTO/AIA/14 or equivalent)

City | State | Zip | Country

Note: Use an additional PTO/AIA/02 form for each inventor who is deceased, legally incapacitated, cannot be found or reached after diligent effort, or has refused to execute the oath or declaration under 37 CFR 1.63.

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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: Oath
Document Description: Oath or declaration filed

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Title of Invention	ELECTRONIC DEVICE FOR USE IN MOTION DETECTION AND METHOD FOR OBTAINING RESULTANT DEVIATION THEREOF

This statement is directed to:

☒ The attached application,

OR

☐ United States application or PCT international application number _____ filed on _____.

LEGAL NAME of inventor to whom this substitute statement applies:

(*E.g.*, Given Name (first and middle (if any)) and Family Name or Surname)

Chin-Lung Li

Residence (except for a deceased or legally incapacitated inventor):

City	State	Country
Taipei		TW

Mailing Address (except for a deceased or legally incapacitated inventor):

5F-2, No.12, Wenhu St., Neihu Dist.

City	State	Zip	Country
Taipei		11445	TW

I believe the above-named inventor or joint inventor to be the original inventor or an original joint inventor of a claimed invention in the application.

The above-identified application was made or authorized to be made by me.

I hereby acknowledge that any willful false statement made in this statement is punishable under 18 U.S.C. 1001 by fine or imprisonment of not more than five (5) years, or both.

Relationship to the inventor to whom this substitute statement applies:

- ☐ Legal Representative (for deceased or legally incapacitated inventor only),
- ☐ Assignee,
- ☒ Person to whom the inventor is under an obligation to assign,
- ☐ Person who otherwise shows a sufficient proprietary interest in the matter (petition under 37 CFR 1.46 is required), or
- ☐ Joint Inventor.

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SUBSTITUTE STATEMENT

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- ☐ Inventor is deceased,
- ☐ Inventor is under legal incapacity,
- ☒ Inventor cannot be found or reached after diligent effort, or
- ☐ Inventor has refused to execute the oath or declaration under 37 CFR 1.63.

If there are joint inventors, please check the appropriate box below:

- ☒ An application data sheet under 37 CFR 1.76 (PTO/AIA/14 or equivalent) naming the entire inventive entity has been or is currently submitted.

OR

- ☐ An application data sheet under 37 CFR 1.76 (PTO/AIA/14 or equivalent) has not been submitted. Thus, a Substitute Statement Supplemental Sheet (PTO/AIA/11 or equivalent) naming the entire inventive entity and providing inventor information is attached. See 37 CFR 1.64(b).

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PERSON EXECUTING THIS SUBSTITUTE STATEMENT:

Name: Shun-Nan Liou	Date (Optional):
Signature:	

APPLICANT NAME AND TITLE OF PERSON EXECUTING THIS SUBSTITUTE STATEMENT:

If the applicant is a juristic entity, list the applicant name and the title of the signer:

Applicant Name: CM HK LIMITED

Title of Person Executing This Substitute Statement: CEO

The signer, whose title is supplied above, is authorized to act on behalf of the applicant.

Residence of the signer (unless provided in an application data sheet, PTO/AIA/14 or equivalent):

City	State	Country Hong Kong

Mailing Address of the signer (unless provided in an application data sheet, PTO/AIA/14 or equivalent)

City	State	Zip	Country

Note: Use an additional PTO/AIA/02 form for each inventor who is deceased, legally incapacitated, cannot be found or reached after diligent effort, or has refused to execute the oath or declaration under 37 CFR 1.63.

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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 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.

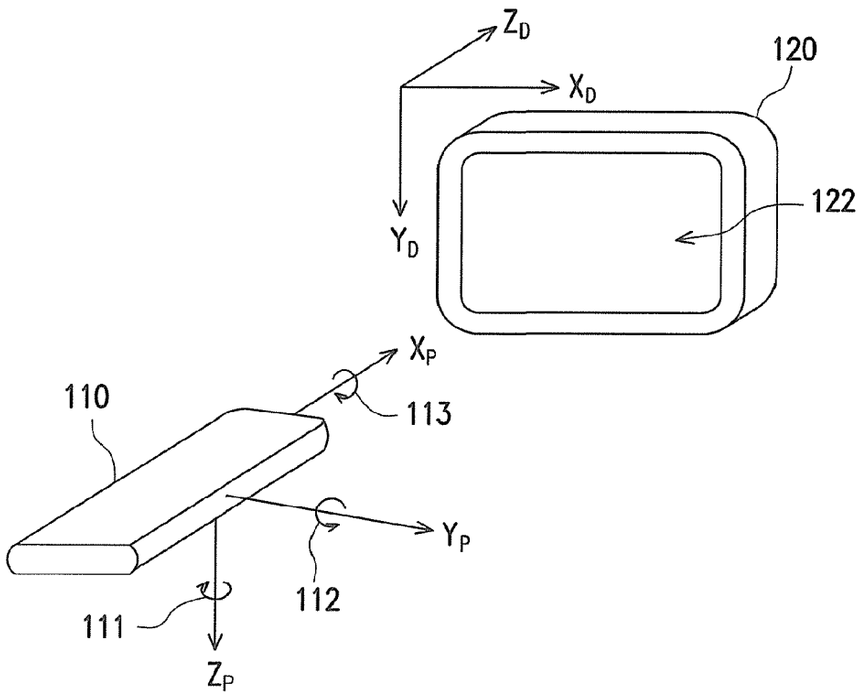


FIG. 1 (RELATED ART)

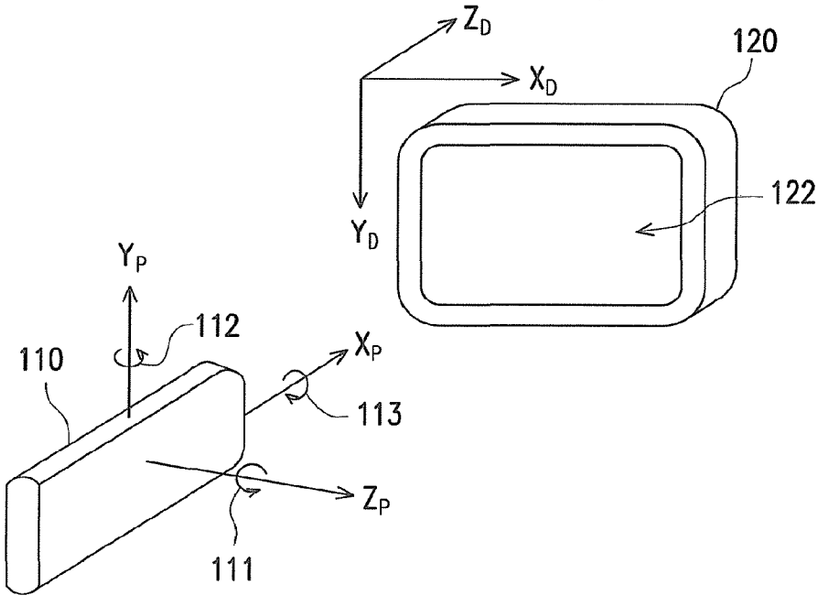


FIG. 2 (RELATED ART)

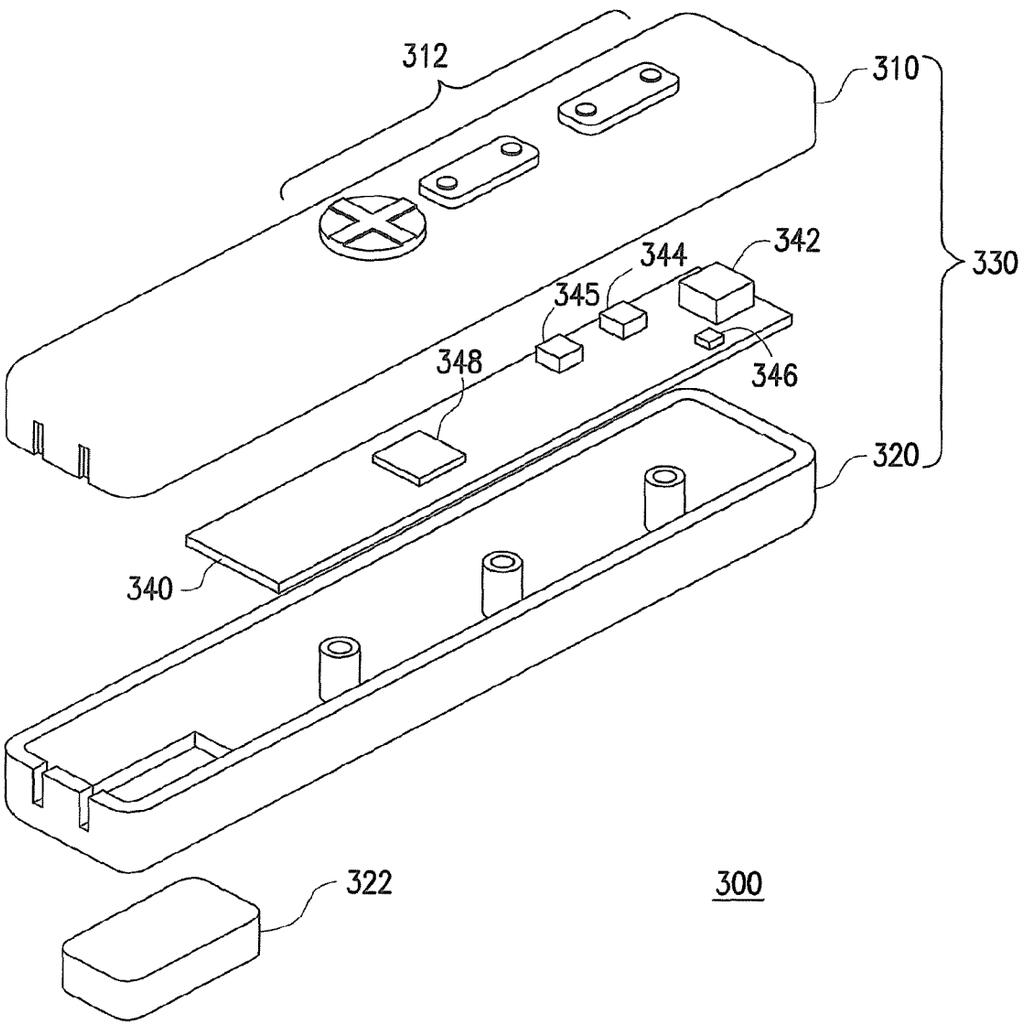


FIG. 3

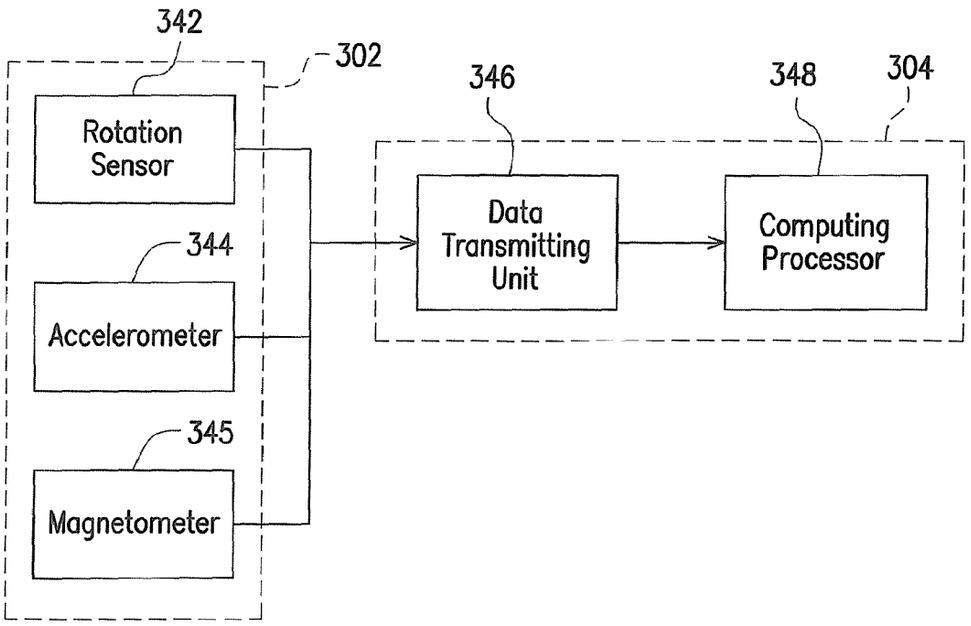

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Rotation Sensor
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Accelerometer
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Magnetometer
Data Transmitting Unit
Computing Processor

FIG. 4

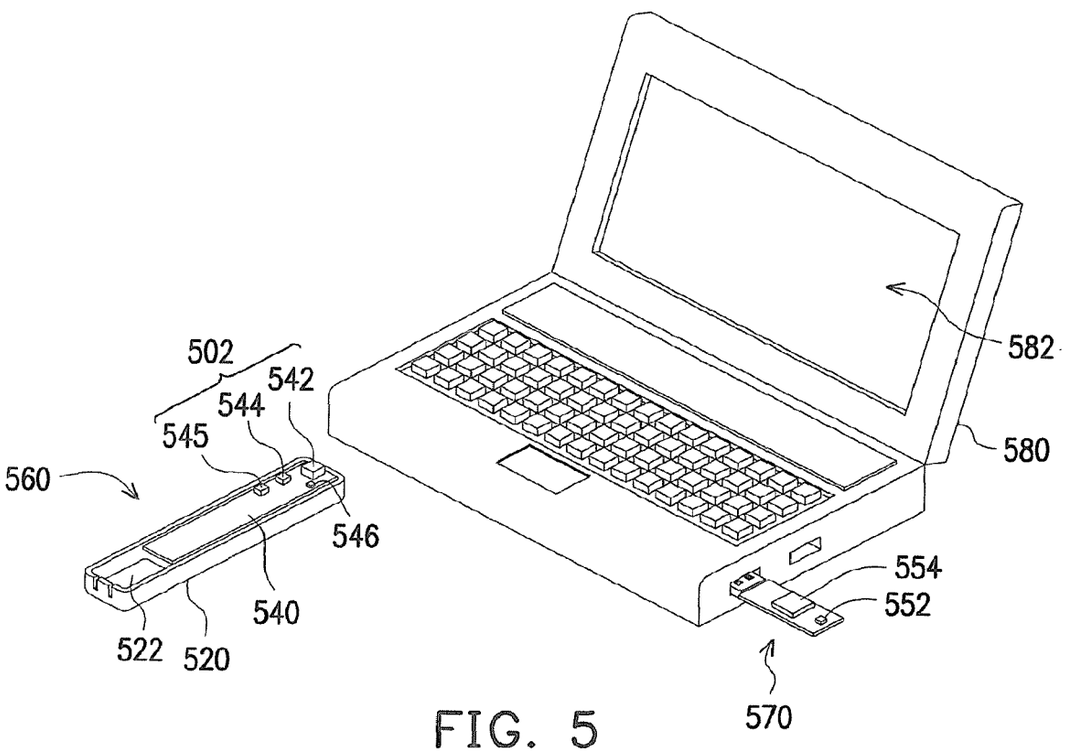

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FIG. 5

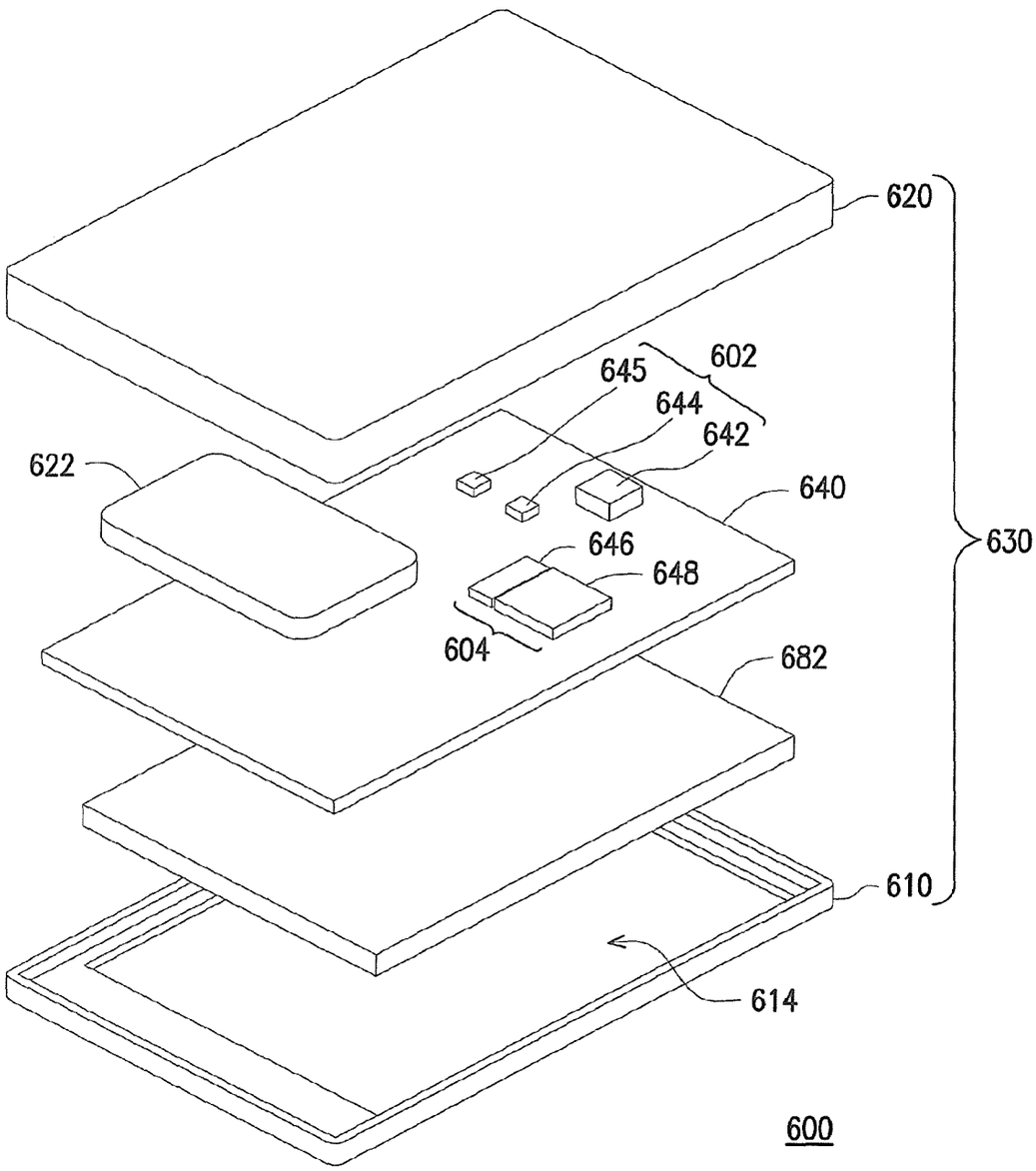


FIG. 6

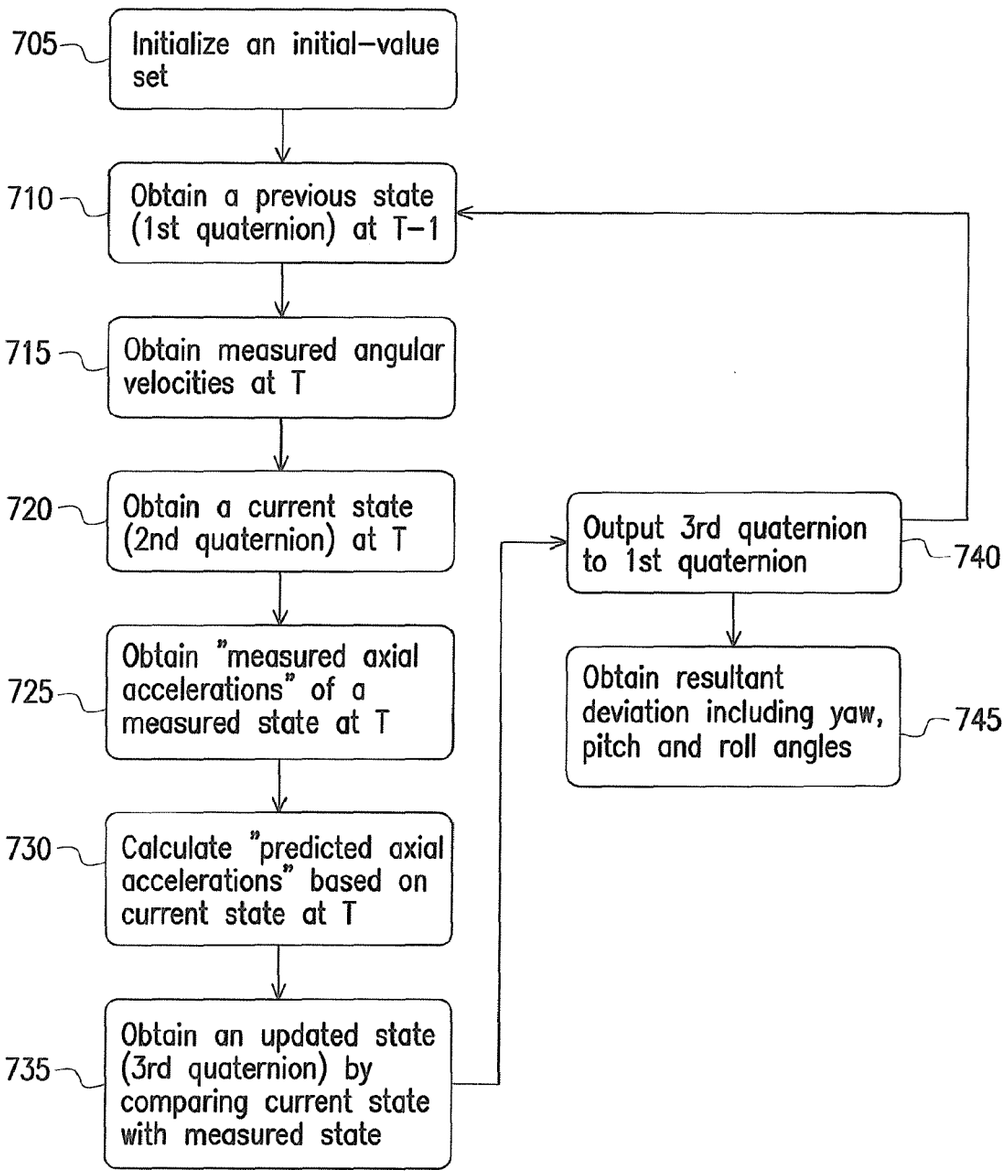

705
Initialize an initial-value set
710
Obtain a previous state (1st quaternion) at T-1
715
Obtain measured angular velocities at T
720
Obtain a current state (2nd quaternion) at T
725
Obtain "measured axial accelerations" of a measured state at T
730
Calculate "predicted axial accelerations" based on current state at T
735
Obtain an updated state (3rd quaternion) by comparing current state with measured state
Output 3rd quaternion to 1st quaternion
740
Obtain resultant deviation including yaw, pitch and roll angles
745

FIG. 7

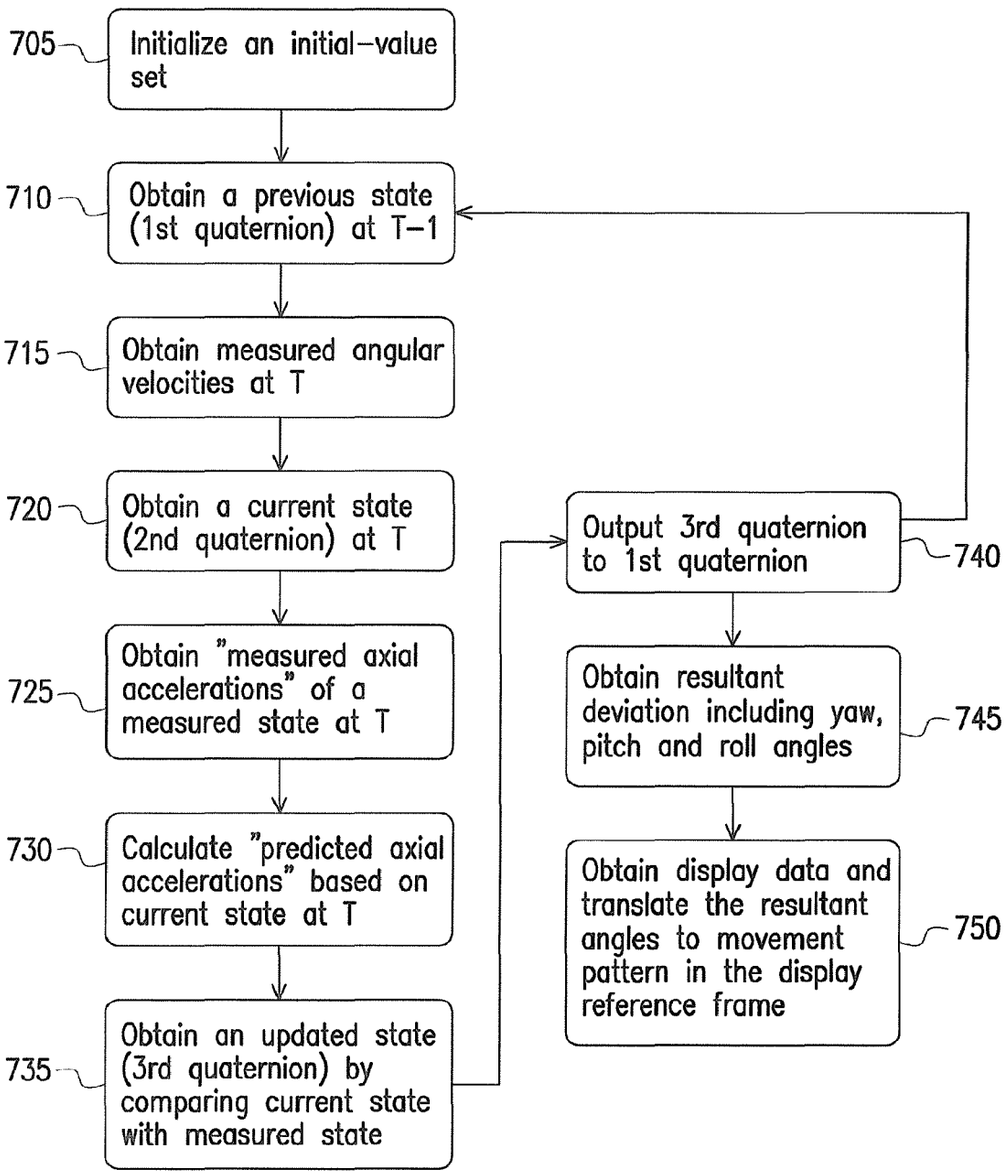

705
Initialize an initial-value set
710
Obtain a previous state (1st quaternion) at T-1
715
Obtain measured angular velocities at T
720
Obtain a current state (2nd quaternion) at T
725
Obtain "measured axial accelerations" of a measured state at T
730
Calculate "predicted axial accelerations" based on current state at T
735
Obtain an updated state (3rd quaternion) by comparing current state with measured state
740
Output 3rd quaternion to 1st quaternion
745
Obtain resultant deviation including yaw, pitch and roll angles
750
Obtain display data and translate the resultant angles to movement pattern in the display reference frame

FIG. 8

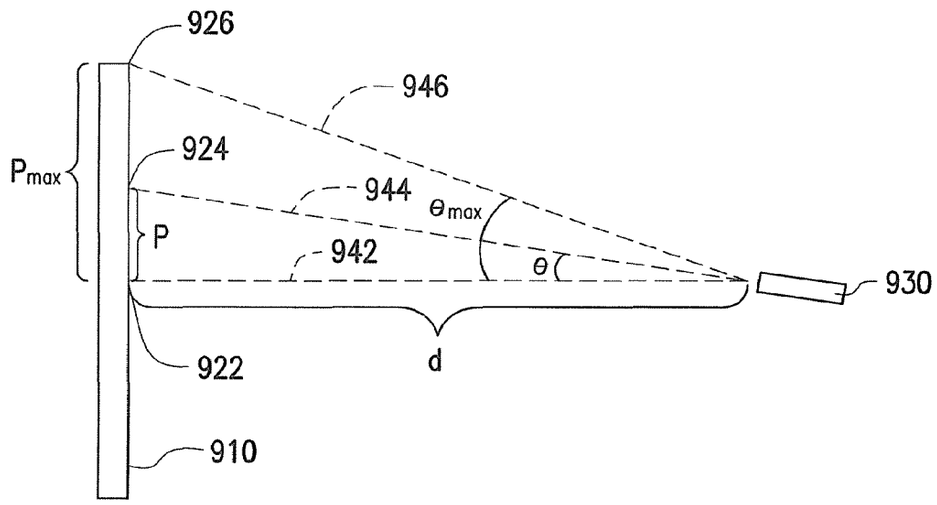


FIG. 9

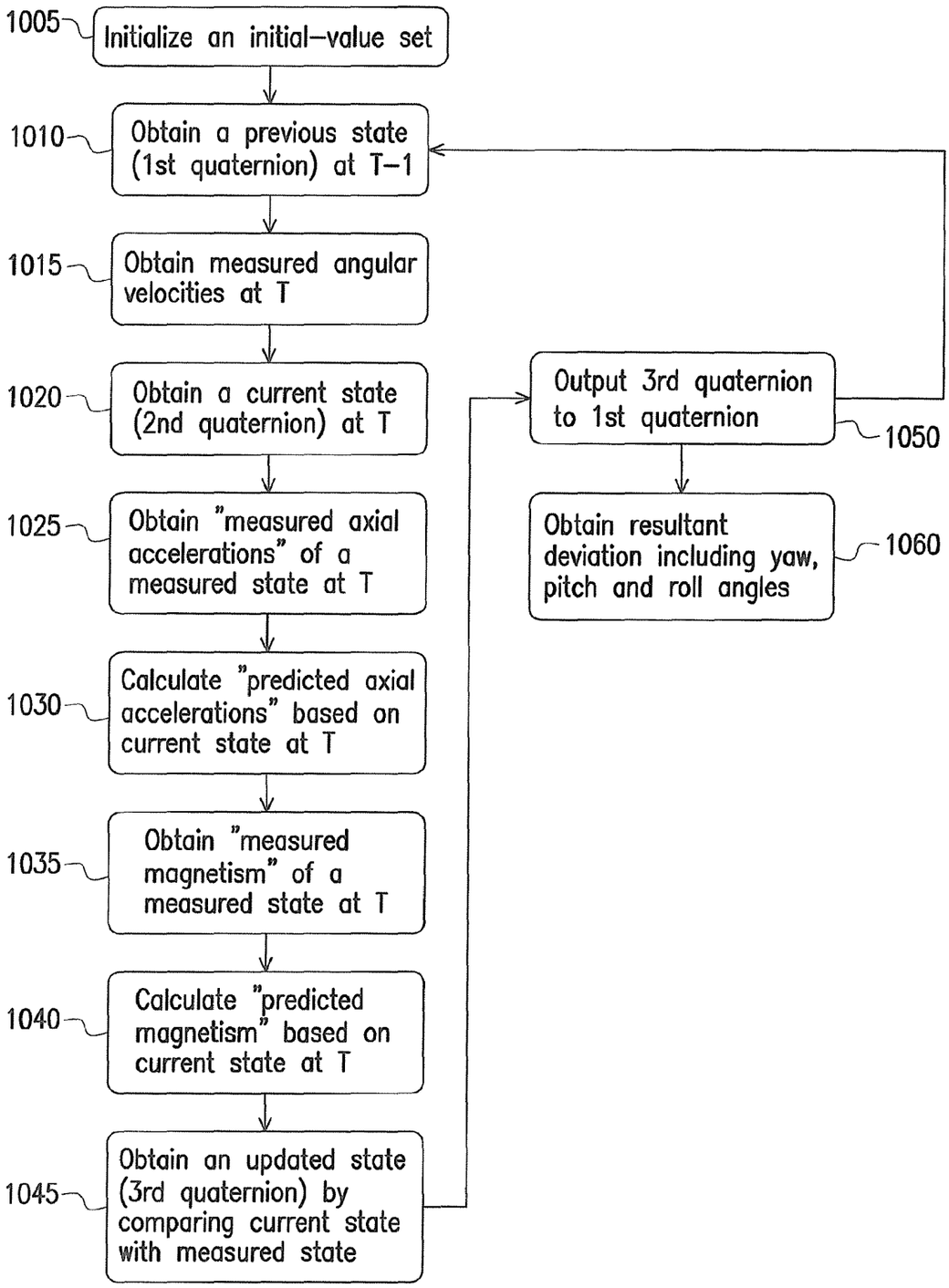

1005
Initialize an initial-value set
1010
Obtain a previous state (1st quaternion) at T-1
1015
Obtain measured angular velocities at T
1020
Obtain a current state (2nd quaternion) at T
1025
Obtain "measured axial accelerations" of a measured state at T
1030
Calculate "predicted axial accelerations" based on current state at T
1035
Obtain "measured magnetism" of a measured state at T
1040
Calculate "predicted magnetism" based on current state at T
1045
Obtain an updated state (3rd quaternion) by comparing current state with measured state
Output 3rd quaternion to 1st quaternion
1050
Obtain resultant deviation including yaw, pitch and roll angles
1060

FIG. 10

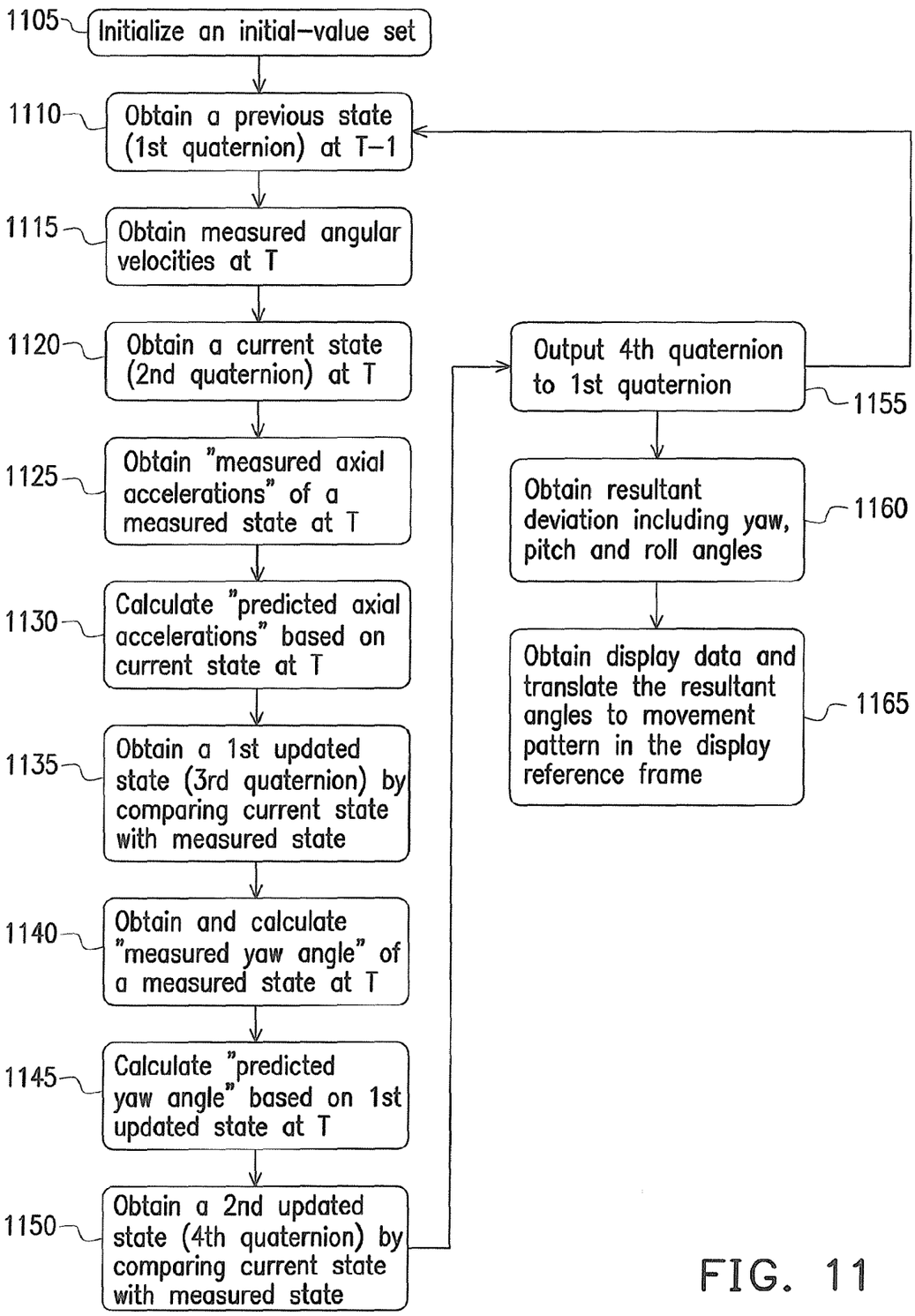

1105
Initialize an initial-value set
1110
Obtain a previous state (1st quaternion) at T-1
1115
Obtain measured angular velocities at T
1120
Obtain a current state (2nd quaternion) at T
1125
Obtain "measured axial accelerations" of a measured state at T
1130
Calculate "predicted axial accelerations" based on current state at T
1135
Obtain a 1st updated state (3rd quaternion) by comparing current state with measured state
1140
Obtain and calculate "measured yaw angle" of a measured state at T
1145
Calculate "predicted yaw angle" based on 1st updated state at T
1150
Obtain a 2nd updated state (4th quaternion) by comparing current state with measured state
Output 4th quaternion to 1st quaternion
1155
Obtain resultant deviation including yaw, pitch and roll angles
1160
Obtain display data and translate the resultant angles to movement pattern in the display reference frame
1165

FIG. 11

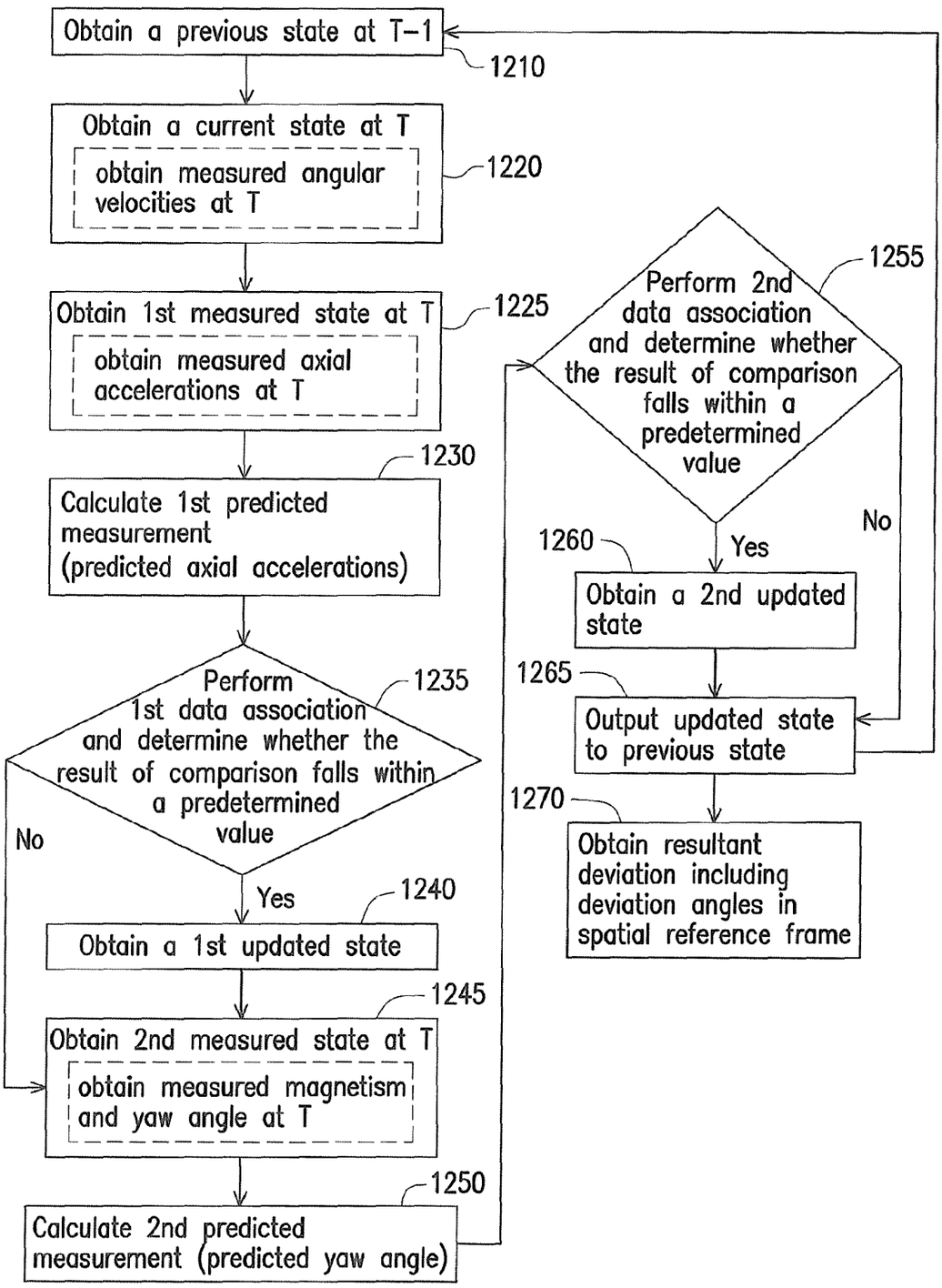

Obtain a previous state at T-1
1210
Obtain a current state at T
obtain measured angular velocities at T
1220
Obtain 1st measured state at T
obtain measured axial accelerations at T
1225
1230
Calculate 1st predicted measurement (predicted axial accelerations)
Perform 1st data association and determine whether the result of comparison falls within a predetermined value
1235
No
Yes
1240
Obtain a 1st updated state
1245
Obtain 2nd measured state at T
obtain measured magnetism and yaw angle at T
1250
Calculate 2nd predicted measurement (predicted yaw angle)
1255
Perform 2nd data association and determine whether the result of comparison falls within a predetermined value
No
Yes
1260
Obtain a 2nd updated state
1265
Output updated state to previous state
1270
Obtain resultant deviation including deviation angles in spatial reference frame

FIG. 12

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

First Named Inventor:

Liou, et al.

Serial No.: Unassigned

Filed: 2017-06-02

Confirmation No.: Unassigned

Group Art Unit: Unassigned

Examiner: Unassigned

Docket No. 250303-1021

For: Electronic Device for Use in Motion Detection and Method for Obtaining Resultant Deviation Thereof

INFORMATION DISCLOSURE STATEMENT

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

Sir:

This information disclosure statement is filed in accordance with 37 C.F.R. §§ 1.56, 1.97, and 1.98. Listed on the accompanying form SB_08(a) are documents which may or may not be considered material to the examination of this application. These documents were made of record in a prior application filed March 28, 2011, and having serial no. 13/072,794, to which priority is claimed relative to the present application pursuant to 35 U.S.C. §120. Copies of these documents are not being provided pursuant to 37 C.F.R. § 1.98(d)(1) and (2), which provides:

> (d) A copy of any patent, publication, pending U.S. application or other information, as specified in paragraph (a) of this section, listed in an information disclosure statement is required to be provided, even if the patent, publication, pending U.S. application or other information was previously submitted to, or cited by, the Office in an earlier application, unless:

(1) The application is properly identified in the information disclosure statement and is relied on for an earlier effective filing date under 35 U.S.C. §120; and

(2) The information disclosure statement submitted in the earlier application complies with a paragraphs (a) through (c) of this section.

The following rights are reserved by the Applicant(s): the right to establish the patentability of the claimed invention over any of the listed documents should they be applied as reference, the right to prove that some of these documents may not be prior art, and/or the right to prove that some of these documents may not be enabling for the teachings they purport to offer.

This statement should not be construed as a representation that an exhaustive search has been made, or that information more material to the examination of the present application does not exist. The Examiner is specifically requested not to rely solely on the materials submitted herewith. The Examiner is requested to conduct an independent and thorough review of the documents, and to form independent opinions as to their significance.

It is respectfully requested that the Examiner initial and return a copy of the enclosed PTO-1449 to indicate the documents have been considered.

Respectfully submitted,

McClure, Qualey & Rodack, LLP

/M.PaulQualey,Jr./

By: _____

M. Paul Qualey, Jr., Reg. No. 43,024

Customer No. 109673
Docket: 250303-1021

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

PTO/SB/08a (03-15)
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INFORMATION DISCLOSURE STATEMENT BY APPLICANT (**Not for submission under 37 CFR 1.99)**		
	Application Number	
	Filing Date	2017-06-02
	First Named Inventor	Liou, et al.
	Art Unit	
	Examiner Name	
	Attorney Docket Number	250303-1021

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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
	1	6957156	B2	2005-10-18	Jo, et al.	
	2	5138154		1992-08-11	Hotelling	
	3	5440326		1995-08-08	Quinn	
	4	5898421		1999-04-27	Quinn	
	5	7158118		2007-01-02	Liberty	
	6	7236156		2007-06-26	Liberty, et al.	
	7	7239301		2007-07-03	Liberty, et al.	
	8	7262760		2007-08-28	Liberty	

EFS Web 2.1.17

INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)		
	Application Number	
	Filing Date	2017-06-02
	First Named Inventor	Liou, et al.
	Art Unit	
	Examiner Name	
	Attorney Docket Number	250303-1021

	9	7414611		2008-08-19	Liberty	
	10	7489298		2009-02-10	Liberty, et al.	
	11	7535456		2009-05-19	Liberty, et al.	

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	1	20090115724	A1	2009-05-07	Yamamoto	
	2	20110199298	A1	2011-08-18	Bassompiere, et al.	
	3	20100161084	A1	2010-06-24	Zhao, et al.	
	4	20090182503	A1	2009-07-16	Changey, et al.	
	5	20090262074	A1	2009-10-22	Nasiri, et al.	

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	Art Unit	
	Examiner Name	
	Attorney Docket Number	250303-1021

Examiner Initial*	Cite No	Foreign Document Number[3]	Country Code[2] i	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]
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	1	Azuma, Ronald et al. Improving Static and Dynamic Registration in an Optical See-Through HMO. Proceedings of SIGGRAPH '94 (Orlando, Fla., 24 29 Jul., 1994), Computer Graphics, Annual Conference Series, 1994, 197 204.	

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EXAMINER SIGNATURE

Examiner Signature		Date Considered	

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

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

INFORMATION DISCLOSURE STATEMENT BY APPLICANT (**Not for submission under 37 CFR 1.99)**		
	Application Number	
	Filing Date	2017-06-02
	First Named Inventor	Liou, et al.
	Art Unit	
	Examiner Name	
	Attorney Docket Number	250303-1021

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.

The fee set forth in 37 CFR 1.17 (p) has been submitted herewith.

A certification statement is not submitted herewith.

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	/M.PaulQualey,Jr./	Date (YYYY-MM-DD)	2017-06-02
Name/Print	M. Paul Qualey, Jr.	Registration Number	43024

This collection of information is required by 37 CFR 1.97 and 1.98. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.14. This collection is estimated to take 1 hour to complete, including gathering, preparing and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. **SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.**

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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
15/611,970	06/02/2017	2621	730	250303-1021	16	2

CONFIRMATION NO. 5932

109673
McClure, Qualey & Rodack, LLP
3100 Interstate North Circle
Suite 150
Atlanta, GA 30339

FILING RECEIPT

OC000000091982974

Date Mailed: 06/12/2017

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)

Shun-Nan Liou, Taipei, TAIWAN;
Zhou Ye, Taipei, TAIWAN;
Chin-Lung Li, Taipei, TAIWAN;

Applicant(s)

CM HK LIMITED, FORTRESS HILL, HONG KONG;

Power of Attorney: None

Domestic Priority data as claimed by applicant

This application is a CON of 13/072,794 03/28/2011
which is a CIP of 12/943,934 11/11/2010 PAT 8441438
which claims benefit of 61/292,558 01/06/2010

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.

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The country code and number of your priority application, to be used for filing abroad under the Paris Convention, is **US 15/611,970**

Projected Publication Date: 09/21/2017

Non-Publication Request: No

Early Publication Request: No
**** SMALL ENTITY ****
Title

ELECTRONIC DEVICE FOR USE IN MOTION DETECTION AND METHOD FOR OBTAINING RESULTANT DEVIATION THEREOF

Preliminary Class

345

Statement under 37 CFR 1.55 or 1.78 for AIA (First Inventor to File) Transition Applications: No

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APPLICATION NUMBER	FILING OR 371(C) DATE	FIRST NAMED APPLICANT	ATTY. DOCKET NO./TITLE
15/611,970	06/02/2017	Shun-Nan Liou	250303-1021

CONFIRMATION NO. 5932

109673
McClure, Qualey & Rodack, LLP
3100 Interstate North Circle
Suite 150
Atlanta, GA 30339

PUBLICATION NOTICE

OC000000094236748

Title:ELECTRONIC DEVICE FOR USE IN MOTION DETECTION AND METHOD FOR OBTAINING RESULTANT DEVIATION THEREOF

Publication No.US-2017-0269714-A1
Publication Date:09/21/2017

NOTICE OF PUBLICATION OF APPLICATION

The above-identified application will be electronically published as a patent application publication pursuant to 37 CFR 1.211, et seq. The patent application publication number and publication date are set forth above.

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The publication process established by the Office does not provide for mailing a copy of the publication to applicant. A copy of the publication may be obtained from the Office upon payment of the appropriate fee set forth in 37 CFR 1.19(a)(1). Orders for copies of patent application publications are handled by the USPTO's Public Records Division. The Public Records Division can be reached by telephone at (571) 272-3150 or (800) 972-6382, by facsimile at (571) 273-3250, by mail addressed to the United States Patent and Trademark Office, Public Records Division, Alexandria, VA 22313-1450 or via the Internet.

In addition, information on the status of the application, including the mailing date of Office actions and the dates of receipt of correspondence filed in the Office, may also be accessed via the Internet through the Patent Electronic Business Center at www.uspto.gov using the public side of the Patent Application Information and Retrieval (PAIR) system. The direct link to access this status information is currently https://portal.uspto.gov/pair/PublicPair. Prior to publication, such status information is confidential and may only be obtained by applicant using the private side of PAIR.

Further assistance in electronically accessing the publication, or about PAIR, is available by calling the Patent Electronic Business Center at 1-866-217-9197.

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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
15/611,970	06/02/2017	Shun-Nan Liou	250303-1021	5932

109673 7590 11/26/2018

McClure, Qualey & Rodack, LLP
280 Interstate North Circle SE
Suite 550
Atlanta, GA 30339

EXAMINER	
EARLES, BRYAN E	

ART UNIT	PAPER NUMBER
2625	

NOTIFICATION DATE	DELIVERY MODE
11/26/2018	ELECTRONIC

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.

Notice of the Office communication was sent electronically on above-indicated "Notification Date" to the following e-mail address(es):

dan.mcclure@mqrlaw.com
gina.silverio@mqrlaw.com
uspatents@mqrlaw.com

PTOL-90A (Rev. 04/07)

Office Action Summary	**Application No.** 15/611,970	**Applicant(s)** Liou et al.	
	Examiner BRYAN EARLES	**Art Unit** 2625	**AIA Status** No

-- 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 MONTHS 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 02 June 2017.

☐ A declaration(s)/affidavit(s) under **37 CFR 1.130(b)** was/were filed on _____.

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) 1-16 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) 1-16 is/are rejected.

8) ☐ Claim(s) _____ is/are objected to.

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

* If any claims have been determined allowable, 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.**

Application Papers

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

11)☑ The drawing(s) filed on 02 June 2017 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).

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).

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)).

** 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) ☑ Information Disclosure Statement(s) (PTO/SB/08a and/or PTO/SB/08b) Paper No(s)/Mail Date _____.

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

4) ☐ Other: _____.

DETAILED ACTION

Notice of Pre-AIA or AIA Status

The present application is being examined under the pre-AIA first to invent provisions.

In the event the determination of the status of the application as subject to AIA 35 U.S.C. 102 and 103 (or as subject to pre-AIA 35 U.S.C. 102 and 103) is incorrect, any correction of the statutory basis for the rejection will not be considered a new ground of rejection if the prior art relied upon, and the rationale supporting the rejection, would be the same under either status.

Claim Rejections - 35 USC § 102

The following is a quotation of the appropriate paragraphs of pre-AIA 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.

Claims 1 and 9 are rejected under pre-AIA 35 U.S.C. 102(b) as being clearly anticipated by Yamashita et al. (US 8,267,785, hereinafter "Yamashita").

With respect to **claims 9 and 1**, Yamashita teaches a method for determining movements and rotations in dynamic environments, comprising:

generating, with a rotation sensor having sensor circuitry, a first signal set comprising measured angular velocities ωx, ωy, ωz (Yamashita: Fig. 7, gyrosensor unit 7 includes gyrosensors 55 and 56 for producing tri-axial angular velocity data);

generating, with an accelerometer having accelerometer circuitry, a second signal set comprising measured axial accelerations Ax, Ay, Az (Yamashita: Fig. 7; Col. 12, line 47 – Col. 13, line 10, output from the acceleration sensor 37 represented as a three-dimensional vector (ax,ay,az) in an XYZ coordinate system); and

calculating, with a computing processor having processor circuitry, a resulting deviation comprising resultant angles in a spatial reference frame (Yamashita: Col. 12, line 62 – Col. 13, line 24; Col. 14, line 18 – Col. 15, line 8) by:

providing a current state associated with the first signal set (Yamashita: Fig. 23, gyrosensor unit 7 outputs angular velocity d1);

comparing (Paragraph [0004], of Applicant's Specification, "The term of "comparison" of the present invention may generally refer to the calculating and obtaining of the actual deviation angles of the 3D pointing device …") a predicted measurement based on the first signal set and a measurement of the second signal set such that a comparison result is provided as a measured state (Yamashita: Fig. 23; Col. 19, lines 1-8, angular velocity d1 and acceleration d2 are input to the process of posture estimation p1); and

obtaining an updated state based on the current state and the measured state (Yamashita: Fig. 23; Col. 19, lines 8-13, a posture vector represented by the angular velocity is corrected by a vector represented by the acceleration to calculate the posture of the input device 8).

Claim Rejections - 35 USC § 103

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

> A patent for a claimed invention may not be obtained, notwithstanding that the claimed invention is not identically disclosed as set forth in section 102 of this title, if the differences between the claimed invention and the prior art are such that the claimed invention as a whole would have been obvious before the effective filing date of the claimed invention to a person having ordinary skill in the art to which the claimed invention pertains. Patentability shall not be negated by the manner in which the invention was made.

Claims 2-8 and 10-16 are rejected under 35 U.S.C. 103 as being unpatentable over Yamashita in view of Bachmann et al. (US 7,089,148, hereinafter "Bachmann").

With respect to **claims 10 and 2**, Yamashita teaches the method of claim 9.

Yamashita does not disclose:

a magnetometer having magnetometer circuitry, a third signal set comprising measured magnetism Mx, My, Mz.

However, Bachmann discloses:

a magnetometer having magnetometer circuitry, a third signal set comprising measured magnetism Mx, My, Mz (Bachmann: Fig. 3, magnetometers 38 generate magnetisms b1, b2, b3); and

calculating the resulting deviation further comprises comparing the predicted measurement obtained based on the update state and the first signal set to a measurement of the third signal set (Bachmann: Para. [0055] – [0056]; Fig. 6a, step 609).

Therefore, it would be obvious to one of ordinary skill in the art at the time the invention was made to modify the method, as taught by Yamashita, to incorporate additional types of detectors into the motion sensing module, as taught by Bachmann, in order overcome the shortcomings of individual detector types by capitalizing on the advantages of each (Bachmann: Col. 4, lines 15-30, Col. 13, lines 1-10).

With respect to **claims 11 and 3**, the combination of Yamashita as modified by Bachmann teach the method of claim 10,

wherein the measured state correlates to a comparison result between the predicted measurement, and the measurement of the second signal set and the measurement of the third signal set (Bachmann: Col. 9, lines 21-48; Fig. 3, estimated orientation quaternion 39 is correlated with the measurement vector 34).

With respect to **claims 12 and 4**, the combination of Yamashita as modified by Bachmann teach the method of claim 10, wherein calculating the resulting deviation further comprises:

utilizing a data association model to determine whether compensation is needed to obtain the update state based on the measured axial accelerations or the measured magnetisms (Bachmann: Col. 9, line 49 – Col. 10, line 45; Col. 13, lines 1-62; Fig. 3, detector data is iteratively weighted to place greater or less reliance on data received from the detectors 31, 32, 33); and

obtaining the update state in response to determining that the compensation is needed (Bachmann: Col. 13, lines 1-62, defining the error vector epsilon based on a

threshold parameter .rho. to either emphasize magnetometer data or places greater weight on accelerometer data in order to determine an updated orientation).

With respect to **claims 13 and 5**, the combination of Yamashita as modified by Bachmann teach the method of claim 10, wherein utilizing **the** data association model further comprises:

comparing the measured state associated with at least the second signal set or the third signal set with a predicted measurement calculated and obtained from the current state and associated with at least the first signal set (Bachmann: Figs. 5(a) – 5(b), steps 514 – 517); and

determining whether compensation is needed to obtain the update state based on whether the comparison result is a predetermined value or within a predetermined range (Bachmann: Fig. 5(b), step 517 minimizing the criterion function to output an orientation error estimate).

With respect to **claims 14 and 6**, the combination of Yamashita as modified by Bachmann teach the method of claim 10, wherein calculating the resulting deviation further comprises:

calculating the measured state associated with the third signal set by obtaining measured yaw based on measured magnetism Mx, My, Mz (Bachmann: Fig. 3, 32); and

calculating predicted yaw associated with the predicted measurement, wherein the predicted measurement is calculated and obtained from the update state and associated with the first signal set (Bachmann: Fig. 3, an estimated orientation

quaternion 39 is correlated with the measurement vector 34; Col. 16, line 40 – Col. 17, line 5, each iteration produces an updated estimated quaternion yielding a new estimate of sensor orientation including azimuth, elevation and roll angles in the sensor coordinate system).

With respect to **claims 15 and 7**, the combination of Yamashita as modified by Bachmann teach the method of claim 14,

wherein the measured yaw is *calculated and obtained* based on the measured state associated with the third signal set, a temporary pitch value, and a temporary roll value; and

the temporary pitch value and the temporary roll value are calculated and converted from the update state (Bachmann: Fig. 3, includes intermediate sensor orientations represented in the form of quaternions (e.g., old and new q.sub.circumflex); Col. 7, lines 4-31; transforming estimated body rates to updated Euler Rates or Quaternion Rates).

With respect to **claims 16 and 8**, the combination of Yamashita as modified by Bachmann and Horton teach the method of claim 14, wherein calculating the resulting deviation further comprises:

obtaining a first update state based on the current state associated with the first signal set and a first measured state, wherein the first measured state is correlated to the measurement of the second signal set and a first predicted measurement calculated and obtained from the current state and associated with the first signal set (Bachmann:

Fig. 3, an estimated orientation quaternion 39 is correlated with the measurement vector 34 and the angular rate information 37; Col. 16, line 40 – Col. 17, line 5, each iteration computes an updated estimated quaternion representative of a new estimate of sensor orientation); and

obtaining a second update state based on the first update state and a second measured state, wherein the second measured state is correlated to the measured yaw and a predicted yaw associated with a second predicted measurement, which is calculated and obtained from the current state or the first update state and associated with the first signal set, wherein the resultant angles are based on the second update state (Bachmann: Col. 9, lines 22-32; Fig. 3, a second updated state is interpreted as a subsequent iteration using the previously updated state; Equation 16).

Conclusion

The prior art made of record and not relied upon is considered pertinent to applicant's disclosure. Please see the attached PTO-892 Notice of References Cited.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to BRYAN EARLES whose telephone number is (571)272-4628. The examiner can normally be reached on Monday - Thursday at 7:30am - 5:00pm.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, William Boddie can be reached on 571-272-0666. 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.

/BRYAN EARLES/
Primary Examiner, Art Unit 2625

Notice of References Cited	Application/Control No. 15/611,970	Applicant(s)/Patent Under Reexamination Liou et al.	
	Examiner BRYAN EARLES	Art Unit 2625	Page 1 of 1

U.S. PATENT DOCUMENTS

*		Document Number Country Code-Number-Kind Code	Date MM-YYYY	Name	CPC Classification	US Classification
*	A	US-6636826-B1	10-2003	Abe; Hiroshi	G01C19/56	702/151
*	B	US-7305315-B2	12-2007	Kwon; Oh Jo	G01C17/38	702/151
*	C	US-7216055-B1	05-2007	Horton; Michael A.	G01C21/16	702/150
*	D	US-8267785-B2	09-2012	Yamashita; Yoshikazu	A63F13/02	436/3
*	E	US-5953683-A	09-1999	Hansen; Per Krogh	G01C21/165	324/207.17
*	F	US-20070213889-A1	09-2007	Parra Carque; Sergio De La	G01C3/08	701/7
*	G	US-7089148-B1	08-2006	Bachmann; Eric R.	A61B5/1114	600/595
*	H	US-6377906-B1	04-2002	Rowe; Jeffrey D.	G01C21/16	244/164
*	I	US-20040095317-A1	05-2004	Zhang, Jingxi	G06F3/0346	345/158
	J					
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FOREIGN PATENT DOCUMENTS

*		Document Number Country Code-Number-Kind Code	Date MM-YYYY	Country	Name	CPC Classification
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NON-PATENT DOCUMENTS

*		Include as applicable: Author, Title Date, Publisher, Edition or Volume, Pertinent Pages)
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*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.

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

PTO/SB/08a (03-15)
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INFORMATION DISCLOSURE STATEMENT BY APPLICANT (**Not for submission under 37 CFR 1.99)**		
	Application Number	
	Filing Date	2017-06-02
	First Named Inventor	Liou, et al.
	Art Unit	
	Examiner Name	
	Attorney Docket Number	250303-1021

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
	1	6957156	B2	2005-10-18	Jo, et al.	
	2	5138154		1992-08-11	Hotelling	
	3	5440326		1995-08-08	Quinn	
	4	5898421		1999-04-27	Quinn	
	5	7158118		2007-01-02	Liberty	
	6	7236156		2007-06-26	Liberty, et al.	
	7	7239301		2007-07-03	Liberty, et al.	
	8	7262760		2007-08-28	Liberty	

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INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)		
	Application Number	
	Filing Date	2017-06-02
	First Named Inventor	Liou, et al.
	Art Unit	
	Examiner Name	
	Attorney Docket Number	250303-1021

	9	7414611		2008-08-19	Liberty	
	10	7489298		2009-02-10	Liberty, et al.	
	11	7535456		2009-05-19	Liberty, et al.	

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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
	1	20090115724	A1	2009-05-07	Yamamoto	
	2	20110199298	A1	2011-08-18	Bassompiere, et al.	
	3	20100161084	A1	2010-06-24	Zhao, et al.	
	4	20090182503	A1	2009-07-16	Changey, et al.	
	5	20090262074	A1	2009-10-22	Nasiri, et al.	

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INFORMATION DISCLOSURE STATEMENT BY APPLICANT (**Not for submission under 37 CFR 1.99)**	Application Number	
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	Art Unit	
	Examiner Name	
	Attorney Docket Number	250303-1021

Examiner Initial*	Cite No	Foreign Document Number[3]	Country Code[2] i	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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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]
	1	Azuma, Ronald et al. Improving Static and Dynamic Registration in an Optical See-Through HMO. Proceedings of SIGGRAPH '94 (Orlando, Fla., 24 29 Jul., 1994), Computer Graphics, Annual Conference Series, 1994, 197 204.	

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

EXAMINER SIGNATURE

Examiner Signature	/BRYAN EARLES/	Date Considered	10/29/2018

*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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INFORMATION DISCLOSURE STATEMENT BY APPLICANT (**Not for submission under 37 CFR 1.99)**	Application Number	
	Filing Date	2017-06-02
	First Named Inventor	Liou, et al.
	Art Unit	
	Examiner Name	
	Attorney Docket Number	250303-1021

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.

The fee set forth in 37 CFR 1.17 (p) has been submitted herewith.

A certification statement is not submitted herewith.

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	/M.PaulQualey,Jr./	Date (YYYY-MM-DD)	2017-06-02
Name/Print	M. Paul Qualey, Jr.	Registration Number	43024

This collection of information is required by 37 CFR 1.97 and 1.98. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.14. This collection is estimated to take 1 hour to complete, including gathering, preparing and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. **SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.**

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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:

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.

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PTO/AIA/22 (03-13)
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PETITION FOR EXTENSION OF TIME UNDER 37 CFR 1.136(a)	Docket Number (Optional) 250303-1021
Application Number 15/611,970	Filed June 2, 2017
For Electronic Device for Use in Motion Detection and Method for Obtaining Resultant Deviation Thereof	
Art Unit 2625	Examiner Earles, Bryan E.

This is a request under the provisions of 37 CFR 1.136(a) to extend the period for filing a reply in the above-identified application.

The requested extension and fee are as follows (check time period desired and enter the appropriate fee below):

		Fee	Small Entity Fee	Micro Entity Fee	
☐	One month (37 CFR 1.17(a)(1))	$200	$100	$50	$
☑	Two months (37 CFR 1.17(a)(2))	$600	$300	$150	$ 300.00
☐	Three months (37 CFR 1.17(a)(3))	$1,400	$700	$350	$
☐	Four months (37 CFR 1.17(a)(4))	$2,200	$1,100	$550	$
☐	Five months (37 CFR 1.17(a)(5))	$3,000	$1,500	$750	$

☑ Applicant asserts small entity status. See 37 CFR 1.27.

☐ Applicant certifies micro entity status. See 37 CFR 1.29.
Form PTO/SB/15A or B or equivalent must either be enclosed or have been submitted previously.

☐ A check in the amount of the fee is enclosed.

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

☐ The Director has already been authorized to charge fees in this application to a Deposit Account.

☑ The Director is hereby authorized to charge any fees which may be required, or credit any overpayment, to Deposit Account Number 50-5954.

☑ Payment made via EFS-Web.

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.

I am the

☐ applicant.

☑ attorney or agent of record. Registration number 43,024.

☐ attorney or agent acting under 37 CFR 1.34. Registration number _____.

/M.PaulQualey,Jr./ — Signature

April 10, 2019 — Date

M. Paul Qualey, Jr. — Typed or printed name

678-483-8899 — Telephone Number

NOTE: This form must be signed in accordance with 37 CFR 1.33. See 37 CFR 1.4 for signature requirements and certifications. Submit multiple forms if more than one signature is required, see below*.

☑ * Total of 1 forms are submitted.

This collection of information is required by 37 CFR 1.136(a). 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 6 minutes to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. SEND TO: Mail Stop PCT, Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.

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:	15611970
Filing Date:	02-Jun-2017
Title of Invention:	ELECTRONIC DEVICE FOR USE IN MOTION DETECTION AND METHOD FOR OBTAINING RESULTANT DEVIATION THEREOF
First Named Inventor/Applicant Name:	Shun-Nan Liou
Filer:	Daniel R. McClure/Alison Anderson
Attorney Docket Number:	250303-1021
Filed as Small Entity	
Filing Fees for Utility under 35 USC 111(a)	

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($)
Extension - 2 months with $0 paid	2252	1	300	300
Miscellaneous:				
		Total in USD ($)		**300**

Electronic Acknowledgement Receipt	
EFS ID:	35681737
Application Number:	15611970
International Application Number:	
Confirmation Number:	5932
Title of Invention:	ELECTRONIC DEVICE FOR USE IN MOTION DETECTION AND METHOD FOR OBTAINING RESULTANT DEVIATION THEREOF
First Named Inventor/Applicant Name:	Shun-Nan Liou
Customer Number:	109673
Filer:	Daniel R. McClure/Alison Anderson
Filer Authorized By:	Daniel R. McClure
Attorney Docket Number:	250303-1021
Receipt Date:	10-APR-2019
Filing Date:	02-JUN-2017
Time Stamp:	12:15:46
Application Type:	Utility under 35 USC 111(a)

Payment information:

Submitted with Payment	yes
Payment Type	CARD
Payment was successfully received in RAM	$300
RAM confirmation Number	041019INTEFSW12162100
Deposit Account	505954
Authorized User	Alison Anderson
The Director of the USPTO is hereby authorized to charge indicated fees and credit any overpayment as follows: 37 CFR 1.16 (National application filing, search, and examination fees) 37 CFR 1.17 (Patent application and reexamination processing fees)	

37 CFR 1.19 (Document supply fees)

37 CFR 1.20 (Post Issuance fees)

37 CFR 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	Amendment/Req. Reconsideration-After Non-Final Reject	00667067.PDF	134513 d36bbd7ab561e5f22eac04f6c41e3b3ace20a2b3	no	12
Warnings:					
Information:					
2	Extension of Time	00667001.PDF	141409 b471891555b2f0c453c803aa5b98c0ccf4f3bdd2	no	2
Warnings:					
Information:					
3	Fee Worksheet (SB06)	fee-info.pdf	30540 db9dde5c404650d5ae4020b88643b69f304b6b14	no	2
Warnings:					
Information:					
		Total Files Size (in bytes):	306462		

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

<u>New Applications Under 35 U.S.C. 111</u>
If a new application is being filed and the application includes the necessary components for a filing date (see 37 CFR 1.53(b)-(d) and MPEP 506), a Filing Receipt (37 CFR 1.54) will be issued in due course and the date shown on this Acknowledgement Receipt will establish the filing date of the application.
<u>National Stage of an International Application under 35 U.S.C. 371</u>
If a timely submission to enter the national stage of an international application is compliant with the conditions of 35 U.S.C. 371 and other applicable requirements a Form PCT/DO/EO/903 indicating acceptance of the application as a national stage submission under 35 U.S.C. 371 will be issued in addition to the Filing Receipt, in due course.
<u>New International Application Filed with the USPTO as a Receiving Office</u>
If a new international application is being filed and the international application includes the necessary components for an international filing date (see PCT Article 11 and MPEP 1810), a Notification of the International Application Number and of the International Filing Date (Form PCT/RO/105) will be issued in due course, subject to prescriptions concerning national security, and the date shown on this Acknowledgement Receipt will establish the international filing date of the application.

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

First Named Inventor:

Liou, et al.

Serial No.: 15/611,970

Filed: June 2, 2017

Confirmation No.: 5932

Group Art Unit: 2625

Examiner: Earles, Bryan E.

MQR Ref.: 250303-1021
Client Ref.: CWM11002-1-US

For: Electronic Device for Use in Motion Detection and Method for Obtaining Resultant Deviation Thereof

RESPONSE TO NON-FINAL OFFICE ACTION

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

Director:

The Office Action mailed on November 26, 2018 has been carefully considered. In response, Applicant submits the following remarks.

AMENDMENTS

In the Claims

1. (Currently Amended) An electronic device subject to movements and rotations in dynamic environments, comprising:

a motion sensor module comprising a rotation sensor and an accelerometer, both of which are subjected to the movements and the rotations in the dynamic environments, the rotation sensor having sensor circuitry configured to generate a first signal set comprising measured angular velocities ωx, ωy, ωz, the accelerometer having accelerometer circuitry configured to generate a second signal set comprising measured axial accelerations Ax, Ay, Az; and

a computing processor having processor circuitry configured to calculate a resulting deviation comprising resultant angles in a spatial reference frame by:

providing a current state associated with the first signal set;

comparing a predicted measurement based on the first signal set to a measurement of the second signal set such that a comparison result is provided as a measured state; and

obtaining an update state based on the current state and the measured state;

wherein the computing processor is further configured to translate deviation angles of the resulting deviation to a movement pattern in a display reference frame of a display based on a user-adjustable sensitivity input.

2. (Original) The electronic device of claim 1, wherein:

the motion sensor module further comprises a magnetometer having magnetometer circuitry configured to generate a third signal set comprising measured magnetism Mx, My, Mz; and

in calculating the resulting deviation, the computing processor is further configured to compare the predicted measurement obtained based on the update state and the first signal set to a measurement of the third signal set.

3. (Original) The electronic device of claim 2, wherein the measured state correlates to a comparison result between the predicted measurement, and the measurement of the second signal set and the measurement of the third signal set.

4. (Original) The electronic device of claim 3, wherein, in calculating the resulting deviation, the computing processor is further configured to:

utilize a data association model to determine whether compensation is needed to obtain the update state based on the measured axial accelerations or the measured magnetisms; and

obtain the update state in response to determining that the compensation is needed.

5. (Original) The electronic device of claim 4, wherein, in calculating the resulting deviation, the computing processor is further configured to utilize the data association model to:

compare the measured state associated with at least the second signal set or the third signal set with a predicted measurement calculated and obtained from the current state and associated with at least the first signal set; and

determine whether compensation is needed to obtain the update state based on whether the comparison result is a predetermined value or within a predetermined range.

6. (Original) The electronic device of claim 3, wherein computing processor is further configured to:

calculate the measured state associated with the third signal set by obtaining measured yaw based on measured magnetism Mx, My, Mz; and

calculate predicted yaw associated with the predicted measurement, wherein the predicted measurement is calculated and obtained from the update state and associated with the first signal set.

7. (Original) The electronic device of claim 6, wherein the measured yaw is calculated and obtained based on the measured state associated with the third signal set, a temporary pitch value, and a temporary roll value, wherein the temporary pitch value and the temporary roll value are calculated and converted from the update state.

8. (Original) The electronic device of claim 6, wherein, in calculating the resulting deviation, the computing processor is further configured to:

obtain a first update state based on the current state associated with the first signal set and a first measured state, wherein the first measured state is correlated to the measurement of the second signal set and a first predicted measurement calculated and obtained from the current state and associated with the first signal set; and

obtain a second update state based on the first update state and a second measured state, wherein the second measured state is correlated to the measured yaw and a predicted yaw associated with a second predicted measurement, which is calculated and obtained from the current state or the first update state and associated with the first signal set, wherein the resultant angles are based on the second update state.

9. (Currently Amended) A method for determining movements and rotations in dynamic environments, comprising:

generating, with a rotation sensor having sensor circuitry, a first signal set comprising measured angular velocities ωx, ωy, ωz;

generating, with an accelerometer having accelerometer circuitry, a second signal set comprising measured axial accelerations Ax, Ay, Az; and

calculating, with a computing processor having processor circuitry, a resulting deviation comprising resultant angles in a spatial reference frame by:

providing a current state associated with the first signal set;

comparing a predicted measurement based on the first signal set and a measurement of the second signal set such that a comparison result is provided as a measured state; [[and]]

obtaining an updated state based on the current state and the measured state; and

translating deviation angles of the resulting deviation to a movement pattern in a display reference frame of a display based on a user-adjustable sensitivity input.

10. (Original) The method of claim 9, wherein:

the method further comprises generating, with a magnetometer having magnetometer circuitry, a third signal set comprising measured magnetism Mx, My, Mz; and

calculating the resulting deviation further comprises comparing the predicted measurement obtained based on the update state and the first signal set to a measurement of the third signal set.

11. (Original) The method of claim 10, wherein the measured state correlates to a comparison result between the predicted measurement, and the measurement of the second signal set and the measurement of the third signal set.

12. (Original)The method of claim 10, wherein calculating the resulting deviation further comprises:

utilizing a data association model to determine whether compensation is needed to obtain the update state based on the measured axial accelerations or the measured magnetisms; and

obtaining the update state in response to determining that the compensation is needed.

13. (Original) The method of claim 10, wherein utilizing the data association model further comprises:

comparing the measured state associated with at least the second signal set or the third signal set with a predicted measurement calculated and obtained from the current state and associated with at least the first signal set; and

determining whether compensation is needed to obtain the update state based on whether the comparison result is a predetermined value or within a predetermined range.

14. (Original) The method of claim 10, wherein calculating the resulting deviation further comprises:

calculating the measured state associated with the third signal set by obtaining measured yaw based on measured magnetism Mx, My, Mz; and

calculating predicted yaw associated with the predicted measurement, wherein the predicted measurement is calculated and obtained from the update state and associated with the first signal set.

15. (Original) The method of claim 14, wherein:

the measured yaw is calculated and obtained based on the measured state associated with the third signal set, a temporary pitch value, and a temporary roll value; and

the temporary pitch value and the temporary roll value are calculated and converted from the update state.

16. (Original) The method of claim 14, wherein calculating the resulting deviation further comprises:

obtaining a first update state based on the current state associated with the first signal set and a first measured state, wherein the first measured state is correlated to the measurement of the second signal set and a first predicted measurement calculated and obtained from the current state and associated with the first signal set; and

obtaining a second update state based on the first update state and a second measured state, wherein the second measured state is correlated to the measured yaw and a predicted yaw associated with a second predicted measurement, which is calculated and obtained from the current state or the first update state and associated with the first signal set, wherein the resultant angles are based on the second update state.

REMARKS

The Examiner is thanked for the thorough examination of the present application. Upon entry of the amendments in this response, claims 1 - 16 remain pending. In particular, claims 1 and 9 have been amended. Reconsideration of the rejections is respectfully requested.

Claim Rejections - 35 USC §§ 102 & 103

The Office Action indicates that claims 1 and 9 are rejected under pre-AIA 35 U.S.C. 102(b) as being anticipated by Yamashita et al. (US 8,267,785, hereinafter "Yamashita"). Additionally, the Office Action indicates that claims 2-8 and 10-16 are rejected under 35 U.S.C. 103 as being unpatentable over Yamashita in view of Bachmann et al. (US 7,089,148, hereinafter "Bachmann"). Applicant respectfully traverses the rejections.

Independent Claim 1 is Allowable

Claim 1 recites the following:

> 1. An electronic device subject to movements and rotations in dynamic environments, comprising:
> a motion sensor module comprising a rotation sensor and an accelerometer, both of which are subjected to the movements and the rotations in the dynamic environments, the rotation sensor having sensor circuitry configured to generate a first signal set comprising measured angular velocities ωx, ωy, ωz, the accelerometer having accelerometer circuitry configured to generate a second signal set comprising measured axial accelerations Ax, Ay, Az; and
> a computing processor having processor circuitry configured to calculate a resulting deviation comprising resultant angles in a spatial reference frame by:
> providing a current state associated with the first signal set;

> comparing a predicted measurement based on the first signal set to a measurement of the second signal set such that a comparison result is provided as a measured state; and
>
> obtaining an update state based on the current state and the measured state;
>
> wherein ***the computing processor is further configured to translate deviation angles of the resulting deviation to a movement pattern in a display reference frame of a display based on a user-adjustable sensitivity input***.

(Emphasis added).

Applicant respectfully asserts that the cited art is legally deficient for rendering claim 1 unpatentable. In particular, the cited art (either individually or in combination) does not teach or reasonably suggest at least the features emphasized above in claim 1, including "the computing processor is further configured to translate deviation angles of the resulting deviation to a movement pattern in a display reference frame of a display based on a user-adjustable sensitivity input". Support for this feature may be found at various portions of the application as originally filed, such as at [0059]-[0061], for example. Thus, no new matter is added.

With respect to the cited art, Yamashita and Bachmann are not involved with a user-adjustable sensitivity input, much less a computing processor configured to translate deviation angles of the resulting deviation to a movement pattern in a display reference frame of a display based on a user-adjustable sensitivity input. Therefore, Applicant respectfully asserts that claim 1 is in condition for allowance.

Independent Claim 9 is Allowable

Claim 9 recites the following:

> 9. A method for determining movements and rotations in dynamic environments, comprising:

> generating, with a rotation sensor having sensor circuitry, a first signal set comprising measured angular velocities ωx, ωy, ωz;
>
> generating, with an accelerometer having accelerometer circuitry, a second signal set comprising measured axial accelerations Ax, Ay, Az; and
>
> calculating, with a computing processor having processor circuitry, a resulting deviation comprising resultant angles in a spatial reference frame by:
>
> providing a current state associated with the first signal set;
>
> comparing a predicted measurement based on the first signal set and a measurement of the second signal set such that a comparison result is provided as a measured state;
>
> obtaining an updated state based on the current state and the measured state; and
>
> ***translating deviation angles of the resulting deviation to a movement pattern in a display reference frame of a display based on a user-adjustable sensitivity input***.

(Emphasis added).

Applicant respectfully asserts that the cited art is legally deficient for rendering claim 9 unpatentable. In particular, the cited art (either individually or in combination) does not teach or reasonably suggest at least the features emphasized above in claim 9, including "translating deviation angles of the resulting deviation to a movement pattern in a display reference frame of a display based on a user-adjustable sensitivity input". Support for this feature may be found at various portions of the application as originally filed, such as at [0059]-[0061], for example. Thus, no new matter is added.

With respect to the cited art, Yamashita and Bachmann are not involved with a user-adjustable sensitivity input, much less translating deviation angles of the resulting deviation to a movement pattern in a display reference frame of a display based on a user-adjustable sensitivity input. Therefore, Applicant respectfully asserts that claim 9 is in condition for allowance.

Dependent Claims are Allowable

Applicant respectfully asserts that the pending dependent claims are allowable for incorporating the features of their respective independent claims. Additionally, these dependent claims recite other features that may serve as independent bases for patentablity.

CONCLUSION

Based on the above, it is respectfully submitted that this application is in condition for allowance.

Should the Examiner feel that further discussion of the application would be conducive to prosecution and allowance of the application, please do not hesitate to contact the undersigned by phone (678-483-8893).

No fee is believed to be due in connection with this submission. If, however, any fee is believed to be due, you are hereby authorized to charge any such fee to deposit account No. 50-5954.

Respectfully submitted,

McClure, Qualey & Rodack, LLP

/M.PaulQualey,Jr./

By: _____

M. Paul Qualey, Jr., Reg. No. 43,024

Customer No. 109673

UNITED STATES PATENT AND TRADEMARK OFFICE

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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
15/611,970	06/02/2017	Shun-Nan Liou	250303-1021	5932

109673 7590 05/24/2019

McClure, Qualey & Rodack, LLP
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EXAMINER	
EARLES, BRYAN E	

ART UNIT	PAPER NUMBER
2625	

NOTIFICATION DATE	DELIVERY MODE
05/24/2019	ELECTRONIC

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.

Notice of the Office communication was sent electronically on above-indicated "Notification Date" to the following e-mail address(es):

dan.mcclure@mqrlaw.com
gina.silverio@mqrlaw.com
uspatents@mqrlaw.com

Office Action Summary	Application No. 15/611,970	Applicant(s) Liou et al.	
	Examiner BRYAN EARLES	Art Unit 2625	AIA (FITF) Status No

-- 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 MONTHS 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 10 April 2019.

☐ A declaration(s)/affidavit(s) under **37 CFR 1.130(b)** was/were filed on _____.

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) 1-16 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) 1-16 is/are rejected.

8) ☐ Claim(s) _____ is/are objected to.

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

* If any claims have been determined allowable, 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.**

Application Papers

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

11)☐ 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).

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).

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)).

** 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) ☐ Information Disclosure Statement(s) (PTO/SB/08a and/or PTO/SB/08b) Paper No(s)/Mail Date _____.

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

4) ☐ Other: _____.

DETAILED ACTION

Notice of Pre-AIA or AIA Status

The present application is being examined under the pre-AIA first to invent provisions.

The Office acknowledges the amendment dated 10 April 2019, in which:

Claims **1-16** are currently pending.

Claims **1 and 9** are amended.

Claim Rejections - 35 USC § 103

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

> A patent for a claimed invention may not be obtained, notwithstanding that the claimed invention is not identically disclosed as set forth in section 102 of this title, if the differences between the claimed invention and the prior art are such that the claimed invention as a whole would have been obvious before the effective filing date of the claimed invention to a person having ordinary skill in the art to which the claimed invention pertains. Patentability shall not be negated by the manner in which the invention was made.

Claims 1 and 9 are rejected under 35 U.S.C. 103 as being unpatentable over Yamashita et al. (US 8,267,785, hereinafter "Yamashita") in view of Lu et al. (US 2009/0062005).

With respect to **claims 9 and 1**, Yamashita teaches a method for determining movements and rotations in dynamic environments, comprising:

generating, with a rotation sensor having sensor circuitry, a first signal set comprising measured angular velocities ωx, ωy, ωz (Yamashita: Fig. 7, gyrosensor unit 7 includes gyrosensors 55 and 56 for producing tri-axial angular velocity data);

generating, with an accelerometer having accelerometer circuitry, a second signal set comprising measured axial accelerations Ax, Ay, Az (Yamashita: Fig. 7; Col. 12, line 47 – Col. 13, line 10, output from the acceleration sensor 37 represented as a three-dimensional vector (ax,ay,az) in an XYZ coordinate system); and

calculating, with a computing processor having processor circuitry, a resulting deviation comprising resultant angles in a spatial reference frame (Yamashita: Col. 12, line 62 – Col. 13, line 24; Col. 14, line 18 – Col. 15, line 8) by:

providing a current state associated with the first signal set (Yamashita: Fig. 23, gyrosensor unit 7 outputs angular velocity d1);

comparing (Paragraph [0004], of Applicant's Specification, "The term of "comparison" of the present invention may generally refer to the calculating and obtaining of the actual deviation angles of the 3D pointing device …") a predicted measurement based on the first signal set and a measurement of the second signal set such that a comparison result is provided as a measured state (Yamashita: Fig. 23; Col. 19, lines 1-8, angular velocity d1 and acceleration d2 are input to the process of posture estimation p1); and

obtaining an updated state based on the current state and the measured state (Yamashita: Fig. 23; Col. 19, lines 8-13, a posture vector represented by the angular velocity is corrected by a vector represented by the acceleration to calculate the posture of the input device 8).

Yamashita fails to *expressly* disclose:

wherein the computing processor is further configured to translate deviation angles of the resulting deviation to a movement pattern in a display reference frame of a display *based on a user-adjustable sensitivity input*

However, Lu teaches:

wherein the computing processor is further configured to translate deviation angles of the resulting deviation to a movement pattern in a display reference frame of a display *based on a user-adjustable sensitivity input* (Lu: Figs. 4A-B; Para. [0046]: the inertia interactive apparatus and system includes a switch selection for enabling users to adjust the sensing range and sensitivity dynamically according to various user statuses).

Therefore, it would be obvious to one of ordinary skill in the art at the time the invention was made to modify the method, as taught by Yamashita, to incorporate the switch selection, as taught by Lu, in order to enable users to adjust the sensing range and sensitivity dynamically (Lu: Para. [0009]).

Claims 2-8 and 10-16 are rejected under 35 U.S.C. 103 as being unpatentable over Yamashita and Lu, as applied to claims 1 and 9 above, and further in view of Bachmann et al. (US 7,089,148, hereinafter "Bachmann").

With respect to **claims 10 and 2**, Yamashita and Lu teaches the method of claim 9.

Yamashita does not disclose:

a magnetometer having magnetometer circuitry, a third signal set comprising measured magnetism Mx, My, Mz.

However, Bachmann discloses:

a magnetometer having magnetometer circuitry, a third signal set comprising measured magnetism Mx, My, Mz (Bachmann: Fig. 3, magnetometers 38 generate magnetisms b1, b2, b3); and

calculating the resulting deviation further comprises comparing the predicted measurement obtained based on the update state and the first signal set to a measurement of the third signal set (Bachmann: Para. [0055] – [0056]; Fig. 6a, step 609).

Therefore, it would be obvious to one of ordinary skill in the art at the time the invention was made to modify the method, as taught by Yamashita, to incorporate additional types of detectors into the motion sensing module, as taught by Bachmann, in order overcome the shortcomings of individual detector types by capitalizing on the advantages of each (Bachmann: Col. 4, lines 15-30, Col. 13, lines 1-10).

With respect to **claims 11 and 3**, the combination of Yamashita as modified by Bachmann teach the method of claim 10,

wherein the measured state correlates to a comparison result between the predicted measurement, and the measurement of the second signal set and the measurement of the third signal set (Bachmann: Col. 9, lines 21-48; Fig. 3, estimated orientation quaternion 39 is correlated with the measurement vector 34).

With respect to **claims 12 and 4**, the combination of Yamashita as modified by Bachmann teach the method of claim 10, wherein calculating the resulting deviation further comprises:

utilizing a data association model to determine whether compensation is needed to obtain the update state based on the measured axial accelerations or the measured magnetisms (Bachmann: Col. 9, line 49 – Col. 10, line 45; Col. 13, lines 1-62; Fig. 3, detector data is iteratively weighted to place greater or less reliance on data received from the detectors 31, 32, 33); and

obtaining the update state in response to determining that the compensation is needed (Bachmann: Col. 13, lines 1-62, defining the error vector epsilon based on a threshold parameter .rho. to either emphasize magnetometer data or places greater weight on accelerometer data in order to determine an updated orientation).

With respect to **claims 13 and 5**, the combination of Yamashita as modified by Bachmann teach the method of claim 10, wherein utilizing **the** data association model further comprises:

comparing the measured state associated with at least the second signal set or the third signal set with a predicted measurement calculated and obtained from the current state and associated with at least the first signal set (Bachmann: Figs. 5(a) – 5(b), steps 514 – 517); and

determining whether compensation is needed to obtain the update state based on whether the comparison result is a predetermined value or within a predetermined

range (Bachmann: Fig. 5(b), step 517 minimizing the criterion function to output an orientation error estimate).

With respect to **claims 14 and 6**, the combination of Yamashita as modified by Bachmann teach the method of claim 10, wherein calculating the resulting deviation further comprises:

calculating the measured state associated with the third signal set by obtaining measured yaw based on measured magnetism Mx, My, Mz (Bachmann: Fig. 3, 32); and

calculating predicted yaw associated with the predicted measurement, wherein the predicted measurement is calculated and obtained from the update state and associated with the first signal set (Bachmann: Fig. 3, an estimated orientation quaternion 39 is correlated with the measurement vector 34; Col. 16, line 40 – Col. 17, line 5, each iteration produces an updated estimated quaternion yielding a new estimate of sensor orientation including azimuth, elevation and roll angles in the sensor coordinate system).

With respect to **claims 15 and 7**, the combination of Yamashita as modified by Bachmann teach the method of claim 14,

wherein the measured yaw is *calculated and obtained* based on the measured state associated with the third signal set, a temporary pitch value, and a temporary roll value; and

the temporary pitch value and the temporary roll value are calculated and converted from the update state (Bachmann: Fig. 3, includes intermediate sensor

orientations represented in the form of quaternions (e.g., old and new q.sub.circumflex); Col. 7, lines 4-31; transforming estimated body rates to updated Euler Rates or Quaternion Rates).

With respect to **claims 16 and 8**, the combination of Yamashita as modified by Bachmann and Horton teach the method of claim 14, wherein calculating the resulting deviation further comprises:

obtaining a first update state based on the current state associated with the first signal set and a first measured state, wherein the first measured state is correlated to the measurement of the second signal set and a first predicted measurement calculated and obtained from the current state and associated with the first signal set (Bachmann: Fig. 3, an estimated orientation quaternion 39 is correlated with the measurement vector 34 and the angular rate information 37; Col. 16, line 40 – Col. 17, line 5, each iteration computes an updated estimated quaternion representative of a new estimate of sensor orientation); and

obtaining a second update state based on the first update state and a second measured state, wherein the second measured state is correlated to the measured yaw and a predicted yaw associated with a second predicted measurement, which is calculated and obtained from the current state or the first update state and associated with the first signal set, wherein the resultant angles are based on the second update state (Bachmann: Col. 9, lines 22-32; Fig. 3, a second updated state is interpreted as a subsequent iteration using the previously updated state; Equation 16).

Response to Arguments/Amendments/Remarks

Applicant's arguments with respect to claims 1-16 have been considered but are moot because the arguments do not apply to the combination of references used in the current rejection.

Conclusion

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.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to BRYAN EARLES whose telephone number is (571)272-4628. The examiner can normally be reached on Monday - Thursday at 7:30am - 5:00pm.

Examiner interviews are available via telephone, in-person, and video conferencing using a USPTO supplied web-based collaboration tool. To schedule an interview, applicant is encouraged to use the USPTO Automated Interview Request (AIR) at http://www.uspto.gov/interviewpractice.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, William Boddie can be reached on 571-272-0666. 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.

/BRYAN EARLES/
Primary Examiner, Art Unit 2625

Notice of References Cited	Application/Control No. 15/611,970	Applicant(s)/Patent Under Reexamination Liou et al.	
	Examiner BRYAN EARLES	Art Unit 2625	Page 1 of 1

U.S. PATENT DOCUMENTS

*		Document Number Country Code-Number-Kind Code	Date MM-YYYY	Name	CPC Classification	US Classification
*	A	US-20090062005-A1	03-2009	Lu; Ying-Ko	A63F13/10	463/37
	B					
	C					
	D					
	E					
	F					
	G					
	H					
	I					
	J					
	K					
	L					
	M					

FOREIGN PATENT DOCUMENTS

*		Document Number Country Code-Number-Kind Code	Date MM-YYYY	Country	Name	CPC 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.

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

PTO/SB/30EFS (02-18)
Approved for use through 11/30/2020. 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.

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

Application Number	15611970	Filing Date	2017-06-02	Docket Number (if applicable)	250303-1021	Art Unit	2625
First Named Inventor	Shun-Nan LIOU, et al.			Examiner Name	Earles, Bryan E.		

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 505954

SIGNATURE OF APPLICANT, ATTORNEY, OR AGENT REQUIRED

☒ Patent Practitioner Signature

Applicant Signature

EFS - Web 2.1.16

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

PTO/SB/30EFS (02-18)
Approved for use through 11/30/2020. 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	/M.PaulQualey,Jr./	Date (YYYY-MM-DD)	2019-08-23
Name	M. Paul Qualey, Jr.	Registration Number	43024

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.

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.

Electronic Patent Application Fee Transmittal	
Application Number:	15611970
Filing Date:	02-Jun-2017
Title of Invention:	ELECTRONIC DEVICE FOR USE IN MOTION DETECTION AND METHOD FOR OBTAINING RESULTANT DEVIATION THEREOF
First Named Inventor/Applicant Name:	Shun-Nan Liou
Filer:	Michael P. Qualey/Brooke French
Attorney Docket Number:	250303-1021
Filed as Small Entity	
Filing Fees for Utility under 35 USC 111(a)	

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($)
Miscellaneous:				
RCE- 1ST REQUEST	2801	1	650	650
		Total in USD ($)		**650**

Electronic Acknowledgement Receipt	
EFS ID:	36963233
Application Number:	15611970
International Application Number:	
Confirmation Number:	5932
Title of Invention:	ELECTRONIC DEVICE FOR USE IN MOTION DETECTION AND METHOD FOR OBTAINING RESULTANT DEVIATION THEREOF
First Named Inventor/Applicant Name:	Shun-Nan Liou
Customer Number:	109673
Filer:	Michael P. Qualey/Brooke French
Filer Authorized By:	Michael P. Qualey
Attorney Docket Number:	250303-1021
Receipt Date:	23-AUG-2019
Filing Date:	02-JUN-2017
Time Stamp:	14:06:43
Application Type:	Utility under 35 USC 111(a)

Payment information:

Submitted with Payment	yes
Payment Type	CARD
Payment was successfully received in RAM	$650
RAM confirmation Number	E20198ME07049960
Deposit Account	505954
Authorized User	Brooke French
The Director of the USPTO is hereby authorized to charge indicated fees and credit any overpayment as follows: 37 CFR 1.21 (Miscellaneous fees and charges)	

File Listing:

Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
1	Request for Continued Examination (RCE)	00709478.PDF	1350176 2a08e2eb9d9de788d6cc467851afd9b09b264190	no	3
Warnings:					
Information:					
2	Amendment Submitted/Entered with Filing of CPA/RCE	00709486.PDF	136496 ac39556d114859615f4854caa249f452cf0779bf	no	14
Warnings:					
Information:					
3	Fee Worksheet (SB06)	fee-info.pdf	30526 0d93af28aca93f2bb0904224aab9b74429f24364	no	2
Warnings:					
Information:					
		Total Files Size (in bytes):	1517198		

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.

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

First Named Inventor:

Liou, et al.

Serial No.: 15/611,970

Filed: June 2, 2017

Confirmation No.: 5932

Group Art Unit: 2625

Examiner: Earles, Bryan E.

MQR Ref.: 250303-1021
Client Ref.: CWM11002-1-US

For: Electronic Device for Use in Motion Detection and Method for Obtaining Resultant Deviation Thereof

RESPONSE TO FINAL OFFICE ACTION

Mail Stop: RCE
Commissioner for Patents
P.O. Box 1450
Alexandria, Virginia 22313-1450

Director:

The Office Action mailed on May 24, 2019 has been carefully considered. In response, Applicant submits the following remarks and Request for Continued Examination.

AMENDMENTS

In the Claims

1. (Currently Amended) An electronic device subject to movements and rotations in dynamic environments, comprising:

a motion sensor module comprising a rotation sensor and an accelerometer, both of which are subjected to the movements and the rotations in the dynamic environments, the rotation sensor having sensor circuitry configured to generate a first signal set comprising measured angular velocities ωx, ωy, ωz, the accelerometer having accelerometer circuitry configured to generate a second signal set comprising measured axial accelerations Ax, Ay, Az; and

a computing processor having processor circuitry configured to calculate a resulting deviation comprising resultant angles in a spatial reference frame by:

providing a previous state corresponding to time T-1;

providing a current state, corresponding to time T, associated with the first signal set and the previous state;

comparing a predicted measurement, corresponding to time T, based on the first signal set to a measurement, corresponding to time T, of the second signal set such that a comparison result is provided as a measured state corresponding to time T; [[and]]

obtaining an update state, corresponding to time T, based on the current state and the measured state;

providing the resulting deviation based on the update state; and

using the update state as a next occurrence of the previous state

~~wherein the computing processor is further configured to translate deviation angles of the resulting deviation to a movement pattern in a display reference frame of a display based on a user-adjustable sensitivity input~~.

2. (Original) The electronic device of claim 1, wherein:

the motion sensor module further comprises a magnetometer having magnetometer circuitry configured to generate a third signal set comprising measured magnetism Mx, My, Mz; and

in calculating the resulting deviation, the computing processor is further configured to compare the predicted measurement obtained based on the update state and the first signal set to a measurement of the third signal set.

3. (Original) The electronic device of claim 2, wherein the measured state correlates to a comparison result between the predicted measurement, and the measurement of the second signal set and the measurement of the third signal set.

4. (Original) The electronic device of claim 3, wherein, in calculating the resulting deviation, the computing processor is further configured to:

utilize a data association model to determine whether compensation is needed to obtain the update state based on the measured axial accelerations or the measured magnetisms; and

obtain the update state in response to determining that the compensation is needed.

5. (Original) The electronic device of claim 4, wherein, in calculating the resulting deviation, the computing processor is further configured to utilize the data association model to:

compare the measured state associated with at least the second signal set or the third signal set with a predicted measurement calculated and obtained from the current state and associated with at least the first signal set; and

determine whether compensation is needed to obtain the update state based on whether the comparison result is a predetermined value or within a predetermined range.

6. (Original) The electronic device of claim 3, wherein computing processor is further configured to:

calculate the measured state associated with the third signal set by obtaining measured yaw based on measured magnetism Mx, My, Mz; and

calculate predicted yaw associated with the predicted measurement, wherein the predicted measurement is calculated and obtained from the update state and associated with the first signal set.

7. (Original) The electronic device of claim 6, wherein the measured yaw is calculated and obtained based on the measured state associated with the third signal set, a temporary pitch value, and a temporary roll value, wherein the temporary pitch value and the temporary roll value are calculated and converted from the update state.

8. (Original) The electronic device of claim 6, wherein, in calculating the resulting deviation, the computing processor is further configured to:

obtain a first update state based on the current state associated with the first signal set and a first measured state, wherein the first measured state is correlated to the measurement of the second signal set and a first predicted measurement calculated and obtained from the current state and associated with the first signal set; and

obtain a second update state based on the first update state and a second measured state, wherein the second measured state is correlated to the measured yaw and a predicted yaw associated with a second predicted measurement, which is calculated and obtained from the current state or the first update state and associated with the first signal set, wherein the resultant angles are based on the second update state.

9. (Currently Amended) A method for determining movements and rotations in dynamic environments, comprising:

generating, with a rotation sensor having sensor circuitry, a first signal set comprising measured angular velocities ωx, ωy, ωz;

generating, with an accelerometer having accelerometer circuitry, a second signal set comprising measured axial accelerations Ax, Ay, Az; and

calculating, with a computing processor having processor circuitry, a resulting deviation comprising resultant angles in a spatial reference frame by:

providing a previous state corresponding to time T-1;

providing a current state, corresponding to time T, associated with the first signal set and the previous state;

comparing a predicted measurement, corresponding to time T, based on the first signal set to a measurement, corresponding to time T, of the second signal set such that a comparison result is provided as a measured state corresponding to time T;

obtaining an ~~updated~~ update state, corresponding to time T, based on the current state and the measured state;

providing the resulting deviation based on the update state; and

using the update state as a next occurrence of the previous state

~~translating deviation angles of the resulting deviation to a movement pattern in a display reference frame of a display based on a user-adjustable sensitivity input~~.

10. (Original) The method of claim 9, wherein:

the method further comprises generating, with a magnetometer having magnetometer circuitry, a third signal set comprising measured magnetism Mx, My, Mz; and

calculating the resulting deviation further comprises comparing the predicted measurement obtained based on the update state and the first signal set to a measurement of the third signal set.

11. (Original) The method of claim 10, wherein the measured state correlates to a comparison result between the predicted measurement, and the measurement of the second signal set and the measurement of the third signal set.

12. (Original)The method of claim 10, wherein calculating the resulting deviation further comprises:

utilizing a data association model to determine whether compensation is needed to obtain the update state based on the measured axial accelerations or the measured magnetisms; and

obtaining the update state in response to determining that the compensation is needed.

13. (Original) The method of claim 10, wherein utilizing the data association model further comprises:

comparing the measured state associated with at least the second signal set or the third signal set with a predicted measurement calculated and obtained from the current state and associated with at least the first signal set; and

determining whether compensation is needed to obtain the update state based on whether the comparison result is a predetermined value or within a predetermined range.

14. (Original) The method of claim 10, wherein calculating the resulting deviation further comprises:

calculating the measured state associated with the third signal set by obtaining measured yaw based on measured magnetism Mx, My, Mz; and

calculating predicted yaw associated with the predicted measurement, wherein the predicted measurement is calculated and obtained from the update state and associated with the first signal set.

15. (Original) The method of claim 14, wherein:

the measured yaw is calculated and obtained based on the measured state associated with the third signal set, a temporary pitch value, and a temporary roll value; and

the temporary pitch value and the temporary roll value are calculated and converted from the update state.

16. (Original) The method of claim 14, wherein calculating the resulting deviation further comprises:

obtaining a first update state based on the current state associated with the first signal set and a first measured state, wherein the first measured state is correlated to the measurement of the second signal set and a first predicted measurement calculated and obtained from the current state and associated with the first signal set; and

obtaining a second update state based on the first update state and a second measured state, wherein the second measured state is correlated to the measured yaw and a predicted yaw associated with a second predicted measurement, which is calculated

and obtained from the current state or the first update state and associated with the first signal set, wherein the resultant angles are based on the second update state.

REMARKS

The Examiner is thanked for the thorough examination of the present application. Upon entry of the amendments in this response, claims 1 - 16 remain pending. Reconsideration of the rejections is respectfully requested.

Claim Rejections - 35 USC §103

The Office Action indicates that claims 1 and 9 are rejected under 35 U.S.C. 103 as allegedly being unpatentable by Yamashita et al. (US 8,267,785, hereinafter "Yamashita") in view of Lu et al. US 2009/0062005, hereinafter "Lu"). Additionally, the Office Action indicates that claims 2-8 and 10-16 are rejected under 35 U.S.C. 103 as being unpatentable over Yamashita and Lu, in view of Bachmann et al. (US 7,089,148, hereinafter "Bachmann"). Applicant respectfully traverses the rejections.

Independent Claim 1 is Allowable

Claim 1 recites the following:

> 1. An electronic device subject to movements and rotations in dynamic environments, comprising:
> a motion sensor module comprising a rotation sensor and an accelerometer, both of which are subjected to the movements and the rotations in the dynamic environments, the rotation sensor having sensor circuitry configured to generate a first signal set comprising measured angular velocities ωx, ωy, ωz, the accelerometer having accelerometer circuitry configured to generate a second signal set comprising measured axial accelerations Ax, Ay, Az; and
> ***a computing processor having processor circuitry configured to calculate a resulting deviation comprising resultant angles in a spatial reference frame by:***
> ***providing a previous state corresponding to time T-1;***
> ***providing a current state, corresponding to time T, associated with the first signal set and the previous state;***

comparing a predicted measurement, corresponding to time T, based on the first signal set to a measurement, corresponding to time T, of the second signal set such that a comparison result is provided as a measured state corresponding to time T;

obtaining an update state, corresponding to time T, based on the current state and the measured state;

providing the resulting deviation based on the update state; and

using the update state as a next occurrence of the previous state.

(Emphasis added).

Applicant respectfully asserts that the cited art is legally deficient for rendering claim 1 unpatentable. In particular, the cited art (either individually or in combination) does not teach or reasonably suggest at least the following features recited in claim 1: "providing a previous state corresponding to time T-1"; "providing a current state, corresponding to time T, associated with the first signal set and the previous state"; "comparing a predicted measurement, corresponding to time T, based on the first signal set to a measurement, corresponding to time T, of the second signal set such that a comparison result is provided as a measured state corresponding to time T"; "obtaining an update state, corresponding to time T, based on the current state and the measured state"; "providing the resulting deviation based on the update state"; and "using the update state as a next occurrence of the previous state". Of note, the cited art does not appear to be involved with the various states and the associated times recited in claim 1.

With respect to the cited art, it appears that the Office has interpreted Figure 23 of Yamashita as disclosing many of the recited states. However, as best understood by Applicant, the present interpretation does not appear to account for numerous aspects of the claim language, including Applicant's express references to time (T-1 and T),

measurements (values corresponding to sensor signals) and predicted measurements (calculated values). The other references appear inadequate for remedying these deficiencies. Therefore, Applicant respectfully asserts that the rejections are improper, particularly in light of the recitations in amended claim 1.

Independent Claim 9 is Allowable

Claim 9 recites the following:

> 9. A method for determining movements and rotations in dynamic environments, comprising:
> generating, with a rotation sensor having sensor circuitry, a first signal set comprising measured angular velocities ωx, ωy, ωz;
> generating, with an accelerometer having accelerometer circuitry, a second signal set comprising measured axial accelerations Ax, Ay, Az; and
> calculating, with a computing processor having processor circuitry, a resulting deviation comprising resultant angles in a spatial reference frame by:
> ***providing a previous state corresponding to time T-1;***
> ***providing a current state, corresponding to time T, associated with the first signal set and the previous state;***
> ***comparing a predicted measurement, corresponding to time T, based on the first signal set to a measurement, corresponding to time T, of the second signal set such that a comparison result is provided as a measured state corresponding to time T;***
> ***obtaining an update state, corresponding to time T, based on the current state and the measured state;***
> ***providing the resulting deviation based on the update state; and***
> ***using the update state as a next occurrence of the previous state***.

(Emphasis added).

Applicant respectfully asserts that the cited art is legally deficient for rendering claim 9 unpatentable. In particular, the cited art (either individually or in combination) does not teach or reasonably suggest at least the following features recited in claim 9: "providing a

previous state corresponding to time T-1"; "providing a current state, corresponding to time T, associated with the first signal set and the previous state"; "comparing a predicted measurement, corresponding to time T, based on the first signal set to a measurement, corresponding to time T, of the second signal set such that a comparison result is provided as a measured state corresponding to time T"; "obtaining an update state, corresponding to time T, based on the current state and the measured state"; "providing the resulting deviation based on the update state"; and "using the update state as a next occurrence of the previous state". Specifically, the cited art does not appear to be involved with the various states and the associated times recited in claim 9.

With respect to the cited art, it appears that the Office has interpreted Figure 23 of Yamashita as disclosing many of the recited states. However, as best understood by Applicant, the present interpretation does not appear to account for numerous aspects of the claim language, including Applicant's express references to time (T-1 and T), measurements (values corresponding to sensor signals) and predicted measurements (calculated values). The other references appear inadequate for remedying these deficiencies. Therefore, Applicant respectfully asserts that the rejections are improper, particularly in light of the recitations in amended claim 9.

Dependent Claims are Allowable

Applicant respectfully asserts that the pending dependent claims are allowable for incorporating the features of their respective independent claims. Additionally, these dependent claims recite other features that may serve as independent bases for patentability.

CONCLUSION

Based on the above, it is respectfully submitted that this application is in condition for allowance.

Should the Examiner feel that further discussion of the application would be conducive to prosecution and allowance of the application, please do not hesitate to contact the undersigned by phone (678-483-8893).

No fee is believed to be due in connection with this submission other than those already submitted. If, however, any fee is believed to be due, you are hereby authorized to charge any such fee to deposit account No. 50-5954.

Respectfully submitted,

McClure, Qualey & Rodack, LLP

/M.PaulQualey,Jr./

By: _____

M. Paul Qualey, Jr., Reg. No. 43,024

Customer No. 109673

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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
15/611,970	06/02/2017	Shun-Nan Liou	250303-1021	5932

109673 7590 09/12/2019

McClure, Qualey & Rodack, LLP
280 Interstate North Circle SE
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Atlanta, GA 30339

EXAMINER	
EARLES, BRYAN E	

ART UNIT	PAPER NUMBER
2625	

NOTIFICATION DATE	DELIVERY MODE
09/12/2019	ELECTRONIC

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.

Notice of the Office communication was sent electronically on above-indicated "Notification Date" to the following e-mail address(es):

dan.mcclure@mqrlaw.com
terri.logan@mqrlaw.com
uspatents@mqrlaw.com

PTOL-90A (Rev. 04/07)

Office Action Summary	**Application No.** 15/611,970	**Applicant(s)** Liou et al.	
	Examiner BRYAN EARLES	**Art Unit** 2625	**AIA (FITF) Status** No

-- 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 MONTHS 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 23 August 2019.

☐ A declaration(s)/affidavit(s) under **37 CFR 1.130(b)** was/were filed on _____.

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) 1-16 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) 1-16 is/are rejected.

8) ☐ Claim(s) _____ is/are objected to.

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

* If any claims have been determined allowable, 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.**

Application Papers

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

11)☐ 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).

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).

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)).

** 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) ☐ Information Disclosure Statement(s) (PTO/SB/08a and/or PTO/SB/08b) Paper No(s)/Mail Date _____.

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

4) ☐ Other: _____.

DETAILED ACTION

Notice of Pre-AIA or AIA Status

The present application is being examined under the pre-AIA first to invent provisions.

The Office acknowledges the Request for Continued Examination (RCE) dated 23 August 2019, in which:

Claims **1-16** are currently pending.

Claims **1 and 9** are amended.

Claim Rejections - 35 USC § 112

The following is a quotation of 35 U.S.C. 112 (pre-AIA), second paragraph:
The specification shall conclude with one or more claims particularly pointing out and distinctly claiming the subject matter which the applicant regards as his invention.

Claims 1-16 are rejected under 35 U.S.C. 112 (pre-AIA), second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which the inventor or a joint inventor, or for pre-AIA the applicant regards as the invention.

Apparatus claim 1 recites a comparing operation and method claim 9 recites the same subject matter in the form of a process. Applicant's Specification, as submitted, at paragraph [0073], discloses,

> it is preferable to compare the second quaternion in relation to the measured angular velocities of the current state at present time T with the measured axial accelerations Ax, Ay, Az, the predicted axial accelerations Ax', Ay', Az', the measured yaw angle and the predicted yaw angle also at present time T. Following which, a result may be obtained...

The limitation regarding the comparing step is indefinite because it requires a nonsensical 'apples-to-oranges' comparison for which there is no reasonable certainty as to what the inventor regards as the invention. Claim 1 requires an electronic device "comparing a predicted measurement, corresponding to time T, based on the first signal set [comprising angular velocities ωx, ωy, ωz] to a measurement, corresponding to time T, of the second signal set [comprising axial accelerations Ax, Ay, Az] such that a comparison result is provided as a measured state." These two signal sets measure different physical properties with different units. The first signal set provides "angular velocities ωx, ωy, ωz" (i.e., angular speeds) measured in terms of rotations per time (e.g., revolutions per minute). The second signal set provides "axial accelerations Ax, Ay, Az" measured in terms of distance per time squared (e.g., m/s^2). It does not make mathematical sense to "compare" two measurements that represent different quantities and units of measure, so one of ordinary skill in the art is left without reasonable certainty as to what is required to perform the claimed comparison. One can no more compare angular velocities to axial accelerations than one could compare 20 inches to 5 seconds. Therefore, claims 1 and 9 are indefinite. Additionally, claims 2-8 and 10-16 are rejected herewith by virtue of claim dependency.

Claim Rejections - 35 USC § 102

The following is a quotation of the appropriate paragraphs of pre-AIA 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.

Claims 1 and 9 are rejected under pre-AIA 35 U.S.C. 102(b) as being anticipated by Yamashita et al. (US 8,267,785, hereinafter "Yamashita").

With respect to **claims 9 and 1** (Currently Amended), Yamashita teaches a method for determining movements and rotations in dynamic environments, comprising:

generating, with a rotation sensor having sensor circuitry, a first signal set comprising measured angular velocities ωx, ωy, ωz (Yamashita: Fig. 7, gyrosensor unit 7 includes gyrosensors 55 and 56 for producing tri-axial angular velocity data);

generating, with an accelerometer having accelerometer circuitry, a second signal set comprising measured axial accelerations Ax, Ay, Az (Yamashita: Fig. 7; Col. 12, line 47 – Col. 13, line 10, output from the acceleration sensor 37 represented as a three-dimensional vector (ax,ay,az) in an XYZ coordinate system); and

calculating, with a computing processor having processor circuitry, a resulting deviation comprising resultant angles in a spatial reference frame (Yamashita: Fig. 25; Col. 12, line 62 – Col. 13, line 24; Col. 14, line 18 – Col. 15, line 8) by:

providing a previous state corresponding to time T-1 (Yamashita: Fig. 25; Col. 22, lines 32-39, a previous state is interpreted as the motion data obtained by the processing in the immediately previous frame);

providing a current state, corresponding to time T, associated with the first signal set (Yamashita: Fig. 23, gyrosensor unit 7 outputs angular velocity d1) and the previous state (Yamashita: Col. 21, line 67 – Col. 22, line 6; Col. 22, lines 31-39, a current state

is interpreted as the motion data including the angular velocities obtained by the processing in the current frame);

comparing (Paragraph [0004], of Applicant's Specification, "The term of "comparison" of the present invention may generally refer to the calculating and obtaining of the actual deviation angles of the 3D pointing device …") a predicted measurement, corresponding to time T, based on the first signal set and a measurement, corresponding to time T, of the second signal set such that a comparison result is provided as a measured state, corresponding to time T (Yamashita: Fig. 23; Col. 19, lines 1-8, angular velocity d1 and acceleration d2 are input to the process of posture estimation p1);

obtaining an update state, corresponding to time T, based on the current state and the measured state (Yamashita: Figs. 23 and 25; Col. 21, line 61 – Col. 22, line 6, a posture vector represented by the angular velocity is corrected using a vector represented by the acceleration to calculate the posture of the input device 8);

providing the resulting deviation based on the update state (Yamashita: Fig. 25; Col. 4, lines 31-44, step S5 calculating a rotational motion vector Rs based on the angular velocity data 123, the angular acceleration data 130 and the motion component data 129 by applying expression 6; the change in vector Rs over time is illustrated in Fig. 21); and

using the update state as a next occurrence of the previous state (Yamashita: Fig. 25, calculations S2-S6 are updated for each iteration step s10 relative to the processing obtained in the previous frame, for example, the angular acceleration is

calculated by using the time series difference between the angular velocity of at a current time step and the angular velocity at a previous time step).

Claim Rejections - 35 USC § 103

The following is a quotation of pre-AIA 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, 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 2-8 and 10-16 are rejected under 35 U.S.C. 103 as being unpatentable over Yamashita in view of Bachmann et al. (US 7,089,148, hereinafter "Bachmann").

With respect to **claims 10 and 2**, Yamashita teaches the method of claim 9.

Yamashita does not disclose:

a magnetometer having magnetometer circuitry, a third signal set comprising measured magnetism Mx, My, Mz.

However, Bachmann discloses:

a magnetometer having magnetometer circuitry, a third signal set comprising measured magnetism Mx, My, Mz (Bachmann: Fig. 3, magnetometers 38 generate magnetisms b1, b2, b3); and

calculating the resulting deviation further comprises comparing the predicted measurement obtained based on the update state and the first signal set to a

measurement of the third signal set (Bachmann: Para. [0055] – [0056]; Fig. 6a, step 609).

Therefore, it would be obvious to one of ordinary skill in the art at the time the invention was made to modify the method, as taught by Yamashita, to incorporate additional types of detectors into the motion sensing module, as taught by Bachmann, in order overcome the shortcomings of individual detector types by capitalizing on the advantages of each (Bachmann: Col. 4, lines 15-30, Col. 13, lines 1-10).

With respect to **claims 11 and 3**, the combination of Yamashita as modified by Bachmann teach the method of claim 10,

wherein the measured state correlates to a comparison result between the predicted measurement, and the measurement of the second signal set and the measurement of the third signal set (Bachmann: Col. 9, lines 21-48; Fig. 3, estimated orientation quaternion 39 is correlated with the measurement vector 34).

With respect to **claims 12 and 4**, the combination of Yamashita as modified by Bachmann teach the method of claim 10, wherein calculating the resulting deviation further comprises:

utilizing a data association model to determine whether compensation is needed to obtain the update state based on the measured axial accelerations or the measured magnetisms (Bachmann: Col. 9, line 49 – Col. 10, line 45; Col. 13, lines 1-62; Fig. 3, detector data is iteratively weighted to place greater or less reliance on data received from the detectors 31, 32, 33); and

obtaining the update state in response to determining that the compensation is needed (Bachmann: Col. 13, lines 1-62, defining the error vector epsilon based on a threshold parameter .rho. to either emphasize magnetometer data or places greater weight on accelerometer data in order to determine an updated orientation).

With respect to **claims 13 and 5**, the combination of Yamashita as modified by Bachmann teach the method of claim 10, wherein utilizing the data association model further comprises:

comparing the measured state associated with at least the second signal set or the third signal set with a predicted measurement calculated and obtained from the current state and associated with at least the first signal set (Bachmann: Figs. 5(a) – 5(b), steps 514 – 517); and

determining whether compensation is needed to obtain the update state based on whether the comparison result is a predetermined value or within a predetermined range (Bachmann: Fig. 5(b), step 517 minimizing the criterion function to output an orientation error estimate).

With respect to **claims 14 and 6**, the combination of Yamashita as modified by Bachmann teach the method of claim 10, wherein calculating the resulting deviation further comprises:

calculating the measured state associated with the third signal set by obtaining measured yaw based on measured magnetism Mx, My, Mz (Bachmann: Fig. 3, 32); and

calculating predicted yaw associated with the predicted measurement, wherein the predicted measurement is calculated and obtained from the update state and associated with the first signal set (Bachmann: Fig. 3, an estimated orientation quaternion 39 is correlated with the measurement vector 34; Col. 16, line 40 – Col. 17, line 5, each iteration produces an updated estimated quaternion yielding a new estimate of sensor orientation including azimuth, elevation and roll angles in the sensor coordinate system).

With respect to **claims 15 and 7**, the combination of Yamashita as modified by Bachmann teach the method of claim 14,

wherein the measured yaw is *calculated and obtained* based on the measured state associated with the third signal set, a temporary pitch value, and a temporary roll value; and

the temporary pitch value and the temporary roll value are calculated and converted from the update state (Bachmann: Fig. 3, includes intermediate sensor orientations represented in the form of quaternions (e.g., old and new q.sub.circumflex); Col. 7, lines 4-31; transforming estimated body rates to updated Euler Rates or Quaternion Rates).

With respect to **claims 16 and 8**, the combination of Yamashita as modified by Bachmann and Horton teach the method of claim 14, wherein calculating the resulting deviation further comprises:

obtaining a first update state based on the current state associated with the first signal set and a first measured state, wherein the first measured state is correlated to the measurement of the second signal set and a first predicted measurement calculated and obtained from the current state and associated with the first signal set (Bachmann: Fig. 3, an estimated orientation quaternion 39 is correlated with the measurement vector 34 and the angular rate information 37; Col. 16, line 40 – Col. 17, line 5, each iteration computes an updated estimated quaternion representative of a new estimate of sensor orientation); and

obtaining a second update state based on the first update state and a second measured state, wherein the second measured state is correlated to the measured yaw and a predicted yaw associated with a second predicted measurement, which is calculated and obtained from the current state or the first update state and associated with the first signal set, wherein the resultant angles are based on the second update state (Bachmann: Col. 9, lines 22-32; Fig. 3, a second updated state is interpreted as a subsequent iteration using the previously updated state; Equation 16).

Response to Arguments/Amendments/Remarks

Applicant's arguments with respect to claims 1-16 have been fully considered but are not persuasive.

On page 11 of Remarks, Applicant argues, "it appears that the Office has interpreted Figure 23 of Yamashita as disclosing many of the recited states."

The Office notes that Yamashita's Figure 23 illustrates an overview of the processing executed by the game apparatus. Figure 25 and corresponding portions of

the disclosure, as cited above, provide a more robust description of the game processing.

Additionally, on pages 11-12 of Remarks, Applicant argues, "as best understood by Applicant, the present interpretation does not appear to account for numerous aspects of the claim language, including Applicant's express reference to time (T-1 and T), measurements (values corresponding to sensor signals) and predicted measurements (calculated values)."

The Office respectfully disagrees. Yamashita, as cited above, expressly discloses obtaining sensor signals as axial accelerations and angular velocities (Figure 1, S1). Calculating the changes in motion parameters with respect to time involves estimation of motion parameters (e.g., velocity estimation d3, posture estimation p1) and time dependent calculations (expressions 1-6) in order to express movement of the input device in a spatial coordinate system. Yamashita, as cited above, fully discloses the broadest reasonable interpretation (BRI) of the claims, in light of Applicant's specification.

Conclusion

Any inquiry concerning this communication or earlier communications from the examiner should be directed to BRYAN EARLES whose telephone number is (571)272-4628. The examiner can normally be reached on Monday - Thursday at 7:30am - 5:00pm.

Examiner interviews are available via telephone, in-person, and video conferencing using a USPTO supplied web-based collaboration tool. To schedule an interview, applicant is encouraged to use the USPTO Automated Interview Request (AIR) at http://www.uspto.gov/interviewpractice.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, William Boddie can be reached on 571-272-0666. 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.

/BRYAN EARLES/
Primary Examiner, Art Unit 2625

Electronic Acknowledgement Receipt

EFS ID:	37646546
Application Number:	15611970
International Application Number:	
Confirmation Number:	5932
Title of Invention:	ELECTRONIC DEVICE FOR USE IN MOTION DETECTION AND METHOD FOR OBTAINING RESULTANT DEVIATION THEREOF
First Named Inventor/Applicant Name:	Shun-Nan Liou
Customer Number:	109673
Filer:	Michael P. Qualey/Brooke French
Filer Authorized By:	Michael P. Qualey
Attorney Docket Number:	250303-1021
Receipt Date:	04-NOV-2019
Filing Date:	02-JUN-2017
Time Stamp:	14:29:37
Application Type:	Utility under 35 USC 111(a)

Payment information:

Submitted with Payment	no

File Listing:

Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
1	Amendment/Req. Reconsideration-After Non-Final Reject	00732640.PDF	128191 818255f189fe377a72c793767c2cf48d8c8513f0	no	16

Warnings:

Information:	
Total Files Size (in bytes):	128191

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.

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

First Named Inventor:

Liou, et al.

Serial No.: 15/611,970

Filed: June 2, 2017

Confirmation No.: 5932

Group Art Unit: 2625

Examiner: Earles, Bryan E.

MQR Ref.: 250303-1021
Client Ref.: CWM11002-1-US

For: Electronic Device for Use in Motion Detection and Method for Obtaining Resultant Deviation Thereof

RESPONSE TO OFFICE ACTION

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

Director:

The Office Action mailed on 12 September 2019 has been carefully considered. In response, Applicant respectfully submits the following amendments and remarks.

AMENDMENTS

Please amend the application as follows.

In the Claims

1. (Currently Amended) An electronic device subject to movements and rotations in dynamic environments, comprising:

a display device associated with a display reference frame;

a motion sensor module comprising a rotation sensor and an accelerometer, the rotation sensor having sensor circuitry configured to generate measured angular velocities and the accelerometer having circuitry configured to generate measured axial accelerations, with both ~~of which are~~ the rotation sensor and the accelerometer being associated with ~~subjected to~~ the movements and the rotations of the electronic device in a spatial reference frame ~~the dynamic environments, the rotation sensor having sensor circuitry configured to generate a first signal set comprising measured angular velocities ωx, ωy, ωz, the accelerometer having accelerometer circuitry configured to generate a second signal set comprising measured axial accelerations Ax, Ay, Az~~; and

a computing processor having processor circuitry configured to calculate a resulting deviation comprising resultant angles associated with the movements and the rotations of the electronic device in [[a]] the spatial reference frame by:

providing a previous ~~state~~ quaternion corresponding to time T-1;

converting the measured angular velocities based on the previous quaternion into a current quaternion and predicted axial accelerations;

~~providing a current state, corresponding to time T, associated with the first signal set and the previous state;~~

~~comparing a predicted measurement, corresponding to time T, based on the first signal set to a measurement, corresponding to time T, of the second signal set such that a comparison result is provided as a measured state corresponding to time T;~~

comparing the predicted axial accelerations with the measured axial accelerations corresponding to time T to obtain a first comparison result;

~~obtaining an update state, corresponding to time T, based on the current state and the measured state;~~

obtaining an updated quaternion associated with time T based on the current quaternion and the first comparison result and using the updated quaternion as a next occurrence of the previous quaternion; and

providing the resulting deviation based on the updated quaternion ~~update state~~; [[and]]

~~using the update state as a next occurrence of the previous state~~

wherein the current quaternion and the predicted axial accelerations are converted from the measured angular velocities corresponding to time T so that the first comparison result and the updated quaternion correspond to time T; and

wherein the processor circuitry is further configured to translate the resultant angles of the resulting deviation in the spatial reference frame into a real-time movement pattern in the display reference frame.

2. (Currently Amended) The electronic device of claim 1, wherein:

the motion sensor module further comprises a magnetometer having magnetometer circuitry configured to generate ~~a third signal set comprising~~ measured magnetisms Mx, My, Mz; and

in calculating the resulting deviation, the computing processor is further configured to:

~~compare the predicted measurement obtained based on the update state and the first signal set to a measurement of the third signal set~~

convert the measured magnetisms corresponding to time T to a measured yaw angle and convert the angular velocities corresponding to time T to a predicted yaw angle;

compare the predicted yaw angle with the measured yaw angle to obtain a second comparison result; and

obtain the updated quaternion based on the second comparison result.

3. (Currently Amended) The electronic device of claim [[2]] 1, wherein ~~the measured state correlates to a comparison result between the predicted measurement, and the measurement of the second signal set and the measurement of the third signal set~~, in calculating the resulting deviation, the computing processor is further configured to:

utilize a first data association model to determine whether compensation is needed to obtain the updated quaternion based on the measured axial accelerations corresponding to time T; and

obtain the updated quaternion in response to determining that the compensation is needed.

4. (Currently Amended) The electronic device of claim 3, wherein, in calculating the resulting deviation, the computing processor is further configured to[[:]] utilize [[a]] the first data association model to determine whether compensation is needed to obtain the updated quaternion based on whether the first comparison result is a first predetermined value or within a first predetermined range ~~update state based on the measured axial accelerations or the measured magnetisms; and~~

~~obtain the update state in response to determining that the compensation is needed~~.

5. – 6. (Canceled)

7. (Currently Amended) The electronic device of claim [[6]] 2, wherein the measured yaw is calculated and obtained based on the measured magnetisms ~~state associated with the third signal set~~, a temporary pitch value, and a temporary roll value, wherein the temporary pitch value and the temporary roll value are calculated and converted from the ~~update state~~ updated quaternion.

8. (Currently Amended) The electronic device of claim [[6]] 2, wherein, in calculating the resulting deviation, the computing processor is further configured to:

obtain a first updated quaternion ~~update state~~ based on the current quaternion and the first comparison result ~~state associated with the first signal set and a first measured state, wherein the first measured state is correlated to the measurement of the second signal set and a first predicted measurement calculated and obtained from the current state and associated with the first signal set~~; and

obtain a second updated quaternion ~~update state~~ based on the first updated quaternion ~~update state~~ and the second comparison result ~~a second measured state~~, ~~wherein the second measured state is correlated to the measured yaw and a predicted yaw associated with a second predicted measurement, which is calculated and obtained from the current state or the first update state and associated with the first signal set,~~ wherein the resultant angles are based on the second updated quaternion ~~update state~~.

9. (Currently Amended) A method for determining movements and rotations in dynamic environments, comprising:

generating, with a rotation sensor having sensor circuitry~~, a first signal set comprising~~ measured angular velocities ~~ωx, ωy, ωz~~;

generating, with an accelerometer having accelerometer circuitry~~, a second signal set comprising~~ measured axial accelerations ~~Ax, Ay, Az~~; [[and]]

calculating, with a computing processor having processor circuitry, a resulting deviation comprising resultant angles associated with the movements and the rotations in a spatial reference frame by:

providing a previous ~~state~~ quaternion corresponding to time T-1;

converting the measured angular velocities based on the previous quaternion into a current quaternion and predicted axial accelerations;

~~providing a current state, corresponding to time T, associated with the first signal set and the previous state;~~

~~comparing a predicted measurement, corresponding to time T, based on the first signal set to a measurement, corresponding to time T, of the second signal set~~

~~such that a comparison result is provided as a measured state corresponding to time T;~~

comparing the predicted axial accelerations with the measured axial accelerations corresponding to time T to obtain a first comparison result;

~~obtaining an update state, corresponding to time T, based on the current state and the measured state;~~

obtaining an updated quaternion associated with time T based on the current quaternion and the comparison result and using the updated quaternion as a next occurrence of the previous quaternion; and

providing the resulting deviation based on the updated quaternion ~~update state~~; [[and]]

~~using the update state as a next occurrence of the previous state~~

wherein the current quaternion and the predicted axial accelerations are converted from the measured angular velocities corresponding to time T so that the comparison result and the updated quaternion correspond to time T; and

translating the resultant angles of the resulting deviation in the spatial reference frame into a real-time movement pattern in a display reference frame associated with a display device.

10. (Currently Amended I) The method of claim 9, wherein:

the method further comprises generating, with a magnetometer having magnetometer circuitry, ~~a third signal set comprising~~ measured magnetism ~~Mx, My, Mz~~; and

calculating the resulting deviation further comprises:

~~comparing the predicted measurement obtained based on the update state and the first signal set to a measurement of the third signal set~~

converting the measured magnetisms corresponding to time T to a measured yaw angle and converting the angular velocities corresponding to time T to a predicted yaw angle;

comparing the predicted yaw angle with the measured yaw angle to obtain a second comparison result; and

obtaining the updated quaternion based on the second comparison result.

11. (Currently Amended) The method of claim [[10]] 9, wherein ~~the measured state correlates to a comparison result between the predicted measurement, and the measurement of the second signal set and the measurement of the third signal set~~ calculating the resulting deviation further comprises:

utilizing a first data association model to determine whether compensation is needed to obtain the updated quaternion based on the measured axial accelerations corresponding to time T; and

obtaining the updated quaternion in response to determining that the compensation is needed.

12. (Currently Amended) The method of claim [[10]] 11, wherein calculating the resulting deviation further comprises[[:]] utilizing [[a]] the first data association model to determine whether compensation is needed to obtain the updated quaternion based on

whether the first comparison result is a first predetermined value or within a first predetermined range ~~update state based on the measured axial accelerations or the measured magnetisms; and~~

~~obtaining the update state in response to determining that the compensation is needed~~.

13. – 14. (Canceled)

15. (Currently Amended) The method of claim [[14]] 10, wherein:

the measured yaw is calculated and obtained based on the measured magnetisms ~~state associated with the third signal set~~, a temporary pitch value, and a temporary roll value; and

the temporary pitch value and the temporary roll value are calculated and converted from the ~~update state~~ updated quaternion.

16. (Currently Amended) The method of claim [[14]] 10, wherein calculating the resulting deviation further comprises:

obtaining a first updated quaternion ~~update state~~ based on the current quaternion and the first comparison result ~~state associated with the first signal set and a first measured state, wherein the first measured state is correlated to the measurement of the second signal set and a first predicted measurement calculated and obtained from the current state and associated with the first signal set~~; and

obtaining a second updated quaternion ~~update state~~ based on the first updated quaternion ~~update state~~ and the second comparison result ~~a second measured state~~, ~~wherein the second measured state is correlated to the measured yaw and a predicted yaw associated with a second predicted measurement, which is calculated and obtained from the current state or the first update state and associated with the first signal set,~~ wherein the resultant angles are based on the second updated quaternion ~~update state~~.

REMARKS

The Examiner is thanked for the thorough examination of the present application. Upon entry of the amendments in this response, claims 1 – 4, 7 – 12, 15 and 16 remain pending, with claims 5, 6, 13 and 14 having been canceled without waiver, disclaimer or prejudice. Reconsideration of the rejections is respectfully requested.

Telephone Interview

Applicant sincerely appreciates the time the examiner spent discussing the application with the undersigned on 31 October 2019. Although no specific agreement was reached as to allowability, it is believed that the amendments presented herein place the application in condition for allowance.

Claim Rejections - 35 USC §112

The Office Action indicates that claims 1 - 16 are rejected under 35 U.S.C. 112, second paragraph, as allegedly being indefinite. As set forth above, Applicant has amended the pending claims and respectfully asserts that the rejections have been accommodated.

Claim Rejections - 35 USC §102 and §103

The Office Action indicates that claims 1 and 9 are rejected under 35 U.S.C. 102 as allegedly being unpatentable by Yamashita et al. (US 8,267,785, hereinafter "Yamashita"). Additionally, the Office Action indicates that claims 2-8 and 10-16 are

rejected under 35 U.S.C. 103 as being unpatentable over Yamashita in view of Bachmann et al. (US 7,089,148, hereinafter "Bachmann").

As set forth above, Applicant has canceled claims 5, 6, 13 and 14 and respectfully assert that the rejections as to these claims has been rendered moot. With respect to the remaining claims, Applicant respectfully traverses the rejections.

Independent Claim 1 is Allowable

Claim 1 recites the following:

> 1. An electronic device subject to movements and rotations in dynamic environments, comprising:
> a display device associated with a display reference frame;
> a motion sensor module comprising a rotation sensor and an accelerometer, the rotation sensor having sensor circuitry configured to generate measured angular velocities and the accelerometer having circuitry configured to generate measured axial accelerations, with both the rotation sensor and the accelerometer being associated with the movements and the rotations of the electronic device in a spatial reference frame; and
> a computing processor having ***processor circuitry configured to calculate a resulting deviation comprising resultant angles associated with the movements and the rotations of the electronic device in the spatial reference frame by:***
> ***providing a previous quaternion corresponding to time T-1;***
> ***converting the measured angular velocities based on the previous quaternion into a current quaternion and predicted axial accelerations;***
> ***comparing the predicted axial accelerations with the measured axial accelerations corresponding to time T to obtain a first comparison result;***
> ***obtaining an updated quaternion associated with time T based on the current quaternion and the first comparison result and using the updated quaternion as a next occurrence of the previous quaternion; and***
> ***providing the resulting deviation based on the updated quaternion;***
> ***wherein the current quaternion and the predicted axial accelerations are converted from the measured angular***

velocities corresponding to time T so that the first comparison result and the updated quaternion correspond to time T; and

wherein the processor circuitry is further configured to translate the resultant angles of the resulting deviation in the spatial reference frame into a real-time movement pattern in the display reference frame.

(Emphasis added).

Applicant respectfully asserts that the cited art is legally deficient for rendering claim 1 unpatentable. In particular, the cited art (either individually or in combination) does not teach or reasonably suggest at least the following features recited in claim 1: "providing a previous quaternion corresponding to time T-1"; "converting the measured angular velocities based on the previous quaternion into a current quaternion and predicted axial accelerations"; "comparing the predicted axial accelerations with the measured axial accelerations corresponding to time T to obtain a first comparison result"; "obtaining an updated quaternion associated with time T based on the current quaternion and the first comparison result and using the updated quaternion as a next occurrence of the previous quaternion"; "providing the resulting deviation based on the updated quaternion"; "wherein the current quaternion and the predicted axial accelerations are converted from the measured angular velocities corresponding to time T so that the first comparison result and the updated quaternion correspond to time T"; and "wherein the processor circuitry is further configured to translate the resultant angles of the resulting deviation in the spatial reference frame into a real-time movement pattern in the display reference frame".

With respect to the pending rejection, the cited art does not appear to be involved with the various quaternions and the associated times (e.g., time T, time T-1) recited in claim 1. Thus, claim 1 clearly distinguishes over Yamashita and Bachmann is unale to remedy these deficiencies. Specifically, in Bachmann, the vector $\overline{y}(\hat{q})$ in Fig. 3 does not

use any information measured at time T. On the contrary, Bachmann discloses "where q is a quaternion representing the current orientation" and "where $\hat{q}$ is the previous estimate for q". Thus, the vector $\bar{y}(\hat{q})$ should not be interpreted as "predicted measurements". Therefore, Applicant respectfully asserts that claim 1 is in condition for allowance.

Independent Claim 9 is Allowable

Claim 9 recites the following:

> 9. A method for determining movements and rotations in dynamic environments, comprising:
> generating, with a rotation sensor having sensor circuitry measured angular velocities;
> generating, with an accelerometer having accelerometer circuitry;
> ***calculating, with a computing processor having processor circuitry, a resulting deviation comprising resultant angles associated with the movements and the rotations in a spatial reference frame by:***
> ***providing a previous quaternion corresponding to time T-1;***
> ***converting the measured angular velocities based on the previous quaternion into a current quaternion and predicted axial accelerations;***
> ***comparing the predicted axial accelerations with the measured axial accelerations corresponding to time T to obtain a first comparison result;***
> ***obtaining an updated quaternion associated with time T based on the current quaternion and the comparison result and using the updated quaternion as a next occurrence of the previous quaternion; and***
> ***providing the resulting deviation based on the updated quaternion;***
> ***wherein the current quaternion and the predicted axial accelerations are converted from the measured angular velocities corresponding to time T so that the comparison result and the updated quaternion correspond to time T; and***
> ***translating the resultant angles of the resulting deviation in the spatial reference frame into a real-time movement pattern in a display reference frame associated with a display device***.

(Emphasis added).

Applicant respectfully asserts that the cited art is legally deficient for rendering claim 9 unpatentable. In particular, the cited art (either individually or in combination) does not teach or reasonably suggest at least the following features recited in claim 9: "providing a previous quaternion corresponding to time T-1"; "converting the measured angular velocities based on the previous quaternion into a current quaternion and predicted axial accelerations"; "comparing the predicted axial accelerations with the measured axial accelerations corresponding to time T to obtain a first comparison result"; "obtaining an updated quaternion associated with time T based on the current quaternion and the comparison result and using the updated quaternion as a next occurrence of the previous quaternion"; "providing the resulting deviation based on the updated quaternion"; "wherein the current quaternion and the predicted axial accelerations are converted from the measured angular velocities corresponding to time T so that the comparison result and the updated quaternion correspond to time T"; and "translating the resultant angles of the resulting deviation in the spatial reference frame into a real-time movement pattern in a display reference frame associated with a display device."

For reasons similar to those described above with respect to the deficiencies of the cited art, Applicant respectfully asserts that claim 9 is in condition for allowance.

Dependent Claims are Allowable

Applicant respectfully asserts that the pending dependent claims are allowable for incorporating the features of their respective independent claims. Additionally, these

dependent claims recite other features that may serve as independent bases for patentability.

CONCLUSION

Based on the above, it is respectfully submitted that this application is in condition for allowance.

Should the Examiner feel that further discussion of the application would be conducive to prosecution and allowance of the application, please do not hesitate to contact the undersigned by phone (678-483-8893).

No fee is believed to be due in connection with this submission other than those already submitted. If, however, any fee is believed to be due, you are hereby authorized to charge any such fee to deposit account No. 50-5954.

Respectfully submitted,

McClure, Qualey & Rodack, LLP

/M.PaulQualey,Jr./

By: _____

M. Paul Qualey, Jr., Reg. No. 43,024

Customer No. 109673

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

First Named Inventor:
Shun-Nan LIOU, et al.

Serial Number: 15/611,970

Filed: June 2, 2017

Title: Electronic Device for Use in Motion Detection and Method for Obtaining Resultant Deviation Thereof

Confirmation No. 5932

Examiner: Earles, Bryan E.

Group Art Unit: 2625

MQR Ref. 250303-1021

NOTICE OF CONCURRENT PROCEEDINGS

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

Dear Director:

Applicant respectfully informs the Office of the following concurrent proceedings, in which US Patents 8,552,978 and 8,441,438, which are related to the present application, are currently undergoing Inter Partes Review:

1. LG Electronics Inc. (Plaintiff) v. Cywee Group Ltd. (Defendant).

   Case IPR2019-01203, filed 2019-06-15

2. Huawei Device USA Inc., Huawei Device Co., Ltd., Huawei Technologies Co., Ltd., Huawei Device (Dongguan) Co., Ltd., Huawei Device (Hong Kong) Co. Ltd. , Huawei Investment & Holding Co., Ltd., Huawei Tech. Investment Co. Ltd. (Plaintiff) v. Cywee Group Ltd. (Defendant).

   Case IPR2019-00562, filed 2019-01-11

3. ZTE (USA), Inc. (Plaintiff) v. Cywee Group Ltd. (Defendant).

   Case IPR2019-00526, filed 01-10-2019

4. LG Electronics, Inc., LG Electronics Inc. (Plaintiff) v. Cywee Group Ltd. (Defendant).

   Case IPR2019-00559, filed 2019-01-10

5. Samsung Electronics Co., Ltd. (Plaintiff) v. Cywee Group Ltd. (Defendant).

   Case IPR2019-00535, filed 2019-01-08.

6. ZTE (USA), Inc. (Plaintiff) v. Cywee Group Ltd. (Defendant).

   Case IPR2019-00143, filed 2018-10-31

7. Google LLC (Plaintiff) v. Cywee Group Ltd. (Defendant).

   Case IPR2018-01258, filed 2018-06-14

8. Huawei Device USA Inc., Huawei Device Co., Ltd., Huawei Technologies Co., Ltd., Huawei Device (Dongguan) Co., Ltd., Huawei Investment & Holding Co., Ltd., Huawei Tech. Investment Co. Ltd., Huawei Device (Hong Kong) Co. Ltd. (Plaintiff) v. Cywee Group Ltd. (Defendant).

Case IPR2019-00563, filed 2019-01-11

9. ZTE (USA), Inc. (Plaintiff) v. Cywee Group Ltd. (Defendant).

Case IPR2019-00525, filed 2019-01-10

10. LG Electronics, Inc., LG Electronics Inc. (Plaintiff) v. Cywee Group Ltd. (Defendant).

Case IPR2019-00560, filed 2019-01-10

11. Samsung Electronics Co., Ltd. (Plaintiff) v. Cywee Group Ltd. (Defendant).

Case IPR2019-00534, filed 2019-01-08

12. Google LLC, ZTE (USA), Inc. (Plaintiff) v. Cywee Group Ltd. (Defendant).

Case IPR2018-01257, filed 2018-06-14

Please do not hesitate to contact the undersigned by phone (678-483-8899) if there are any questions.

Respectfully submitted,

/M.PaulQualey,Jr./

By: _____

M. Paul Qualey, Jr.
Registration No. 43,024

Customer No. 109673

Electronic Acknowledgement Receipt	
EFS ID:	37656917
Application Number:	15611970
International Application Number:	
Confirmation Number:	5932
Title of Invention:	ELECTRONIC DEVICE FOR USE IN MOTION DETECTION AND METHOD FOR OBTAINING RESULTANT DEVIATION THEREOF
First Named Inventor/Applicant Name:	Shun-Nan Liou
Customer Number:	109673
Filer:	Michael P. Qualey/Brooke French
Filer Authorized By:	Michael P. Qualey
Attorney Docket Number:	250303-1021
Receipt Date:	05-NOV-2019
Filing Date:	02-JUN-2017
Time Stamp:	12:04:26
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	Miscellaneous Incoming Letter	00733059.PDF	72774 54e45f10f809aefdb667be46f78c3b131c590d99	no	3

Warnings:

Information:	
Total Files Size (in bytes):	72774

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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.
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.

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

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INFORMATION DISCLOSURE STATEMENT BY APPLICANT (**Not for submission under 37 CFR 1.99)**		
	Application Number	15611970
	Filing Date	2017-06-02
	First Named Inventor	Liou, et al.
	Art Unit	2625
	Examiner Name	Earles, Bryan E.
	Attorney Docket Number	250303-1021

U.S.PATENTS Remove

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	2	7414611	B2	2008-08-19	Liberty	

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	1	101915580	CN	A	2010-12-15	CHINESE ACAD INST AUTOMATION	Abstract	X
	2	101915580	CN	A	2010-12-15	CHINESE ACAD INST AUTOMATION		☐

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INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)		
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	Filing Date	2017-06-02
	First Named Inventor	Liou, et al.
	Art Unit	2625
	Examiner Name	Earles, Bryan E.
	Attorney Docket Number	250303-1021

	3	101256456	CN	A	2008-09-03	HILLCREST COMM INC	Abstract	☒
	4	101256456	CN	A	2008-09-03	HILLCREST COMM INC		☐

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NON-PATENT LITERATURE DOCUMENTS [Remove]

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	1	Chinese language office action dated 2020-01-03, issued in application no. 201710093370.8	
	2	Chinese language office action dated 2019-04-25, issued in application no. 201710093370.8.	

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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	15611970
	Filing Date	2017-06-02
	First Named Inventor	Liou, et al.
	Art Unit	2625
	Examiner Name	Earles, Bryan E.
	Attorney Docket Number	250303-1021

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.

☒ The fee set forth in 37 CFR 1.17 (p) has been submitted herewith.

A certification statement is not submitted herewith.

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	/M.PaulQualey,Jr./	Date (YYYY-MM-DD)	2020-01-20
Name/Print	M. Paul Qualey Jr.	Registration Number	43,024

This collection of information is required by 37 CFR 1.97 and 1.98. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.14. This collection is estimated to take 1 hour to complete, including gathering, preparing and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. **SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.**

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

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

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

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

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

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

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

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

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

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

Electronic Patent Application Fee Transmittal	
Application Number:	15611970
Filing Date:	02-Jun-2017
Title of Invention:	ELECTRONIC DEVICE FOR USE IN MOTION DETECTION AND METHOD FOR OBTAINING RESULTANT DEVIATION THEREOF
First Named Inventor/Applicant Name:	Shun-Nan Liou
Filer:	Michael P. Qualey/Brooke French
Attorney Docket Number:	250303-1021
Filed as Small Entity	
Filing Fees for Utility under 35 USC 111(a)	

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($)
Miscellaneous:				
SUBMISSION- INFORMATION DISCLOSURE STMT	2806	1	120	120
		Total in USD ($)		**120**

Electronic Acknowledgement Receipt	
EFS ID:	38348174
Application Number:	15611970
International Application Number:	
Confirmation Number:	5932
Title of Invention:	ELECTRONIC DEVICE FOR USE IN MOTION DETECTION AND METHOD FOR OBTAINING RESULTANT DEVIATION THEREOF
First Named Inventor/Applicant Name:	Shun-Nan Liou
Customer Number:	109673
Filer:	Michael P. Qualey/Brooke French
Filer Authorized By:	Michael P. Qualey
Attorney Docket Number:	250303-1021
Receipt Date:	21-JAN-2020
Filing Date:	02-JUN-2017
Time Stamp:	12:49:11
Application Type:	Utility under 35 USC 111(a)

Payment information:

Submitted with Payment	yes
Payment Type	CARD
Payment was successfully received in RAM	$120
RAM confirmation Number	E20201KC49348011
Deposit Account	505954
Authorized User	Brooke French
The Director of the USPTO is hereby authorized to charge indicated fees and credit any overpayment as follows: 37 CFR 1.16 (National application filing, search, and examination fees) 37 CFR 1.17 (Patent application and reexamination processing fees)	

37 CFR 1.19 (Document supply fees)

37 CFR 1.20 (Post Issuance fees)

37 CFR 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	00755781.PDF	89518 ddc1a7818ec6f0cea569171f483f5d49d2dcb1f9	no	2
Warnings:					
Information:					
2	Information Disclosure Statement (IDS) Form (SB08)	00755414.PDF	1034762 4f41e965170d0929f0aa7c5efe9d801b911b82c7	no	4
Warnings:					
Information:					
3	Other Reference-Patent/App/Search documents	00755390.PDF	10063135 b3e39139df5ce9674dca63756c06e63ec7e298dd	no	9
Warnings:					
Information:					
4	Foreign Reference	00755512.PDF	94573 f448f877573a701a22ae09b4efa6b06d0a6c5753	no	2
Warnings:					
Information:					
5	Foreign Reference	00755394.PDF	23190678 65974716a52917697dd52b6696f673d2cd67a64d	no	18
Warnings:					
Information:					
6	Foreign Reference	00755513.PDF	95640 d8f471e07e5a969d6ade8b90a45e54f372a7d240	no	1
Warnings:					
Information:					

7	Other Reference-Patent/App/Search documents	00755787.PDF	9074875 c428484e44985cba6487dd82144532047f8f9c60	no	20
Warnings:					
Information:					
8	Foreign Reference	00755792.PDF	24334352 d5d816bb4afc106b37214595944612354cb3c3a6	no	47
Warnings:					
Information:					
9	Fee Worksheet (SB06)	fee-info.pdf	30502 2a1a00eeb026ba9181634691c4b44db4d9ebc312	no	2
Warnings:					
Information:					
		Total Files Size (in bytes):	68008035		

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.

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

First Named Inventor:

Liou, et al.

Serial No.: 15/611,970

Filed: June 02, 2017

Confirmation No.: 5932

Group Art Unit: 2625

Examiner: Earles, Bryan E.

Docket No. 250303-1021

For: Electronic Device For Use In motion Detection and Method For Obtaining Resultant Deviation Therof

INFORMATION DISCLOSURE STATEMENT

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

Sir:

This information disclosure statement is filed in accordance with 37 C.F.R. §§ 1.56, 1.97, and 1.98, and specifically:

Applicant(s) submit herewith Form PTO SB/08A-08B-08a - Information Disclosure Statement by Applicant together with copies (where required) of patents, publications or other information of which applicant(s) are aware and for which there may be a duty to disclose in accordance with 37 CFR 1.56. As required by 37 C.F.R. §1.98(a), a legible copy of each document is provided.

The following rights are reserved by the Applicant(s): the right to establish the patentability of the claimed invention over any of the listed documents should they be applied as reference, and/or the right to prove that some of these documents may not be prior art, and/or the right to prove that some of these documents may not be enabling for the teachings they purport to offer.

This statement should not be construed as a representation that an exhaustive search has been made, or that information more material to the examination of the present application does not exist. Any statements or identifications regarding the relevance of any portion(s) of cited references should not be construed as a representation that the most relevant portion(s) have been identified, and the absence of such statements or identifications should not be construed as

representations that there are no relevant portion(s). The Examiner is specifically requested not to rely solely on the materials submitted herewith. The Examiner is requested to conduct an independent and thorough review of the documents, and to form independent opinions as to their significance.

It is requested that the information disclosed herein be made of record in this application and that the Examiner initial and return a copy of the enclosed PTO SB/08A-08B-08a to indicate the documents have been considered.

If any fee is due in connection with this submission, and is not otherwise provided herewith, you are hereby authorized to charge any such fee to deposit account No. 50-5954.

Respectfully submitted,

/M.PaulQualey,Jr./

By: _____

M. Paul Qualey Jr.
Registration No. 43,024

Customer No. 109673

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 NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
15/611,970	06/02/2017	Shun-Nan Liou	250303-1021	5932

109673 7590 01/30/2020

McClure, Qualey & Rodack, LLP
280 Interstate North Circle SE
Suite 550
Atlanta, GA 30339

EXAMINER	
EARLES, BRYAN E	

ART UNIT	PAPER NUMBER
2625	

NOTIFICATION DATE	DELIVERY MODE
01/30/2020	ELECTRONIC

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.

Notice of the Office communication was sent electronically on above-indicated "Notification Date" to the following e-mail address(es):

dan.mcclure@mqrlaw.com
terri.logan@mqrlaw.com
uspatents@mqrlaw.com

Office Action Summary	**Application No.** 15/611,970	**Applicant(s)** Liou et al.	
	Examiner BRYAN EARLES	**Art Unit** 2625	**AIA (FITF) Status** No

-- 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 MONTHS 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 04 November 2019 and 21 January 2020.

☐ A declaration(s)/affidavit(s) under **37 CFR 1.130(b)** was/were filed on _____.

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) 1-4,7-12 and 15-16 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) 1-4,7-12 and 15-16 is/are rejected.

8) ☐ Claim(s) _____ is/are objected to.

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

* If any claims have been determined allowable, 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.**

Application Papers

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

11)☐ 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).

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).

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)).

** 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) ☑ Information Disclosure Statement(s) (PTO/SB/08a and/or PTO/SB/08b) Paper No(s)/Mail Date _____.

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

4) ☐ Other: _____.

DETAILED ACTION

Notice of Pre-AIA or AIA Status

The present application is being examined under the pre-AIA first to invent provisions.

The Office acknowledges the amendment dated 04 November 2019, in which:

Claims **1-4, 7-12 and 15-16** are currently pending.

Claims **1-4, 7-12 and 15-16** are amended.

Claims **5-6 and 13-14** are canceled.

Claim Rejections - 35 USC § 103

The following is a quotation of pre-AIA 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, 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 1-4, 7-12 and 15-16 are rejected under 35 U.S.C. 103 as being unpatentable over Yamashita et al. (US 8,267,785, hereinafter "Yamashita") in view of Bachmann et al. (US 7,089,148, hereinafter "Bachmann").

With respect to **claims 9 and 1** (Currently Amended), Yamashita teaches a method for determining movements and rotations in dynamic environments, comprising:

generating, with a rotation sensor having sensor circuitry measured angular velocities (Yamashita: Fig. 7, gyrosensor unit 7 includes gyrosensors 55 and 56 for producing tri-axial angular velocity data);

generating, with an accelerometer having accelerometer circuitry measured axial accelerations (Yamashita: Fig. 7; Col. 12, line 47 – Col. 13, line 10, output from the acceleration sensor 37 represented as a three-dimensional vector (ax,ay,az) in an XYZ coordinate system).

Yamashita fails to expressly disclose:

calculating, with a computing processor having processor circuitry, a resulting deviation comprising resultant angles associated with the movements and the rotations in a spatial reference by:

providing a previous quaternion corresponding to time T-1;

converting the measured angular velocities based on the previous quaternion into a current quaternion and predicted axial accelerations;

comparing the predicted axial accelerations with the measured axial accelerations corresponding to time T to obtain a first comparison result;

obtaining an updated quaternion associated with time T based on the current quaternion and the comparison result and using the updated quaternion as a next occurrence of the previous quaternion; and

providing the resulting deviation based on the updated quaternion; and

wherein the current quaternion and the predicted axial accelerations are converted from the measured angular velocities corresponding to time T so that the comparison result and the updated quaternion correspond to time T; and

translating the resultant angles of the resulting deviation in the spatial reference frame into a real-time movement pattern in a display reference frame associated with a display device.

However, Bachmann discloses:

calculating, with a computing processor having processor circuitry, a resulting deviation comprising resultant angles associated with the movements and the rotations in a spatial reference (Bachmann: Fig. 3, the angular rates (p, q, r) at box 33 correspond to measured movements and rotations in a sensor reference frame) by:

providing a previous quaternion corresponding to time T-1 (Bachmann: Fig. 3, the previous quaternion corresponds to the prior orientation output quaternion at 39);

converting the measured angular velocities based on the previous quaternion into a current quaternion and predicted axial accelerations (Bachmann: Fig. 3, the angular rates at box 33 are converted at box 37 to a rate quaternion);

comparing (Paragraph [0004], of Applicant's Specification, "The term of "comparison" of the present invention may generally refer to the calculating and obtaining of the actual deviation angles of the 3D pointing device …") the predicted axial accelerations with the measured axial accelerations corresponding to time T to obtain a first comparison result (Bachmann: Fig. 3, the comparison occurs at the junction between boxes 34 and 35, such that the filter chooses a correction factor, that when added to q.dot., will minimize the difference between the actual measurements (h1 h2 h3 b1 b2 b3) and the predicted measurements for those same values);

obtaining an updated quaternion associated with time T based on the current quaternion and the comparison result and using the updated quaternion as a next

occurrence of the previous quaternion (Bachmann: Fig. 3, the updated quaternion is a new value of the orientation output quaternion at 39); and

providing the resulting deviation based on the updated quaternion (Bachmann: Fig. 3, the updated quaternion reflects the correction factor using predicted measurements based on the previous orientation output quaternion); and

wherein the current quaternion and the predicted axial accelerations are converted from the measured angular velocities corresponding to time T so that the comparison result and the updated quaternion correspond to time T (Bachmann: Fig. 3, the prior orientation output quaternion $\hat{q}$ is input to quaternion multiplication at box 35 to calculate predicted measurements $\overline{y}(\hat{q})$ which is used to generate a newly updated orientation quaternion at the output 39); and

translating the resultant angles of the resulting deviation in the spatial reference frame into a real-time movement pattern in a display reference frame associated with a display device (Bachmann: Fig. 4, processing unit translates movements of the person 402 from the sensor reference frame into the display reference frame 404).

Therefore, it would be obvious to one of ordinary skill in the art at the time the invention was made to modify the method, as taught by Yamashita, to incorporate additional types of detectors into the motion sensing module, as taught by Bachmann, in order overcome the shortcomings of individual detector types by capitalizing on the advantages of each (Bachmann: Col. 4, lines 15-30, Col. 13, lines 1-10).

With respect to **claims 10 and 2** (Currently Amended), the combination of Yamashita as modified by Bachmann teaches the method of claim 9, wherein:

the method further comprises generating, with a magnetometer having magnetometer circuitry, measured magnetism (Bachmann: Fig. 3, magnetometers 38 generate measured magnetisms b1, b2, b3); and

calculating the resulting deviation further comprises;

converting the measured magnetisms corresponding to time T to a measured yaw angle (Bachmann: Fig. 3, box 32 outputs measured magnetisms b1, b2, b3 corresponding to yaw pitch and roll angles) and converting the angular velocities corresponding to time T to a predicted yaw angle (Bachmann: Fig. 3, box 33 outputs signal (p, q, r) comprising angular velocities Ωx, Ωy, Ωz. used to calculate each output $\hat{q}$ and are therefore a part of each orientation output quaternion q);

comparing the predicted yaw angle with the measured yaw angle to obtain a second comparison result (Bachmann: Fig. 3, measured magnetisms are compared with respective predicted magnetisms in the computed measurement vector 35a to obtain a six-valued error vector 36 that corresponds to measure of how actual accelerometer and magnetometer measurements differ from the what the filter predicts those measurements should be, based on the angular rate sensor output); and

obtaining the updated quaternion based on the second comparison result (Bachmann: Fig. 3, the filter selects a correction factor output at box 41 that when added to the output at box 37 will minimize the difference between the actual measurements (h1 h2 h3 b1 b2 b3) and the predicted measurements for those same values).

With respect to **claims 11 and 3** (Currently Amended), the combination of Yamashita as modified by Bachmann teaches the method of claim 9,

wherein calculating the resulting deviation further comprises:

utilizing a first data association model to determine whether compensation is needed to obtain the updated quaternion based on the measured axial accelerations corresponding to time T; and

obtaining the updated quaternion in response to determining that the compensation is needed (Bachmann: Fig. 3; performing compensation if the error vector yields a non-zero result, then no deviation exist in the subtracting operation between the actual measurements (h1 h2 h3 b1 b2 b3) and the predicted measurements for those same values then no compensation is performed).

With respect to **claims 12 and 4** (Currently Amended), the combination of Yamashita as modified by Bachmann teaches the method of claim 11,

wherein calculating the resulting deviation further comprises utilizing the first data association model to determine whether compensation is needed to obtain the updated quaternion based on whether the first comparison result is a first predetermined value or within a first predetermined range (Bachmann: Fig. 3; performing the compensation only if the error vector yields a non-zero result, otherwise if no deviation exist in the subtracting operation between the actual measurements (h1 h2 h3 b1 b2 b3) and the predicted measurements for those same values, then no compensation is performed).

With respect to **claims 15 and 7** (Currently Amended), the combination of Yamashita as modified by Bachmann teaches the method of claim 10,

wherein the measured yaw is *calculated and obtained* based on the measured magnetisms, a temporary pitch value, and a temporary roll value; and

the temporary pitch value and the temporary roll value are calculated and converted from the updated quaternion (Bachmann: Fig. 3, includes intermediate sensor orientations represented in the form of quaternions (e.g., old and new q.sub.circumflex); Col. 7, lines 4-31; transforming estimated body rates to updated Euler Rates or Quaternion Rates).

With respect to **claims 16 and 8** (Currently Amended), the combination of Yamashita as modified by Bachmann teaches the method of claim 10, wherein calculating the resulting deviation further comprises:

obtaining a first updated quaternion based on the current quaternion and the first comparison result (Bachmann: Fig. 3, an estimated orientation quaternion 39 is correlated with the measurement vector 34 and the angular rate information 37; Col. 16, line 40 – Col. 17, line 5, each iteration computes an updated estimated quaternion representative of a new estimate of sensor orientation); and

obtaining a second updated quaternion based on the first updated quaternion and the second comparison result, wherein the resultant angles are based on the second updated quaternion (Bachmann: Col. 9, lines 22-32; Fig. 3, a second updated state is interpreted as a subsequent iteration using the previously updated state; Equation 16).

Response to Arguments/Amendments/Remarks

Applicant's arguments with respect to claims 1-16 have been fully considered but are not persuasive.

On pages 3-5 of Remarks, Applicant argues, "the vector $\overline{y}(\hat{q})$ does not use any information measured at time T", and additionally argues, "the vector $\overline{y}(\hat{q})$ should not be interpreted as "predicted measurements"."

The Office respectfully disagrees. The predicted measurement vector $\overline{y}(\hat{q})$ is based on the angular rate information 37 obtained from the angular rage sensors 33, therefore vector $\overline{y}(\hat{q})$ uses information measured at time T. Boxes 34, 35, 35a, 36, 38, and 41 in Bachmann's FIG. 3 show how the accelerometer and magnetometer measurements are used to generate a correction factor, $\dot{q}_\varepsilon$, that is applied to the rate quaternion (Bachmann: Col. 9, line 59 – Col. 10, line 14). In box 34, the accelerometer and magnetometer measurements are combined to form a six-valued measurement vector $y_0 = [h1\ h2\ h3\ b1\ b2\ b3]^T$, where h1, h2, and h3 represent 33 acceleration along the accelerometer's X, Y and Z axes, respectively, and b1, b2, and b3 represent magnetism measurements along the magnetometer's X, Y and Z axes, respectively (Bachmann: Col. 8, lines 37-50). In boxes 35 and 35a, a predicted six-valued measurement vector $\overline{y}(\hat{q})$ is translated from a reference frame fixed with respect to the Earth to the sensors' reference frame (Bachmann: Col. 8, line 61 -Col. 9, line 8). This predicted measurement vector is based on the angular rate information 37 from the angular rate sensors 33 (Bachmann: FIG. 3). Comparing the predicted measurement vector $\overline{y}(\hat{q})$ to the actual measurement vector y0 yields a six-valued error vector $\overline{\varepsilon}(\hat{q})$,

numbered 36 in FIG. 3 (Bachmann: Col. 9, lines 9-17 and Col. 17, lines 12-22). In view of the broadest reasonable interpretation (BRI) of the amended claims, in light of Applicant's specification, the cited prior art fully meets the requirements set forth in the claims. Therefore, claims 1-4, 7-12 and 15-16 are rejected under 35 U.S.C. 103 as being unpatentable over Yamashita in view of Bachmann.

Conclusion

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.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to BRYAN EARLES whose telephone number is (571)272-

4628. The examiner can normally be reached on Monday - Thursday at 7:30am - 5:00pm.

Examiner interviews are available via telephone, in-person, and video conferencing using a USPTO supplied web-based collaboration tool. To schedule an interview, applicant is encouraged to use the USPTO Automated Interview Request (AIR) at http://www.uspto.gov/interviewpractice.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, William Boddie can be reached on 571-272-0666. 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.

/BRYAN EARLES/
Primary Examiner, Art Unit 2625

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

PTO/SB/08a (02-18)
Approved for use through 11/30/2020. 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.

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

Application Number	15611970
Filing Date	2017-06-02
First Named Inventor	Liou, et al.
Art Unit	2625
Examiner Name	Earles, Bryan E.
Attorney Docket Number	250303-1021

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
	1	7089148	B1	2006-08-08	Bachmann	
	2	7414611	B2	2008-08-19	Liberty	

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

U.S.PATENT APPLICATION PUBLICATIONS Remove

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

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FOREIGN PATENT DOCUMENTS Remove

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	101915580	CN	A	2010-12-15	CHINESE ACAD INST AUTOMATION	Abstract	X
	2	101915580	CN	A	2010-12-15	CHINESE ACAD INST AUTOMATION		☐

ALL REFERENCES CONSIDERED EXCEPT WHERE LINED THROUGH. /BE/

INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)		
	Application Number	15611970
	Filing Date	2017-06-02
	First Named Inventor	Liou, et al.
	Art Unit	2625
	Examiner Name	Earles, Bryan E.
	Attorney Docket Number	250303-1021

	3	101256456	CN	A	2008-09-03	HILLCREST COMM INC	Abstract	☒
	4	101256456	CN	A	2008-09-03	HILLCREST COMM INC		☐

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

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]
	1	Chinese language office action dated 2020-01-03, issued in application no. 201710093370.8	
	2	Chinese language office action dated 2019-04-25, issued in application no. 201710093370.8.	

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

EXAMINER SIGNATURE

Examiner Signature	/BRYAN EARLES/	Date Considered	01/24/2020

*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. /BE/

INFORMATION DISCLOSURE STATEMENT BY APPLICANT (**Not for submission under 37 CFR 1.99)**	Application Number	15611970
	Filing Date	2017-06-02
	First Named Inventor	Liou, et al.
	Art Unit	2625
	Examiner Name	Earles, Bryan E.
	Attorney Docket Number	250303-1021

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.

☒ The fee set forth in 37 CFR 1.17 (p) has been submitted herewith.

A certification statement is not submitted herewith.

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	/M.PaulQualey,Jr./	Date (YYYY-MM-DD)	2020-01-20
Name/Print	M. Paul Qualey Jr.	Registration Number	43,024

This collection of information is required by 37 CFR 1.97 and 1.98. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.14. This collection is estimated to take 1 hour to complete, including gathering, preparing and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. **SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.**

EFS Web 2.1.18

ALL REFERENCES CONSIDERED EXCEPT WHERE LINED THROUGH. /BE/

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.

ALL REFERENCES CONSIDERED EXCEPT WHERE LINED THROUGH. /BE/

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

First Named Inventor:

Liou, et al.

Serial No.: 15/611,970

Filed: June 2, 2017

Confirmation No.: 5932

Group Art Unit: 2625

Examiner: Earles, Bryan E.

MQR Ref.: 250303-1021
Client Ref.: CWM11002-1-US

For: Electronic Device for Use in Motion Detection and Method for Obtaining Resultant Deviation Thereof

RESPONSE TO OFFICE ACTION

Mail Stop: AF
Commissioner for Patents
P.O. Box 1450
Alexandria, Virginia 22313-1450

Director:

The Office Action mailed on 30 January 2020 has been carefully considered. In response, Applicant respectfully submits the following amendments and remarks pursuant to the After Final Consideration Pilot.

Doc Code: A.NE.AFCP
Document Description: After Final Consideration Pilot Program Request

PTO/SB/434 (05-13)

CERTIFICATION AND REQUEST FOR CONSIDERATION UNDER THE AFTER FINAL CONSIDERATION PILOT PROGRAM 2.0

Practitioner Docket No.:	Application No.:	Filing Date:
250303-1021	15/611,970	June 2, 2017
First Named Inventor:	**Title:**	
Liou, et al.	Electronic Device for Use in Motion Detection and Method for Obtaining Resultant Deviation Thereof	

APPLICANT HEREBY CERTIFIES THE FOLLOWING AND REQUESTS CONSIDERATION UNDER THE AFTER FINAL CONSIDERATION PILOT PROGRAM 2.0 (AFCP 2.0) OF THE ACCOMPANYING RESPONSE UNDER 37 CFR 1.116.

1. The above-identified application is (i) an original utility, plant, or design nonprovisional application filed under 35 U.S.C. 111(a) [a continuing application (*e.g.*, a continuation or divisional application) is filed under 35 U.S.C. 111(a) and is eligible under (i)], or (ii) an international application that has entered the national stage in compliance with 35 U.S.C. 371(c).
2. The above-identified application contains an outstanding final rejection.
3. Submitted herewith is a response under 37 CFR 1.116 to the outstanding final rejection. The response includes an amendment to at least one independent claim, and the amendment does not broaden the scope of the independent claim in any aspect.
4. This certification and request for consideration under AFCP 2.0 is the only AFCP 2.0 certification and request filed in response to the outstanding final rejection.
5. Applicant is willing and available to participate in any interview requested by the examiner concerning the present response.
6. This certification and request is being filed electronically using the Office's electronic filing system (EFS-Web).
7. Any fees that would be necessary consistent with current practice concerning responses after final rejection under 37 CFR 1.116, *e.g.*, extension of time fees, are being concurrently filed herewith. [There is no additional fee required to request consideration under AFCP 2.0.]
8. By filing this certification and request, applicant acknowledges the following:
   - Reissue applications and reexamination proceedings are not eligible to participate in AFCP 2.0.
   - The examiner will verify that the AFCP 2.0 submission is compliant, *i.e.*, that the requirements of the program have been met (see items 1 to 7 above). For compliant submissions:
     - The examiner will review the response under 37 CFR 1.116 to determine if additional search and/or consideration (i) is necessitated by the amendment and (ii) could be completed within the time allotted under AFCP 2.0. If additional search and/or consideration is required but cannot be completed within the allotted time, the examiner will process the submission consistent with current practice concerning responses after final rejection under 37 CFR 1.116, *e.g.*, by mailing an advisory action.
     - If the examiner determines that the amendment does not necessitate additional search and/or consideration, or if the examiner determines that additional search and/or consideration is required and could be completed within the allotted time, then the examiner will consider whether the amendment places the application in condition for allowance (after completing the additional search and/or consideration, if required). If the examiner determines that the amendment does not place the application in condition for allowance, then the examiner will contact the applicant and request an interview.
       - The interview will be conducted by the examiner, and if the examiner does not have negotiation authority, a primary examiner and/or supervisory patent examiner will also participate.
       - If the applicant declines the interview, or if the interview cannot be scheduled within ten (10) calendar days from the date that the examiner first contacts the applicant, then the examiner will proceed consistent with current practice concerning responses after final rejection under 37 CFR 1.116.

Signature	Date
/M.PaulQualey,Jr./	4/30/2020
Name (Print/Typed) M. Paul Qualey, Jr.	**Practitioner Registration No.** 43,024

***Note**: This form must be signed in accordance with 37 CFR 1.33. See 37 CFR 1.4(d) for signature requirements and certifications. Submit multiple forms if more than one signature is required, see below*.*

[✓] * Total of 1 forms are submitted.

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.
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.
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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 Acknowledgement Receipt

EFS ID:	39311421
Application Number:	15611970
International Application Number:	
Confirmation Number:	5932
Title of Invention:	ELECTRONIC DEVICE FOR USE IN MOTION DETECTION AND METHOD FOR OBTAINING RESULTANT DEVIATION THEREOF
First Named Inventor/Applicant Name:	Shun-Nan Liou
Customer Number:	109673
Filer:	Michael P. Qualey/Brooke French
Filer Authorized By:	Michael P. Qualey
Attorney Docket Number:	250303-1021
Receipt Date:	30-APR-2020
Filing Date:	02-JUN-2017
Time Stamp:	11:45:42
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	After Final Consideration Program Request	00783489.PDF	227308 ecf16abd34e50b562ae4743968dc8d475ec6d56e	no	2

Warnings:

Information:					
2	Response After Final Action	00783618.PDF	147380 4c76d966b9b7f5e1f2188bbdcd3d4c9a65771862	no	17
Warnings:					
Information:					
			Total Files Size (in bytes):	374688	

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.

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

First Named Inventor:

Liou, et al.

Serial No.: 15/611,970

Filed: June 2, 2017

Confirmation No.: 5932

Group Art Unit: 2625

Examiner: Earles, Bryan E.

MQR Ref.: 250303-1021
Client Ref.: CWM11002-1-US

For: Electronic Device for Use in Motion Detection and Method for Obtaining Resultant Deviation Thereof

RESPONSE TO OFFICE ACTION

Mail Stop: AF
Commissioner for Patents
P.O. Box 1450
Alexandria, Virginia 22313-1450

Director:

The Office Action mailed on 30 January 2020 has been carefully considered. In response, Applicant respectfully submits the following amendments and remarks pursuant to the After Final Consideration Pilot.

AMENDMENTS

Please amend the application as follows.

In the Claims

1. (Currently Amended) An electronic device subject to movements and rotations in dynamic environments, comprising:

a display device associated with a display reference frame;

a motion sensor module comprising a rotation sensor and an accelerometer, the rotation sensor having sensor circuitry configured to generate measured angular velocities and the accelerometer having circuitry configured to generate measured axial accelerations, with both the rotation sensor and the accelerometer being associated with the movements and the rotations of the electronic device in a spatial reference frame; and

a computing processor having processor circuitry configured to calculate a resulting deviation comprising resultant angles associated with the movements and the rotations of the electronic device in the spatial reference frame by:

providing a previous quaternion corresponding to time T-1 based on the measured axial accelerations corresponding to time T-1 and the measured angular velocities corresponding to time T-1;

converting the measured angular velocities corresponding to time T based on the previous quaternion into a current quaternion and predicted axial accelerations without using the measured axial accelerations corresponding to time T;

comparing the predicted axial accelerations, which are based on the measured axial accelerations corresponding to time T-1 and the measured angular velocities corresponding to time T, with the measured axial accelerations corresponding to time T to obtain a first comparison result;

obtaining an updated quaternion associated with time T based on the current quaternion and the first comparison result, which is based on the measured axial accelerations corresponding to time T-1, measured axial accelerations corresponding to time T, and angular velocities corresponding to time T, and using the updated quaternion as a next occurrence of the previous quaternion; and

providing the resulting deviation based on the updated quaternion;

wherein the current quaternion and the predicted axial accelerations are converted from the measured angular velocities corresponding to time T so that the first comparison result and the updated quaternion correspond to time T; and

wherein the processor circuitry is further configured to translate the resultant angles of the resulting deviation in the spatial reference frame into a real-time movement pattern in the display reference frame.

2. (Previously Presented) The electronic device of claim 1, wherein:

the motion sensor module further comprises a magnetometer having magnetometer circuitry configured to generate measured magnetisms; and

in calculating the resulting deviation, the computing processor is further configured to:

convert the measured magnetisms corresponding to time T to a measured yaw angle and convert the angular velocities corresponding to time T to a predicted yaw angle;

compare the predicted yaw angle with the measured yaw angle to obtain a second comparison result; and

obtain the updated quaternion based on the second comparison result.

3. (Previously Presented) The electronic device of claim 1, wherein, in calculating the resulting deviation, the computing processor is further configured to:

utilize a first data association model to determine whether compensation is needed to obtain the updated quaternion based on the measured axial accelerations corresponding to time T; and

obtain the updated quaternion in response to determining that the compensation is needed.

4. (Previously Presented) The electronic device of claim 3, wherein, in calculating the resulting deviation, the computing processor is further configured to utilize the first data association model to determine whether compensation is needed to obtain the updated quaternion based on whether the first comparison result is a first predetermined value or within a first predetermined range.

5. – 6. (Canceled)

7. (Previously Presented) The electronic device of claim 2, wherein the measured yaw is calculated and obtained based on the measured magnetisms, a temporary pitch value, and a temporary roll value, wherein the temporary pitch value and the temporary roll value are calculated and converted from the updated quaternion.

8. (Previously Presented) The electronic device of claim 2, wherein, in calculating the resulting deviation, the computing processor is further configured to:

obtain a first updated quaternion based on the current quaternion and the first comparison result; and

obtain a second updated quaternion based on the first updated quaternion and the second comparison result, wherein the resultant angles are based on the second updated quaternion.

9. (Currently Amended) A method for determining movements and rotations in dynamic environments, comprising:

generating, with a rotation sensor having sensor circuitry measured angular velocities;

generating, with an accelerometer having accelerometer circuitry measured axial accelerations;

calculating, with a computing processor having processor circuitry, a resulting deviation comprising resultant angles associated with the movements and the rotations in a spatial reference frame by:

providing a previous quaternion corresponding to time T-1 based on the measured axial accelerations corresponding to time T-1 and the measured angular velocities corresponding to time T-1;

converting the measured angular velocities corresponding to time T based on the previous quaternion into a current quaternion and predicted axial accelerations without using the measured axial accelerations corresponding to time T;

comparing the predicted axial accelerations, which are based on the measured axial accelerations corresponding to time T-1 and the measured angular velocities corresponding to time T, with the measured axial accelerations corresponding to time T to obtain a first comparison result;

obtaining an updated quaternion associated with time T based on the current quaternion and the comparison result, which is based on the measured axial accelerations corresponding to time T-1, measured axial accelerations corresponding to time T, and angular velocities corresponding to time T, and using the updated quaternion as a next occurrence of the previous quaternion; and

providing the resulting deviation based on the updated quaternion[[;]], wherein the current quaternion and the predicted axial accelerations are converted from the measured angular velocities corresponding to time T so that the comparison result and the updated quaternion correspond to time T; and

translating the resultant angles of the resulting deviation in the spatial reference frame into a real-time movement pattern in a display reference frame associated with a display device.

10. (Previously Presented) The method of claim 9, wherein:

the method further comprises generating, with a magnetometer having magnetometer circuitry, measured magnetism; and

calculating the resulting deviation further comprises:

converting the measured magnetisms corresponding to time T to a measured yaw angle and converting the angular velocities corresponding to time T to a predicted yaw angle;

comparing the predicted yaw angle with the measured yaw angle to obtain a second comparison result; and

obtaining the updated quaternion based on the second comparison result.

11. (Previously Presented) The method of claim 9, wherein calculating the resulting deviation further comprises:

utilizing a first data association model to determine whether compensation is needed to obtain the updated quaternion based on the measured axial accelerations corresponding to time T; and

obtaining the updated quaternion in response to determining that the compensation is needed.

12. (Previously Presented) The method of claim 11, wherein calculating the resulting deviation further comprises utilizing the first data association model to determine

whether compensation is needed to obtain the updated quaternion based on whether the first comparison result is a first predetermined value or within a first predetermined range.

13. – 14. (Canceled)

15. (Previously Presented) The method of claim 10, wherein:

the measured yaw is calculated and obtained based on the measured magnetisms, a temporary pitch value, and a temporary roll value; and

the temporary pitch value and the temporary roll value are calculated and converted from the updated quaternion.

16. (Previously Presented) The method of claim 10, wherein calculating the resulting deviation further comprises:

obtaining a first updated quaternion based on the current quaternion and the first comparison result; and

obtaining a second updated quaternion based on the first updated quaternion and the second comparison result, wherein the resultant angles are based on the second updated quaternion.

REMARKS

The Examiner is thanked for the thorough examination of the present application. Upon entry of the amendments in this response, claims 1 – 4, 7 – 12, 15 and 16 remain pending, with claims 5, 6, 13 and 14 having been canceled without waiver, disclaimer or prejudice. Reconsideration of the rejections is respectfully requested.

Claim Rejections - 35 USC §103

The Office Action indicates that claims 1 – 4, 7 – 12 and 15 - 16 are rejected under 35 U.S.C. 103 as being unpatentable over Yamashita (US 8,267,785) in view of Bachmann (US 7,089,148). Applicant respectfully traverses the rejections.

Independent Claim 1 is Allowable

Claim 1, as amended, recites the following:

> 1. An electronic device subject to movements and rotations in dynamic environments, comprising:
> a display device associated with a display reference frame;
> a motion sensor module comprising a rotation sensor and an accelerometer, the rotation sensor having sensor circuitry configured to generate measured angular velocities and the accelerometer having circuitry configured to generate measured axial accelerations, with both the rotation sensor and the accelerometer being associated with the movements and the rotations of the electronic device in a spatial reference frame; and
> a computing processor having processor circuitry configured to calculate a resulting deviation comprising resultant angles associated with the movements and the rotations of the electronic device in the spatial reference frame by:
> ***providing a previous quaternion corresponding to time T-1 based on the measured axial accelerations corresponding to time T-1 and the measured angular velocities corresponding to time T-1;***
> ***converting the measured angular velocities corresponding to time T based on the previous quaternion***

into a current quaternion and predicted axial accelerations without using the measured axial accelerations corresponding to time T;

comparing the predicted axial accelerations, which are based on the measured axial accelerations corresponding to time T-1 and the measured angular velocities corresponding to time T, with the measured axial accelerations corresponding to time T to obtain a first comparison result;

obtaining an updated quaternion associated with time T based on the current quaternion and the first comparison result, which is based on the measured axial accelerations corresponding to time T-1, measured axial accelerations corresponding to time T, and angular velocities corresponding to time T, and using the updated quaternion as a next occurrence of the previous quaternion; and

providing the resulting deviation based on the updated quaternion;

wherein the current quaternion and the predicted axial accelerations are converted from the measured angular velocities corresponding to time T so that the first comparison result and the updated quaternion correspond to time T; and

wherein the processor circuitry is further configured to translate the resultant angles of the resulting deviation in the spatial reference frame into a real-time movement pattern in the display reference frame.

(Emphasis added).

Applicant respectfully asserts that the cited art is legally deficient for rendering claim 1 unpatentable. In particular, the cited art (either individually or in combination) does not teach or reasonably suggest at least the features emphasized above in claim 1.

With respect to the pending rejection, the cited art does not appear to be involved with the various quaternions and the associated times (e.g., time T, time T-1) as recited in claim 1. In particular, Bachman discloses an estimated orientation quaternion 39 which is generated based on angular rate sensor 33. As it is a loop structure, the angular rate (p, q, r) 33 and the measurement vector yo 34 can be generated at any time, such as time T or

T-1, if its relationship with other components and/or the exact round of the loop computation is ignored. However, based on the equation and description in Bachman explaining how the loop computation proceeds, Bachman does not disclose using different quaternions, with respective time frame differences between axial accelerations and angular velocities, as the input of respective computation blocks in the same round of the loop computation. For example, in Applicant's claim 1, the current quaternion (which is based on axial accelerations at time T-1 and angular velocities at time T) is used to produce the predicted axial accelerations, while the previous quaternion (which is based on axial accelerations at time T-1 and angular velocities at time T-1) is used to produce the current quaternion. In contrast, Bachman uses the **same** previous estimated quaternion 39 (col 10; line 50: "where $\hat{q}$ is the previous estimate for q") to conduct quaternion multiplication (Block 35) and discrete time step integration (Block 37).

Bachman further explains how the quaternion multiplication (Block 35) (col 10; line 1) and rate quaternion (Block 37) (col 10; line 21) is computed; specifically, in Equation (16):

$$\hat{q}_{n+1} = \hat{q}_n + \frac{1}{2}\hat{q}^B\omega\Delta t + \alpha[X^T X]^{-1}X^T\varepsilon(\hat{q}_n) \qquad (16)$$
$$= \hat{q}_n + k\Delta t\Delta q_{full} + \hat{q}_{measured}\Delta t$$

,

Bachman summarizes how the rate quaternion $\frac{1}{2}\hat{q}^B\omega$ is computed from Block 37 based on quaternion 39 ($\hat{q}_n$) and how the $\Delta q_{partial}$ (Eq.14) is computed from Block 35 to Block 41 based on the quaternion 39 ($\hat{q}_n$). These two computation results are merged and then integrated by the single integration Block 42 (col 10; line 33). The computations conducted

in each of these blocks are in a specific round of the loop computation. For discrete time step integration, $\hat{q}_{n+1}$ is the sum of $\hat{q}_n$ + 1/2 $\hat{q}$ B$\omega\Delta$ t (integration of the computed result of Block 37, which is based on the quaternion 39) and $\Delta q_{partial}$, which is computed from Block 34, 35, 38, 41 as $\alpha[X^T X] - 1 X^T \varepsilon(\hat{q}_n)$ based on the quaternion 39. That is, even though the same quaternion 39 has been fed to the different routes to obtain rate quaternion and the correction factor respectively, it is the same quaternion 39 which is at an identical time sequence $\hat{q}_n$ as disclosed in Bachman. Thus, the teachings of Bachman clearly differ from the features recited in Applicant's claim 1.

Applicant respectfully asserts that claim 1 is in condition for allowance for at least this reason.

Additionally, as set forth above, Applicant has amended claim 1 to recite, in relevant part:

> . . .
> comparing the predicted axial accelerations, which are based on the measured axial accelerations corresponding to time T-1 and the measured angular velocities corresponding to time T, with the measured axial accelerations corresponding to time T to obtain a first comparison result. . .

This feature also clearly distinguishes over quaternion 39 of Bachman, which the Office interprets as the previous quaternion corresponding to Time T-1. In particular, though Block 37 and Δq_{full} 40 (result of Block 35, later converted to the correction factor $q\varepsilon$ cited in OA page 9) both use angular rate (p, q, r) 33, the angular rate these two components use have a time lapse. Since both Block 37 and Block 35 use the same quaternion 39, Block 37 (which is updated by angular rate sensor 33) uses angular rate at time T, while Block 35 (which is not updated by angular rate sensor 33 at the instant time

frame T) only contains information of angular rate at time T-1. Applicant respectfully asserts that claim 1 is in condition for allowance for at least this additional reason.

For the reasons indicated above, therefore, Applicant respectfully asserts that claim 1 is in condition for allowance.

Independent Claim 9 is Allowable

Claim 9 recites the following:

> 9. A method for determining movements and rotations in dynamic environments, comprising:
> generating, with a rotation sensor having sensor circuitry measured angular velocities;
> generating, with an accelerometer having accelerometer circuitry measured axial accelerations;
> calculating, with a computing processor having processor circuitry, a resulting deviation comprising resultant angles associated with the movements and the rotations in a spatial reference frame by:
> ***providing a previous quaternion corresponding to time T-1 based on the measured axial accelerations corresponding to time T-1 and the measured angular velocities corresponding to time T-1;***
> ***converting the measured angular velocities corresponding to time T based on the previous quaternion into a current quaternion and predicted axial accelerations without using the measured axial accelerations corresponding to time T;***
> ***comparing the predicted axial accelerations, which are based on the measured axial accelerations corresponding to time T-1 and the measured angular velocities corresponding to time T, with the measured axial accelerations corresponding to time T to obtain a first comparison result;***
> ***obtaining an updated quaternion associated with time T based on the current quaternion and the comparison result, which is based on the measured axial accelerations corresponding to time T-1, measured axial accelerations corresponding to time T, and angular velocities corresponding to time T, and using the updated quaternion as a next occurrence of the previous quaternion;*** and

providing the resulting deviation based on the updated quaternion, wherein the current quaternion and the predicted axial accelerations are converted from the measured angular velocities corresponding to time T so that the comparison result and the updated quaternion correspond to time T; and

translating the resultant angles of the resulting deviation in the spatial reference frame into a real-time movement pattern in a display reference frame associated with a display device.

(Emphasis added).

Applicant respectfully asserts that the cited art is legally deficient for rendering claim 9 unpatentable. In particular, the cited art (either individually or in combination) does not teach or reasonably suggest at least the features emphasized above in claim 9.

With respect to the pending rejection, the cited art does not appear to be involved with the various quaternions and the associated times (e.g., time T, time T-1) as recited in claim 9. In particular, Bachman discloses an estimated orientation quaternion 39 which is generated based on angular rate sensor 33. As it is a loop structure, the angular rate (p, q, r) 33 and the measurement vector yo 34 can be generated at any time, such as time T or T-1, if its relationship with other components and/or the exact round of the loop computation is ignored. However, based on the equation and description in Bachman explaining how the loop computation proceeds, Bachman does not disclose using different quaternions, with respective time frame differences between axial accelerations and angular velocities, as the input of respective computation blocks in the same round of the loop computation. For example, in Applicant's claim 9, the current quaternion (which is based on axial accelerations at time T-1 and angular velocities at time T) is used to produce the predicted axial accelerations, while the previous quaternion (which is based on axial accelerations at time T-1 and angular velocities at time T-1) is used to produce the

current quaternion. In contrast, Bachman uses the **same** previous estimated quaternion 39 (col 10; line 50: "where $\hat{q}$ is the previous estimate for q") to conduct quaternion multiplication (Block 35) and discrete time step integration (Block 37).

Bachman further explains how the quaternion multiplication (Block 35) (col 10; line 1) and rate quaternion (Block 37) (col 10; line 21) is computed; specifically, in Equation (16):

$$\hat{q}_{n+1} = \hat{q}_n + \frac{1}{2}\hat{q}^B\omega\Delta t + \alpha[X^T X]^{-1}X^T\varepsilon(\hat{q}_n) \qquad (16)$$
$$= \hat{q}_n + k\Delta t\Delta q_{full} + \dot{q}_{measured}\Delta t$$

,

Bachman summarizes how the rate quaternion $\frac{1}{2}\hat{q}^B\omega$ is computed from Block 37 based on quaternion 39 ($\hat{q}_n$) and how the $\Delta q_{partial}$ (Eq.14) is computed from Block 35 to Block 41 based on the quaternion 39 ($\hat{q}_n$). These two computation results are merged and then integrated by the single integration Block 42 (col 10; line 33). These computations conducted in each blocks are in a specific round of the loop computation. For discrete time step integration, $\hat{q}_{n+1}$ is the sum of $\hat{q}_n$ + 1/2 $\hat{q}$ B$\omega\Delta$ t (integration of the computed result of Block 37, which is based on the quaternion 39) and $\Delta q_{partial}$, which is computed from Block 34, 35, 38, 41 as $\alpha[X^T X]^{-1} X^T \varepsilon(\hat{q}_n)$ based on the quaternion 39. That is, even though the same quaternion 39 has been fed to the different routes to obtain rate quaternion and the correction factor, it is the same quaternion 39 which is at an identical time sequence $\hat{q}_n$ as disclosed in Bachman. Thus, the teachings of Bachman clearly differ from the features recited in Applicant's claim 9.

Applicant respectfully asserts that claim 9 is in condition for allowance for at least this reason.

Additionally, as set forth above, Applicant has amended claim 9 to recite, in relevant part:

> . . .
> comparing the predicted axial accelerations, which are based on the measured axial accelerations corresponding to time T-1 and the measured angular velocities corresponding to time T, with the measured axial accelerations corresponding to time T to obtain a first comparison result. . .

This feature also clearly distinguishes over quaternion 39 of Bachman, which the Office interprets as the previous quaternion corresponding to Time T-1. In particular, though Block 37 and Δq_{full} 40 (result of Block 35, later converted to the correction factor $q\varepsilon$ cited in OA page 9) both use angular rate (p, q, r) 33, the angular rate these two components use have a time lapse. Since both Block 37 and Block 35 use the same quaternion 39, Block 37 (which is updated by angular rate sensor 33) uses angular rate at time T, while Block 35 (which is not updated by angular rate sensor 33 at the instant time frame T) only contains information of angular rate at time T-1. Applicant respectfully asserts that claim 9 is in condition for allowance for at least this additional reason.

For the reasons indicated above, therefore, Applicant respectfully asserts that claim 9 is in condition for allowance.

Dependent Claims are Allowable

Applicant respectfully asserts that the pending dependent claims are allowable for incorporating the features of their respective independent claims. Additionally, these

dependent claims recite other features that may serve as independent bases for patentability.

CONCLUSION

Based on the above, it is respectfully submitted that this application is in condition for allowance.

Should the Examiner feel that further discussion of the application would be conducive to prosecution and allowance of the application, please do not hesitate to contact the undersigned by phone (678-483-8893).

No fee is believed to be due in connection with this submission other than those already submitted. If, however, any fee is believed to be due, you are hereby authorized to charge any such fee to deposit account No. 50-5954.

Respectfully submitted,

McClure, Qualey & Rodack, LLP

/M.PaulQualey,Jr./

By: _____

M. Paul Qualey, Jr., Reg. No. 43,024

Customer No. 109673

UNITED STATES PATENT AND TRADEMARK OFFICE

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

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
15/611,970	06/02/2017	Shun-Nan Liou	250303-1021	5932

109673 7590 05/08/2020

McClure, Qualey & Rodack, LLP
280 Interstate North Circle SE
Suite 550
Atlanta, GA 30339

EXAMINER	
EARLES, BRYAN E	

ART UNIT	PAPER NUMBER
2625	

NOTIFICATION DATE	DELIVERY MODE
05/08/2020	ELECTRONIC

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.

Notice of the Office communication was sent electronically on above-indicated "Notification Date" to the following e-mail address(es):

dan.mcclure@mqrlaw.com
terri.logan@mqrlaw.com
uspatents@mqrlaw.com

PTOL-90A (Rev. 04/07)

Advisory Action Before the Filing of an Appeal Brief	**Application No.** 15/611,970	**Applicant(s)** Liou et al.	
	Examiner BRYAN EARLES	**Art Unit** 2625	**AIA (FITF) Status** No

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

THE REPLY FILED 30 April 2020 FAILS TO PLACE THIS APPLICATION IN CONDITION FOR ALLOWANCE.

NO NOTICE OF APPEAL FILED

1. ☑ The reply was filed after a final rejection. No Notice of Appeal has been filed. 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 if this is a utility or plant application. Note that RCEs are not permitted in design applications. The reply must be filed within one of the following time periods:
   a) ☑ The period for reply expires 3 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.
   c) ☐ A prior Advisory Action was mailed more than 3 months after the mailing date of the final rejection in response to a first after-final reply filed within 2 months of the mailing date of the final rejection.The current period for reply expires ____ months from the mailing date of *the prior Advisory Action* or SIX MONTHS from the mailing date of the final rejection, whichever is earlier.

   Examiner Note: If box 1 is checked, check either box (a), (b) or (c). ONLY CHECK BOX (b) WHEN THIS ADVISORY ACTION IS THE FIRST RESPONSE TO APPLICANTS FIRST AFTER-FINAL REPLY WHICH WAS FILED WITHIN TWO MONTHS OF THE FINAL REJECTION. ONLY CHECK BOX (c) IN THE LIMITED SITUATION SET FORTH UNDER BOX (c). 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) or (c) 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 37CFR 41.37(a).

AMENDMENTS

3. ☑ The proposed amendments 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 37CFR 1.116 and 41.33(a)).
4. ☐ The amendments are not in compliance with 37CFR 1.121. See attached Notice of Non-Compliant Amendment (PTOL-324).
5. ☐ Applicants 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.

AFFIDAVIT OR OTHER EVIDENCE

8. ☐ A declaration(s)/affidavit(s) under **37 CFR 1.130(b)** was/were filed on _____
9. ☐ The affidavit or other evidence filed after 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).
10. ☐ The affidavit or other evidence filed after the date of filing the 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 of good and sufficient reasons why it is necessary and was not earlier presented. See 37 CFR 41.33(d)(1).
11. ☐ 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

12. ☐ The request for reconsideration has been considered but does NOT place the application in condition for allowance because: _____.
13. ☐ Note the attached Information *Disclosure Statement*(s). (PTO/SB/08) Paper No(s). _____
14. ☑ Other: See Continuation Sheet.

STATUS OF CLAIMS

15. The status of the claim(s) is (or will be) as follows:
    Claim(s) allowed:_____.
    Claim(s) objected to:_____.
    Claim(s) rejected:1-4,7-12 and 15-16.
    Claim(s) withdrawn from consideration:_____.

/BRYAN EARLES/ Primary Examiner, Art Unit 2625	

Continuation of REQUEST FOR RECONSIDERATION/OTHER 14. Other:

Applicant's request for entry into AFCP 2.0 is acknowledged, but is denied because the amendments are too extensive. The response cannot be reviewed and a search conducted in the limited amount of time authorized for this pilot program. Therefore, the response is being reviewed under pre-pilot practice

The Applicant is thanked for the amendment dated 30 April 2020. However, if entered, Applicant's proposed claim amendments would newly introduce at least the following limitations:

"providing a previous quaternion corresponding to time T-1 based on the measured axial accelerations corresponding to time T-1 and the measured angular velocities corresponding to time T-1,"

"converting measured angular velocities corresponding to time T without using the measured axial accelerations corresponding to time T,"

"comparing the predicted axial accelerations, which are based on the measured axial accelerations corresponding to time T-1 and the measured angular velocities corresponding to time T" and

"obtaining an updated quaternion ... which is based on the measured axial accelerations corresponding to time T-1, measured axial accelerations corresponding to time T, and angular velocities corresponding to time T" into claim 1 and similar recitations to independent claim 9.

Such limitations if incorporated into present claim language would alter the inventive scope of the claims, requiring additional search and consideration. Due to the proposed amendments not being entered, Applicant's arguments are not commensurate in scope with the current claims.

By such reasoning, non-entry of the proposed Amendment (30 April 2020) is deemed proper and necessary at this time.

AFCP 2.0 Decision	Application No.	Applicant(s)	
	15/611,970	Liou et al.	
	Examiner	Art Unit	AIA (FITF) Status
	BRYAN EARLES	2625	No

This is in response to the After Final Consideration Pilot request filed 30 April 2020.

1. **Improper Request** – The AFCP 2.0 request is improper for the following reason(s) and the after final amendment submitted with the request will be treated under pre-pilot procedure.

   ☐ An AFCP 2.0 request form PTO/SB/434 (or equivalent document) was not submitted.

   ☐ A non-broadening amendment to at least one independent claim was not submitted.

   ☐ The request is not the first proper AFCP 2.0 request submitted in response to the most recent final rejection.

   ☐ Other: _____

2. **Proper Request**

   A. After final amendment submitted with the request will not be treated under AFCP 2.0.
   The after final amendment cannot be reviewed and a search conducted within the guidelines of the pilot program.

   ☑ The after final amendment will be treated under pre-pilot procedure.

   B. Updated search and/or completed additional consideration.
   The examiner performed an updated search and/or completed additional consideration of the after final amendment within the time authorized for the pilot program. The result(s) of the updated search and/or completed additional consideration are:

   ☐ 1. All of the rejections in the most recent final Office action are overcome and a Notice of Allowance is issued herewith.

   ☐ 2. The after final amendment would not overcome all of the rejections in the most recent final Office action . See attached interview summary for further details.

   ☐ 3. The after final amendment was reviewed, and it raises a new issue(s). See attached interview summary for further details.

   ☐ 4. The after final amendment raises new issues, but would overcome all of the rejections in the most recent final Office action. A decision on determining allowability could not be made within the guidelines of the pilot. See attached interview summary for further details, including any newly discovered prior art.

   ☐ 5. Other: _____

   Examiner Note: Please attach an interview summary when necessary as described above.

DO NOT ENTER: /BE/

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

First Named Inventor:

Liou, et al.

Serial No.: 15/611,970

Filed: June 2, 2017

Confirmation No.: 5932

Group Art Unit: 2625

Examiner: Earles, Bryan E.

MQR Ref.: 250303-1021
Client Ref.: CWM11002-1-US

For: Electronic Device for Use in Motion Detection and Method for Obtaining Resultant Deviation Thereof

RESPONSE TO OFFICE ACTION

Mail Stop: AF
Commissioner for Patents
P.O. Box 1450
Alexandria, Virginia 22313-1450

Director:

The Office Action mailed on 30 January 2020 has been carefully considered. In response, Applicant respectfully submits the following amendments and remarks pursuant to the After Final Consideration Pilot.

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

PTO/SB/30EFS (02-18)
Approved for use through 11/30/2020. 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.

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

Application Number	15611970	Filing Date	2017-06-02	Docket Number (if applicable)	250303-1021	Art Unit	2625
First Named Inventor	Shun-Nan LIOU, et al.			Examiner Name	Earles, Bryan E.		

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 PTO Form SB 08A

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 505954

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 (02-18)
Approved for use through 11/30/2020. 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	/M.PaulQualey,Jr./	Date (YYYY-MM-DD)	2020-05-14
Name	M. Paul Qualey, Jr.	Registration Number	43024

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.

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

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

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

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

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

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

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

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

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

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

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

First Named Inventor:

Shun-Nan LIOU, et al.

Serial No.: 15/611,970

Filed: June 02, 2017

Confirmation No.: 5932

Group Art Unit: 2625

Examiner: Earles, Bryan E.

Docket No. 250303-1021

For: Electronic Device For Use In motion Detection and Method For Obtaining Resultant Deviation Thereof

INFORMATION DISCLOSURE STATEMENT

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

Sir:

This information disclosure statement is filed in accordance with 37 C.F.R. §§ 1.56, 1.97, and 1.98, and specifically:

Applicant(s) submit herewith Form PTO SB/08A-08B-08a - Information Disclosure Statement by Applicant together with copies (where required) of patents, publications or other information of which applicant(s) are aware and for which there may be a duty to disclose in accordance with 37 CFR 1.56. As required by 37 C.F.R. §1.98(a), a legible copy of each document is provided.

Please note that U.S. Patent No. 6,993,451 is the English language counterpart to Chinese reference no. CN 1573672. U.S. Patent No. 7,389,590 is the English language counterpart to Chinese reference no. CN 1971310. U.S. Publication No. 2007/273645 is the English language counterpart to Chinese reference no. CN 101078957. U.S. Patent No. 8,531,399 is the English language counterpart to Chinese reference no. CN 101606120.

The abstract provided for CN 100440313 is from corresponding application no. CN 1973316.

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This statement should not be construed as a representation that an exhaustive search has been made, or that information more material to the examination of the present application does not exist. Any statements or identifications regarding the relevance of any portion(s) of cited references should not be construed as a representation that the most relevant portion(s) have been identified, and the absence of such statements or identifications should not be construed as representations that there are no relevant portion(s). The Examiner is specifically requested not to rely solely on the materials submitted herewith. The Examiner is requested to conduct an independent and thorough review of the documents, and to form independent opinions as to their significance.

It is requested that the information disclosed herein be made of record in this application and that the Examiner initial and return a copy of the enclosed PTO SB/08A-08B-08a to indicate the documents have been considered.

If any fee is due in connection with this submission, and is not otherwise provided herewith, you are hereby authorized to charge any such fee to deposit account No. 50-5954.

Respectfully submitted,

/M.PaulQualey,Jr./

By: _____

M. Paul Qualey Jr.
Registration No. 43,024

Customer No. 109673

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

PTO/SB/08a (02-18)
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INFORMATION DISCLOSURE STATEMENT BY APPLICANT (**Not for submission under 37 CFR 1.99)**		
	Application Number	15611970
	Filing Date	2017-06-02
	First Named Inventor	Shun-Nan LIOU, et al.
	Art Unit	2625
	Examiner Name	Earles, Bryan E.
	Attorney Docket Number	250303-1021

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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
	1	6993451	B2	2006-01-31	Chang, et al.	
	2	7389590	B2	2008-06-24	Lee, et al.	
	3	8531399	B2	2013-09-10	Kabasawa, et al.	
	4	5181181	A	1993-01-19	Glynn	
	5	5453758	A	1995-09-26	Sato	
	6	7089148	B1	2006-08-08	Bachmann, et al.	
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	Attorney Docket Number	250303-1021

Examiner Initial*	Cite No	Publication Number	Kind Code[1]	Publication Date	Name of Patentee or Applicant of cited Document	Pages,Columns,Lines where Relevant Passages or Relevant Figures Appear
	1	20070273645	A1	2007-11-29	Bang, et al.	
	2	20040095317	A1	2004-05-20	Zhang, et al.	
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	1	102778965	CN	A	2012-11-14	BRITISH VIRGIN ISLANDS CYWEE CO LTD	Abstract	☒
	2	102778965	CN	A	2012-11-14	BRITISH VIRGIN ISLANDS CYWEE CO LTD		☐
	3	1573672	CN	A	2005-02-02	SAMSUNG ELECTRONICS CO LTD	Abstract	☒
	4	1573672	CN	A	2005-02-02	SAMSUNG ELECTRONICS CO LTD		☐
	5	1971310	CN	A	2007-05-30	SAMSUNG ELECTRONICS CO LTD	Abstract	☒

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	Examiner Name	Earles, Bryan E.
	Attorney Docket Number	250303-1021

	6	1971310	CN	A	2007-05-30	SAMSUNG ELECTRONICS CO LTD		☐
	7	100440313	CN	C	2008-12-03	HILLCREST LAB INC	Abstract	☐
	8	100440313	CN	C	2008-12-03	HILLCREST LAB INC		☐
	9	101078957	CN	A	2007-11-28	SAMSUNG ELECTRONICS CO LTD	Abstract	☒
	10	101078957	CN	A	2007-11-28	SAMSUNG ELECTRONICS CO LTD		☐
	11	101173858	CN	A	2008-05-07	BEIJING CONTROL ENGINEERING IN	Abstract	☒
	12	101173858	CN	A	2008-05-07	BEIJING CONTROL ENGINEERING IN		☐
	13	101256456	CN	A	2008-09-03	HILLCREST COMM INC	Abstract	☒
	14	101256456	CN	A	2008-09-03	HILLCREST COMM INC		☐
	15	101377722	CN	A	2009-03-04	IND TECH RES INST	Abstract	☒
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	Attorney Docket Number	250303-1021

	17	101427570	CN	A	2009-05-06	HILLCREST LAB INC	Abstract	☒
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	28	101872259	CN	A	2010-10-27	SECOND ARTILLERY ENGINEERING UNIVERSITY OF THE CHI		☐
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	31	102778965	CN	B	2017-04-12	BRITISH VIRGIN ISLANDS CYWEE CO LTD		☐
	32	201514612	CN	U	2010-06-23	JIANKANG WU	Abstract	☒
	33	201514612	CN	U	2010-06-23	JIANKANG WU		☐
	34	1 731 996	EP	A2	2006-12-13	ZHANG GUANGLIE; SHI GUANGYI; LUO YILUN; et al.		☐
	35	2007-183138	JP	A	2007-07-19	NONAMI KENZO; SHIN SHIN; SUZUKI SATOSHI; NAKAZAWA	Abstract	☒
	36	2007-183138	JP	A	2007-07-19	NONAMI KENZO; SHIN SHIN; SUZUKI SATOSHI; NAKAZAWA		☐
	37	10-2009-0106767	KR	A	2009-10-12	LG ELECTRONICS INC	Abstract	☒
	38	10-2009-0106767	KR	A	2009-10-12	LG ELECTRONICS INC		☐

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	Examiner Name	Earles, Bryan E.
	Attorney Docket Number	250303-1021

	39	10-2010-0091854	KR	A	2010-08-19	LG ELECTRONICS INC	Abstract	☒
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	1	Chinese language office action dated 2019-05-15, issued in application no. CN 201210084834.6.	
	2	Chinese language office action dated 2019-05-16, issued in application no. CN 201210084834.6.	
	3	Chinese language office action dated 2019-05-17, issued in application no. CN 201210084834.6.	
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	Application Number	15611970
	Filing Date	2017-06-02
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	Art Unit	2625
	Examiner Name	Earles, Bryan E.
	Attorney Docket Number	250303-1021

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	Filing Date	2017-06-02
	First Named Inventor	Shun-Nan LIOU, et al.
	Art Unit	2625
	Examiner Name	Earles, Bryan E.
	Attorney Docket Number	250303-1021

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.

The fee set forth in 37 CFR 1.17 (p) has been submitted herewith.

A certification statement is not submitted herewith.

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	/M.PaulQualey,Jr./	Date (YYYY-MM-DD)	2020-05-14
Name/Print	M. Paul Qualey Jr.	Registration Number	43,024

This collection of information is required by 37 CFR 1.97 and 1.98. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.14. This collection is estimated to take 1 hour to complete, including gathering, preparing and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. **SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.**

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Application Number:	15611970
Filing Date:	02-Jun-2017
Title of Invention:	ELECTRONIC DEVICE FOR USE IN MOTION DETECTION AND METHOD FOR OBTAINING RESULTANT DEVIATION THEREOF
First Named Inventor/Applicant Name:	Shun-Nan Liou
Filer:	Michael P. Qualey/Brooke French
Attorney Docket Number:	250303-1021
Filed as Small Entity	
Filing Fees for Utility under 35 USC 111(a)	

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($)
Miscellaneous:				
RCE- 2ND AND SUBSEQUENT REQUEST	2820	1	950	950
		Total in USD ($)		**950**

Electronic Acknowledgement Receipt	
EFS ID:	39441592
Application Number:	15611970
International Application Number:	
Confirmation Number:	5932
Title of Invention:	ELECTRONIC DEVICE FOR USE IN MOTION DETECTION AND METHOD FOR OBTAINING RESULTANT DEVIATION THEREOF
First Named Inventor/Applicant Name:	Shun-Nan Liou
Customer Number:	109673
Filer:	Michael P. Qualey/Brooke French
Filer Authorized By:	Michael P. Qualey
Attorney Docket Number:	250303-1021
Receipt Date:	14-MAY-2020
Filing Date:	02-JUN-2017
Time Stamp:	13:51:53
Application Type:	Utility under 35 USC 111(a)

Payment information:

Submitted with Payment	yes
Payment Type	CARD
Payment was successfully received in RAM	$950
RAM confirmation Number	E20205DD52186656
Deposit Account	505954
Authorized User	Brooke French
The Director of the USPTO is hereby authorized to charge indicated fees and credit any overpayment as follows: 37 CFR 1.16 (National application filing, search, and examination fees) 37 CFR 1.17 (Patent application and reexamination processing fees)	

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35	Foreign Reference	00789452.PDF	4273650 4cc3a771bec22501a1b86f484429b97d12687db0	no	44
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39	Non Patent Literature	00789587.PDF	18364344 6cc830a594558030539 4fb216247df6d910baee9	no	37
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Information:					
40	Non Patent Literature	00789461.PDF	19318216 4367a3dcd242d433f30caf807d70377715cb3987	no	37
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Information:					
41	Non Patent Literature	00789590.PDF	13686262 82a73f9cca383beac288027fd46282e5df324705	no	32
Warnings:					
Information:					

42	Non Patent Literature	00789591.PDF	13103399 8d072123c82c6294e8d3781447619f82f1ef58ac	no	33
Warnings:					
Information:					
43	Non Patent Literature	00789463.PDF	12760672 052db5d627a9d7a6eab51e5af9ac105121a0f121	no	33
Warnings:					
Information:					
44	Foreign Reference	00789465.PDF	95730 5fbc7216aaab25d6cda652157b6d6becfb35aa1b	no	2
Warnings:					
Information:					
45	Foreign Reference	00789466.PDF	11085655 a84626bfe60f3ec6a5b1c19aa1eca61619b6e1d5	no	18
Warnings:					
Information:					
46	Foreign Reference	00789468.PDF	99359 438899bce6d26bc6e359dd135aac8ca349d6687e	no	1
Warnings:					
Information:					
47	Foreign Reference	00789469.PDF	328492 8318b5db3d22c75720d6595938ed098721ac63a4	no	8
Warnings:					
Information:					
48	Foreign Reference	00789470.PDF	100821 aaa587025b1472f84f03e8fde245fa8c614b9ac6	no	1
Warnings:					
Information:					

49	Foreign Reference	00789471.PDF	508808 afc6cc5defcc2b509deb29c302f26a9a85df059e	no	11
Warnings:					
Information:					
50	Fee Worksheet (SB06)	fee-info.pdf	30547 0e0857c4f58f0b358bbd48dd6b10bb37e2bc43c8	no	2
Warnings:					
Information:					
			Total Files Size (in bytes):	131121617	

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.

Notice of Allowability	Application No. 15/611,970	Applicant(s) Liou et al.	
	Examiner BRYAN EARLES	Art Unit 2625	AIA (FITF) 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 14 May 2020.
   ☐ 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 1-4,7-12 and 15-16 . 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: _____ .

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 _____.

/BRYAN EARLES/
Primary Examiner, Art Unit 2625

DETAILED ACTION

Notice of Pre-AIA or AIA Status

The present application is being examined under the pre-AIA first to invent provisions.

Allowable Subject Matter

The following is an examiner's statement of reasons for allowance:

Claims (1-4, 7-12 and 15-16) are allowed as the prior art does not teach or suggest the applicant's invention.

The amended claim language and the Applicant's remarks (dated 30 April 2020) in response to the First Rejection (dated 30 January 2020) distinguish the Applicant's invention over the references that accompanied the Office Action. The various claimed limitations mentioned in the claims are not taught or suggested by the prior art taken either singly or in combination, with emphasis that it is each claim, taken as a whole, including the interrelationships and interconnections between various claimed elements make them allowable over the prior art of record. In particular, none of the cited prior art teaches or reasonably suggests:

"An electronic device subject to movements and rotations in dynamic environments, comprising:

a display device associated with a display reference frame;

a motion sensor module comprising a rotation sensor and an accelerometer, the rotation sensor having sensor circuitry configured to generate measured angular

velocities and the accelerometer having circuitry configured to generate measured axial accelerations, with both the rotation sensor and the accelerometer being associated with the movements and the rotations of the electronic device in a spatial reference frame; and

a computing processor having processor circuitry configured to calculate a resulting deviation comprising resultant angles associated with the movements and the rotations of the electronic device in the spatial reference frame by:

providing a previous quaternion corresponding to time T-1 based on the measured axial accelerations corresponding to time T-1 and the measured angular velocities corresponding to time T-1;

converting the measured angular velocities corresponding to time T based on the previous quaternion into a current quaternion and predicted axial accelerations *without using the measured axial accelerations corresponding to time T*;

comparing the predicted axial accelerations, which are based on the measured axial accelerations corresponding to time T-1 and the measured angular velocities corresponding to time T, with the measured axial accelerations corresponding to time T to obtain a first comparison result;

obtaining an updated quaternion associated with time T based on the current quaternion and the first comparison result, which is based on the measured axial accelerations corresponding to time T-1, measured axial accelerations corresponding to time T, and angular velocities corresponding to

time T, and using the updated quaternion as a next occurrence of the previous quaternion; and

providing the resulting deviation based on the updated quaternion;

wherein the current quaternion and the predicted axial accelerations are converted from the measured angular velocities corresponding to time T so that the first comparison result and the updated quaternion correspond to time T; and

wherein the processor circuitry is further configured to translate the resultant angles of the resulting deviation in the spatial reference frame into a real-time movement pattern in the display reference frame."

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

Conclusion

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Bryan Earles whose telephone number is (571)272-4628. The examiner can normally be reached on Monday-Friday at 8am-5pm.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, William Boddie can be reached on (571)272-0666. 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.

/BRYAN EARLES/
Primary Examiner, Art Unit 2625

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

PTO/SB/08a (02-18)
Approved for use through 11/30/2020. 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.

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

Application Number	15611970
Filing Date	2017-06-02
First Named Inventor	Shun-Nan LIOU, et al.
Art Unit	2625
Examiner Name	Earles, Bryan E.
Attorney Docket Number	250303-1021

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
	1	6993451	B2	2006-01-31	Chang, et al.	
	2	7389590	B2	2008-06-24	Lee, et al.	
	3	8531399	B2	2013-09-10	Kabasawa, et al.	
	4	5181181	A	1993-01-19	Glynn	
	5	5453758	A	1995-09-26	Sato	
	6	7089148	B1	2006-08-08	Bachmann, et al.	
	7	7414611	B2	2008-08-19	Liberty	

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	Attorney Docket Number	250303-1021

Examiner Initial*	Cite No	Publication Number	Kind Code[1]	Publication Date	Name of Patentee or Applicant of cited Document	Pages,Columns,Lines where Relevant Passages or Relevant Figures Appear
	1	20070273645	A1	2007-11-29	Bang, et al.	
	2	20040095317	A1	2004-05-20	Zhang, et al.	
	3	20070091068	A1	2007-04-26	Liberty	

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FOREIGN PATENT DOCUMENTS Remove

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	102778965	CN	A	2012-11-14	BRITISH VIRGIN ISLANDS CYWEE CO LTD	Abstract	☒
	2	102778965	CN	A	2012-11-14	BRITISH VIRGIN ISLANDS CYWEE CO LTD		☐
	3	1573672	CN	A	2005-02-02	SAMSUNG ELECTRONICS CO LTD	Abstract	☒
	4	1573672	CN	A	2005-02-02	SAMSUNG ELECTRONICS CO LTD		☐
	5	1971310	CN	A	2007-05-30	SAMSUNG ELECTRONICS CO LTD	Abstract	☒

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	Examiner Name	Earles, Bryan E.
	Attorney Docket Number	250303-1021

	6	1971310	CN	A	2007-05-30	SAMSUNG ELECTRONICS CO LTD		☐
	7	100440313	CN	C	2008-12-03	HILLCREST LAB INC	Abstract	☐
	8	100440313	CN	C	2008-12-03	HILLCREST LAB INC		☐
	9	101078957	CN	A	2007-11-28	SAMSUNG ELECTRONICS CO LTD	Abstract	☒
	10	101078957	CN	A	2007-11-28	SAMSUNG ELECTRONICS CO LTD		☐
	11	101173858	CN	A	2008-05-07	BEIJING CONTROL ENGINEERING IN	Abstract	☒
	12	101173858	CN	A	2008-05-07	BEIJING CONTROL ENGINEERING IN		☐
	13	101256456	CN	A	2008-09-03	HILLCREST COMM INC	Abstract	☒
	14	101256456	CN	A	2008-09-03	HILLCREST COMM INC		☐
	15	101377722	CN	A	2009-03-04	IND TECH RES INST	Abstract	☒
	16	101377722	CN	A	2009-03-04	IND TECH RES INST		☐

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	Examiner Name	Earles, Bryan E.
	Attorney Docket Number	250303-1021

	17	101427570	CN	A	2009-05-06	HILLCREST LAB INC	Abstract	☒
	18	101427570	CN	A	2009-05-06	HILLCREST LAB INC		☐
	19	101472095	CN	A	2009-07-01	PIXART IMAGING INC	Abstract	☒
	20	101472095	CN	A	2009-07-01	PIXART IMAGING INC		☐
	21	101606120	CN	A	2009-12-16	SONY CORP	Abstract	☒
	22	101606120	CN	A	2009-12-16	SONY CORP		☐
	23	101726295	CN	A	2010-06-09	CHINESE ACAD INST AUTOMATION	Abstract	☒
	24	101726295	CN	A	2010-06-09	CHINESE ACAD INST AUTOMATION		☐
	25	101788860	CN	A	2010-07-28	YUANZHAN TECHNOLOGIES CO LTD	Abstract	☒
	26	101788860	CN	A	2010-07-28			☐
	27	101872259	CN	A	2010-10-27	SECOND ARTILLERY ENGINEERING UNIVERSITY OF THE CHI	Abstract	☒

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	Attorney Docket Number	250303-1021

	28	101872259	CN	A	2010-10-27	SECOND ARTILLERY ENGINEERING UNIVERSITY OF THE CHI		☐
	29	101915580	CN	A	2010-12-15	CHINESE ACAD INST AUTOMATION	Abstract	☒
	30	101915580	CN	A	2010-12-15	CHINESE ACAD INST AUTOMATION		☐
	31	102778965	CN	B	2017-04-12	BRITISH VIRGIN ISLANDS CYWEE CO LTD		☐
	32	201514612	CN	U	2010-06-23	JIANKANG WU	Abstract	☒
	33	201514612	CN	U	2010-06-23	JIANKANG WU		☐
	34	1 731 996	EP	A2	2006-12-13	ZHANG GUANGLIE; SHI GUANGYI; LUO YILUN; et al.		☐
	35	2007-183138	JP	A	2007-07-19	NONAMI KENZO; SHIN SHIN; SUZUKI SATOSHI; NAKAZAWA	Abstract	☒
	36	2007-183138	JP	A	2007-07-19	NONAMI KENZO; SHIN SHIN; SUZUKI SATOSHI; NAKAZAWA		☐
	37	10-2009-0106767	KR	A	2009-10-12	LG ELECTRONICS INC	Abstract	☒
	38	10-2009-0106767	KR	A	2009-10-12	LG ELECTRONICS INC		☐

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	Attorney Docket Number	250303-1021

	39	10-2010-0091854	KR	A	2010-08-19	LG ELECTRONICS INC	Abstract	☒
	40	10-2010-0091854	KR	A	2010-08-19	LG ELECTRONICS INC		☐

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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]
	1	Chinese language office action dated 2019-05-15, issued in application no. CN 201210084834.6.	
	2	Chinese language office action dated 2019-05-16, issued in application no. CN 201210084834.6.	
	3	Chinese language office action dated 2019-05-17, issued in application no. CN 201210084834.6.	
	4	Chinese language document; 2009; pps. 486-659	
	5	Chinese language document; 2015; pps. 242-659	

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

EXAMINER SIGNATURE

Examiner Signature	/BRYAN EARLES/	Date Considered	07/17/2020

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

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	Examiner Name	Earles, Bryan E.
	Attorney Docket Number	250303-1021

[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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	First Named Inventor	Shun-Nan LIOU, et al.
	Art Unit	2625
	Examiner Name	Earles, Bryan E.
	Attorney Docket Number	250303-1021

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.

The fee set forth in 37 CFR 1.17 (p) has been submitted herewith.

A certification statement is not submitted herewith.

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	/M.PaulQualey,Jr./	Date (YYYY-MM-DD)	2020-05-14
Name/Print	M. Paul Qualey Jr.	Registration Number	43,024

This collection of information is required by 37 CFR 1.97 and 1.98. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.14. This collection is estimated to take 1 hour to complete, including gathering, preparing and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. **SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.**

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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.

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NOTICE OF ALLOWANCE AND FEE(S) DUE

109673 7590 07/29/2020

McClure, Qualey & Rodack, LLP
280 Interstate North Circle SE
Suite 550
Atlanta, GA 30339

EXAMINER
EARLES, BRYAN E

ART UNIT	PAPER NUMBER
2625	

DATE MAILED: 07/29/2020

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
15/611,970	06/02/2017	Shun-Nan Liou	250303-1021	5932

TITLE OF INVENTION: ELECTRONIC DEVICE FOR USE IN MOTION DETECTION AND METHOD FOR OBTAINING RESULTANT DEVIATION THEREOF

APPLN. TYPE	ENTITY STATUS	ISSUE FEE DUE	PUBLICATION FEE DUE	PREV. PAID ISSUE FEE	TOTAL FEE(S) DUE	DATE DUE
nonprovisional	SMALL	$500	$0.00	$0.00	$500	10/29/2020

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 ENTITY STATUS shown above. If the ENTITY STATUS is shown as SMALL or MICRO, verify whether entitlement to that entity status still applies.

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

If the ENTITY STATUS is changed from that shown above, on PART B - FEE(S) TRANSMITTAL, complete section number 5 titled "Change in Entity Status (from status indicated above)".

For purposes of this notice, small entity fees are 1/2 the amount of undiscounted fees, and micro entity fees are 1/2 the amount of small entity fees.

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: Maintenance fees are due in utility patents issuing on applications filed on or after Dec. 12, 1980. It is patentee's responsibility to ensure timely payment of maintenance fees when due. More information is available at www.uspto.gov/PatentMaintenanceFees.

PTOL-85 (Rev. 02/11)

PART B - FEE(S) TRANSMITTAL

Complete and send this form, together with applicable fee(s), by mail or fax, or via EFS-Web.

By mail, send to: Mail Stop ISSUE FEE
Commissioner for Patents
P.O. Box 1450
Alexandria, Virginia 22313-1450

By fax, send to: (571)-273-2885

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

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

109673 7590 07/29/2020

McClure, Qualey & Rodack, LLP
280 Interstate North Circle SE
Suite 550
Atlanta, GA 30339

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 transmitted to the USPTO via EFS-Web or by facsimile to (571) 273-2885, on the date below.

(Typed or printed name)
(Signature)
(Date)

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
15/611,970	06/02/2017	Shun-Nan Liou	250303-1021	5932

TITLE OF INVENTION: ELECTRONIC DEVICE FOR USE IN MOTION DETECTION AND METHOD FOR OBTAINING RESULTANT DEVIATION THEREOF

APPLN. TYPE	ENTITY STATUS	ISSUE FEE DUE	PUBLICATION FEE DUE	PREV. PAID ISSUE FEE	TOTAL FEE(S) DUE	DATE DUE
nonprovisional	SMALL	$500	$0.00	$0.00	$500	10/29/2020

EXAMINER	ART UNIT	CLASS-SUBCLASS
EARLES, BRYAN E	2625	345-156000

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 03-09 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 must have been previously recorded, or filed for recordation, as set forth in 37 CFR 3.11 and 37 CFR 3.81(a). 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. Fees submitted: ❑ Issue Fee ❑ Publication Fee (if required) ❑ Advance Order - # of Copies _____

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

❑ Electronic Payment via EFS-Web ❑ Enclosed check ❑ Non-electronic payment by credit card (Attach form PTO-2038)

❑ The Director is hereby authorized to charge the required fee(s), any deficiency, or credit any overpayment to Deposit Account No. _____

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

❑ Applicant certifying micro entity status. See 37 CFR 1.29

❑ Applicant asserting small entity status. See 37 CFR 1.27

❑ Applicant changing to regular undiscounted fee status.

NOTE: Absent a valid certification of Micro Entity Status (see forms PTO/SB/15A and 15B), issue fee payment in the micro entity amount will not be accepted at the risk of application abandonment.
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.
NOTE: Checking this box will be taken to be a notification of loss of entitlement to small or micro entity status, as applicable.

NOTE: This form must be signed in accordance with 37 CFR 1.31 and 1.33. See 37 CFR 1.4 for signature requirements and certifications.

Authorized Signature _____ Date _____

Typed or printed name _____ Registration No. _____

UNITED STATES PATENT AND TRADEMARK OFFICE

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

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
15/611,970	06/02/2017	Shun-Nan Liou	250303-1021	5932

109673 7590 07/29/2020

McClure, Qualey & Rodack, LLP
280 Interstate North Circle SE
Suite 550
Atlanta, GA 30339

EXAMINER	
EARLES, BRYAN E	

ART UNIT	PAPER NUMBER
2625	

DATE MAILED: 07/29/2020

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

The Office has discontinued providing a Patent Term Adjustment (PTA) calculation with the Notice of Allowance.

Section 1(h)(2) of the AIA Technical Corrections Act amended 35 U.S.C. 154(b)(3)(B)(i) to eliminate the requirement that the Office provide a patent term adjustment determination with the notice of allowance. See Revisions to Patent Term Adjustment, 78 Fed. Reg. 19416, 19417 (Apr. 1, 2013). Therefore, the Office is no longer providing an initial patent term adjustment determination with the notice of allowance. The Office will continue to provide a patent term adjustment determination with the Issue Notification Letter that is mailed to applicant approximately three weeks prior to the issue date of the patent, and will include the patent term adjustment on the patent. Any request for reconsideration of the patent term adjustment determination (or reinstatement of patent term adjustment) should follow the process outlined in 37 CFR 1.705.

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.

OMB Clearance and PRA Burden Statement for PTOL-85 Part B

The Paperwork Reduction Act (PRA) of 1995 requires Federal agencies to obtain Office of Management and Budget approval before requesting most types of information from the public. When OMB approves an agency request to collect information from the public, OMB (i) provides a valid OMB Control Number and expiration date for the agency to display on the instrument that will be used to collect the information and (ii) requires the agency to inform the public about the OMB Control Number's legal significance in accordance with 5 CFR 1320.5(b).

The information collected by PTOL-85 Part B 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 30 minutes to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, Virginia 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, Virginia 22313-1450. Under the Paperwork Reduction Act of 1995, no persons are required to respond to a collection of information unless it displays a valid OMB control number.

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:	15611970
Filing Date:	02-Jun-2017
Title of Invention:	ELECTRONIC DEVICE FOR USE IN MOTION DETECTION AND METHOD FOR OBTAINING RESULTANT DEVIATION THEREOF
First Named Inventor/Applicant Name:	Shun-Nan Liou
Filer:	Michael P. Qualey/Brooke French
Attorney Docket Number:	250303-1021

Filed as Small Entity

Filing Fees for Utility under 35 USC 111(a)

Description	Fee Code	Quantity	Amount	Sub-Total in USD($)
Basic Filing:				
Pages:				
Claims:				
Miscellaneous-Filing:				
Petition:				
Patent-Appeals-and-Interference:				
Post-Allowance-and-Post-Issuance:				
UTILITY APPL ISSUE FEE	2501	1	500	500

Description	Fee Code	Quantity	Amount	Sub-Total in USD($)
Extension-of-Time:				
Miscellaneous:				
		Total in USD ($)		**500**

Electronic Acknowledgement Receipt	
EFS ID:	40955424
Application Number:	15611970
International Application Number:	
Confirmation Number:	5932
Title of Invention:	ELECTRONIC DEVICE FOR USE IN MOTION DETECTION AND METHOD FOR OBTAINING RESULTANT DEVIATION THEREOF
First Named Inventor/Applicant Name:	Shun-Nan Liou
Customer Number:	109673
Filer:	Michael P. Qualey/Brooke French
Filer Authorized By:	Michael P. Qualey
Attorney Docket Number:	250303-1021
Receipt Date:	27-OCT-2020
Filing Date:	02-JUN-2017
Time Stamp:	11:29:19
Application Type:	Utility under 35 USC 111(a)

Payment information:

Submitted with Payment	yes
Payment Type	CARD
Payment was successfully received in RAM	$500
RAM confirmation Number	E20200QB29392486
Deposit Account	505954
Authorized User	Brooke French
The Director of the USPTO is hereby authorized to charge indicated fees and credit any overpayment as follows: 37 CFR 1.16 (National application filing, search, and examination fees) 37 CFR 1.17 (Patent application and reexamination processing fees)	

37 CFR 1.19 (Document supply fees)

37 CFR 1.20 (Post Issuance fees)

37 CFR 1.21 (Miscellaneous fees and charges)

File Listing:

Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
1	Issue Fee Payment (PTO-85B)	00836796.PDF	1005536 411f74e24828094bf4e640d3568374e0c6fdd72b	no	1
Warnings:					
Information:					
2	Fee Worksheet (SB06)	fee-info.pdf	30359 a1cc9f7217f2233fe558cde1ef4028cfbe7a1e20	no	2
Warnings:					
Information:					
		Total Files Size (in bytes):	1035895		

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.

PART B - FEE(S) TRANSMITTAL

Complete and send this form, together with applicable fee(s), by mail or fax, or via EFS-Web.

By mail, send to: Mail Stop ISSUE FEE
Commissioner for Patents
P.O. Box 1450
Alexandria, Virginia 22313-1450

By fax, send to: (571)-273-2885

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

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

109673 7590 07/29/2020

McClure, Qualey & Rodack, LLP
280 Interstate North Circle SE
Suite 550
Atlanta, GA 30339

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 transmitted to the USPTO via EFS-Web or by facsimile to (571) 273-2885, on the date below.

(Typed or printed name)
(Signature)
(Date)

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
15/611,970	06/02/2017	Shun-Nan Liou	250303-1021	5932

TITLE OF INVENTION: ELECTRONIC DEVICE FOR USE IN MOTION DETECTION AND METHOD FOR OBTAINING RESULTANT DEVIATION THEREOF

APPLN. TYPE	ENTITY STATUS	ISSUE FEE DUE	PUBLICATION FEE DUE	PREV. PAID ISSUE FEE	TOTAL FEE(S) DUE	DATE DUE
nonprovisional	SMALL	$500	$0.00	$0.00	$500	10/29/2020

EXAMINER	ART UNIT	CLASS-SUBCLASS
EARLES, BRYAN E	2625	345-156000

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 03-09 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 McClure, Qualey &
2 Rodack, LLP
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 must have been previously recorded, or filed for recordation, as set forth in 37 CFR 3.11 and 37 CFR 3.81(a). Completion of this form is NOT a substitute for filing an assignment.

(A) NAME OF ASSIGNEE: CM HK LIMITED

(B) RESIDENCE: (CITY and STATE OR COUNTRY): FORTRESS HILL, HONG KONG

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

4a. Fees submitted: XX Issue Fee ❑ Publication Fee (if required) ❑ Advance Order - # of Copies _____

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

XX Electronic Payment via EFS-Web ❑ Enclosed check ❑ Non-electronic payment by credit card (Attach form PTO-2038)

XX The Director is hereby authorized to charge the required fee(s), any deficiency, or credit any overpayment to Deposit Account No. 50-5954

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

❑ Applicant certifying micro entity status. See 37 CFR 1.29

❑ Applicant asserting small entity status. See 37 CFR 1.27

❑ Applicant changing to regular undiscounted fee status.

NOTE: Absent a valid certification of Micro Entity Status (see forms PTO/SB/15A and 15B), issue fee payment in the micro entity amount will not be accepted at the risk of application abandonment.
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.
NOTE: Checking this box will be taken to be a notification of loss of entitlement to small or micro entity status, as applicable.

NOTE: This form must be signed in accordance with 37 CFR 1.31 and 1.33. See 37 CFR 1.4 for signature requirements and certifications.

Authorized Signature /M.PaulQualey,Jr./ Date 10/27/2020

Typed or printed name M. Paul Qualey, Jr. Registration No. 43,024

PTOL-85 Part B (08-18) Approved for use through 01/31/2020 OMB 0651-0033 U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE

UNITED STATES PATENT AND TRADEMARK OFFICE

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

APPLICATION NO.	ISSUE DATE	PATENT NO.	ATTORNEY DOCKET NO.	CONFIRMATION NO.
15/611,970	12/01/2020	10852846	250303-1021	5932

109673 7590 11/11/2020

McClure, Qualey & Rodack, LLP
280 Interstate North Circle SE
Suite 550
Atlanta, GA 30339

ISSUE NOTIFICATION

The projected patent number and issue date are specified above.

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

The Patent Term Adjustment is 0 day(s). Any patent to issue from the above-identified application will include an indication of the adjustment on the front page.

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

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

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

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

Shun-Nan Liou, Taipei, TAIWAN;
CM HK LIMITED, FORTRESS HILL, HONG KONG;
Zhou Ye, Taipei, TAIWAN;
Chin-Lung Li, Taipei, TAIWAN;

The United States represents the largest, most dynamic marketplace in the world and is an unparalleled location for business investment, innovation, and commercialization of new technologies. The USA offers tremendous resources and advantages for those who invest and manufacture goods here. Through SelectUSA, our nation works to encourage and facilitate business investment. To learn more about why the USA is the best country in the world to develop technology, manufacture products, and grow your business, visit SelectUSA.gov.

IR103 (Rev. 10/09)

PATENT APPLICATION FEE DETERMINATION RECORD Substitute for Form PTO-875	Application or Docket Number 15/611,970

APPLICATION AS FILED - PART I

	(Column 1)	(Column 2)	SMALL ENTITY		OR	OTHER THAN SMALL ENTITY	
FOR	NUMBER FILED	NUMBER EXTRA	RATE($)	FEE($)		RATE($)	FEE($)
BASIC FEE (37 CFR 1.16(a), (b), or (c))	N/A	N/A	N/A	70		N/A	
SEARCH FEE (37 CFR 1.16(k), (i), or (m))	N/A	N/A	N/A	300		N/A	
EXAMINATION FEE (37 CFR 1.16(o), (p), or (q))	N/A	N/A	N/A	360		N/A	
TOTAL CLAIMS (37 CFR 1.16(i))	16 minus 20 =	*	x 40 =	0.00	OR		
INDEPENDENT CLAIMS (37 CFR 1.16(h))	2 minus 3 =	*	x 210 =	0.00			
APPLICATION SIZE FEE (37 CFR 1.16(s))	If the specification and drawings exceed 100 sheets of paper, the application size fee due is $310 ($155 for small entity) for each additional 50 sheets or fraction thereof. See 35 U.S.C. 41(a)(1)(G) and 37 CFR 1.16(s).			0.00			
MULTIPLE DEPENDENT CLAIM PRESENT (37 CFR 1.16(j))				0.00			
* If the difference in column 1 is less than zero, enter "0" in column 2.			TOTAL	730		TOTAL	

APPLICATION AS AMENDED - PART II

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

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

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

PTO/SB/06 (09-11)
Approved for use through 1/31/2014. OMB 0651-0032
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.

PATENT APPLICATION FEE DETERMINATION RECORD Substitute for Form PTO-875	Application or Docket Number 15/611,970	Filing Date 06/02/2017	☐ To be Mailed

ENTITY: ☐ LARGE ☑ SMALL ☐ MICRO

APPLICATION AS FILED - PART I

	(Column 1)	(Column 2)			
FOR	NUMBER FILED	NUMBER EXTRA		RATE ($)	FEE ($)
☐ BASIC FEE (37 CFR 1.16(a), (b), or (c))	N/A	N/A		N/A	
☐ SEARCH FEE (37 CFR 1.16(k), (i), or (m))	N/A	N/A		N/A	
☐ EXAMINATION FEE (37 CFR 1.16(o), (p), or (q))	N/A	N/A		N/A	
TOTAL CLAIMS (37 CFR 1.16(i))	minus 20 =	*		x $40 =	
INDEPENDENT CLAIMS (37 CFR 1.16(h))	minus 3 =	*		x $210 =	
☐ APPLICATION SIZE FEE (37 CFR 1.16(s))	If the specification and drawings exceed 100 sheets of paper, the application size fee due is $310 ($155 for small entity) for each additional 50 sheets or fraction thereof. See 35 U.S.C. 41(a)(1)(G) and 37 CFR 1.16(s).				
☐ MULTIPLE DEPENDENT CLAIM PRESENT (37 CFR 1.16(j))					
* If the difference in column 1 is less than zero, enter "0" in column 2.				TOTAL	

APPLICATION AS AMENDED - PART II

		(Column 1)		(Column 2)	(Column 3)			
AMENDMENT	08/23/2019	CLAIMS REMAINING AFTER AMENDMENT		HIGHEST NUMBER PREVIOUSLY PAID FOR	PRESENT EXTRA		RATE ($)	ADDITIONAL FEE ($)
	Total (37 CFR 1.16(i))	* 16	Minus	** 20	= 0		x $50 =	0
	Independent (37 CFR 1.16(h))	* 2	Minus	*** 3	= 0		x $230 =	0
	☐ Application Size Fee (37 CFR 1.16(s))							
	☐ FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM (37 CFR 1.16(j))							
							TOTAL ADD'L FEE	0

		(Column 1)		(Column 2)	(Column 3)			
AMENDMENT		CLAIMS REMAINING AFTER AMENDMENT		HIGHEST NUMBER PREVIOUSLY PAID FOR	PRESENT EXTRA		RATE ($)	ADDITIONAL FEE ($)
	Total (37 CFR 1.16(i))	*	Minus	**	=		x $0 =	
	Independent (37 CFR 1.16(h))	*	Minus	***	=		x $0 =	
	☐ Application Size Fee (37 CFR 1.16(s))							
	☐ FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM (37 CFR 1.16(j))							
							TOTAL ADD'L FEE	

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

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

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

PTO/SB/06 (09-11)
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U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE
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PATENT APPLICATION FEE DETERMINATION RECORD Substitute for Form PTO-875	Application or Docket Number 15/611,970	Filing Date 06/02/2017	☐ To be Mailed

ENTITY: ☐ LARGE ☑ SMALL ☐ MICRO

APPLICATION AS FILED - PART I

FOR	(Column 1) NUMBER FILED	(Column 2) NUMBER EXTRA		RATE ($)	FEE ($)
☐ BASIC FEE (37 CFR 1.16(a), (b), or (c))	N/A	N/A		N/A	
☐ SEARCH FEE (37 CFR 1.16(k), (i), or (m))	N/A	N/A		N/A	
☐ EXAMINATION FEE (37 CFR 1.16(o), (p), or (q))	N/A	N/A		N/A	
TOTAL CLAIMS (37 CFR 1.16(i))	minus 20 =	*		x $40 =	
INDEPENDENT CLAIMS (37 CFR 1.16(h))	minus 3 =	*		x $210 =	
☐ APPLICATION SIZE FEE (37 CFR 1.16(s))	If the specification and drawings exceed 100 sheets of paper, the application size fee due is $310 ($155 for small entity) for each additional 50 sheets or fraction thereof. See 35 U.S.C. 41(a)(1)(G) and 37 CFR 1.16(s).				
☐ MULTIPLE DEPENDENT CLAIM PRESENT (37 CFR 1.16(j))					
* If the difference in column 1 is less than zero, enter "0" in column 2.				TOTAL	

APPLICATION AS AMENDED - PART II

		(Column 1) CLAIMS REMAINING AFTER AMENDMENT		(Column 2) HIGHEST NUMBER PREVIOUSLY PAID FOR	(Column 3) PRESENT EXTRA		RATE ($)	ADDITIONAL FEE ($)
AMENDMENT	04/30/2020							
	Total (37 CFR 1.16(i))	* 12	Minus	** 20	= 0		x $50 =	0
	Independent (37 CFR 1.16(h))	* 2	Minus	*** 3	= 0		x $230 =	0
	☐ Application Size Fee (37 CFR 1.16(s))							
	☐ FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM (37 CFR 1.16(j))							
							TOTAL ADD'L FEE	0

		(Column 1) CLAIMS REMAINING AFTER AMENDMENT		(Column 2) HIGHEST NUMBER PREVIOUSLY PAID FOR	(Column 3) PRESENT EXTRA		RATE ($)	ADDITIONAL FEE ($)
AMENDMENT								
	Total (37 CFR 1.16(i))	*	Minus	**	=		x $0 =	
	Independent (37 CFR 1.16(h))	*	Minus	***	=		x $0 =	
	☐ Application Size Fee (37 CFR 1.16(s))							
	☐ FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM (37 CFR 1.16(j))							
							TOTAL ADD'L FEE	

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

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

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PTO/SB/06 (09-11)
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PATENT APPLICATION FEE DETERMINATION RECORD Substitute for Form PTO-875	Application or Docket Number 15/611,970	Filing Date 06/02/2017	☐ To be Mailed

ENTITY: ☐ LARGE ☑ SMALL ☐ MICRO

APPLICATION AS FILED - PART I

FOR	(Column 1) NUMBER FILED	(Column 2) NUMBER EXTRA		RATE ($)	FEE ($)
☐ BASIC FEE (37 CFR 1.16(a), (b), or (c))	N/A	N/A		N/A	
☐ SEARCH FEE (37 CFR 1.16(k), (i), or (m))	N/A	N/A		N/A	
☐ EXAMINATION FEE (37 CFR 1.16(o), (p), or (q))	N/A	N/A		N/A	
TOTAL CLAIMS (37 CFR 1.16(i))	minus 20 =	*		x $40 =	
INDEPENDENT CLAIMS (37 CFR 1.16(h))	minus 3 =	*		x $210 =	
☐ APPLICATION SIZE FEE (37 CFR 1.16(s))	If the specification and drawings exceed 100 sheets of paper, the application size fee due is $310 ($155 for small entity) for each additional 50 sheets or fraction thereof. See 35 U.S.C. 41(a)(1)(G) and 37 CFR 1.16(s).				
☐ MULTIPLE DEPENDENT CLAIM PRESENT (37 CFR 1.16(j))					
* If the difference in column 1 is less than zero, enter "0" in column 2.				TOTAL	

APPLICATION AS AMENDED - PART II

		(Column 1) CLAIMS REMAINING AFTER AMENDMENT		(Column 2) HIGHEST NUMBER PREVIOUSLY PAID FOR	(Column 3) PRESENT EXTRA		RATE ($)	ADDITIONAL FEE ($)
AMENDMENT	04/10/2019							
	Total (37 CFR 1.16(i))	* 16	Minus	** 20	= 0		x $50 =	0
	Independent (37 CFR 1.16(h))	* 2	Minus	*** 3	= 0		x $230 =	0
	☐ Application Size Fee (37 CFR 1.16(s))							
	☐ FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM (37 CFR 1.16(j))							
							TOTAL ADD'L FEE	0

		(Column 1) CLAIMS REMAINING AFTER AMENDMENT		(Column 2) HIGHEST NUMBER PREVIOUSLY PAID FOR	(Column 3) PRESENT EXTRA		RATE ($)	ADDITIONAL FEE ($)
AMENDMENT								
	Total (37 CFR 1.16(i))	*	Minus	**	=		x $0 =	
	Independent (37 CFR 1.16(h))	*	Minus	***	=		x $0 =	
	☐ Application Size Fee (37 CFR 1.16(s))							
	☐ FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM (37 CFR 1.16(j))							
							TOTAL ADD'L FEE	

* If the entry in column 1 is less than the entry in column 2, write "0" in column 3.	LIE
** If the "Highest Number Previously Paid For" IN THIS SPACE is less than 20, enter "20".	/VINCENT S BUTLER/
*** If the "Highest Number Previously Paid For" IN THIS SPACE is less than 3, enter "3".	
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PATENT APPLICATION FEE DETERMINATION RECORD Substitute for Form PTO-875	Application or Docket Number 15/611,970	Filing Date 06/02/2017	☐ To be Mailed

ENTITY: ☐ LARGE ☑ SMALL ☐ MICRO

APPLICATION AS FILED - PART I

FOR	(Column 1) NUMBER FILED	(Column 2) NUMBER EXTRA		RATE ($)	FEE ($)
☐ BASIC FEE (37 CFR 1.16(a), (b), or (c))	N/A	N/A		N/A	
☐ SEARCH FEE (37 CFR 1.16(k), (i), or (m))	N/A	N/A		N/A	
☐ EXAMINATION FEE (37 CFR 1.16(o), (p), or (q))	N/A	N/A		N/A	
TOTAL CLAIMS (37 CFR 1.16(i))	minus 20 =	*		x $40 =	
INDEPENDENT CLAIMS (37 CFR 1.16(h))	minus 3 =	*		x $210 =	
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☐ MULTIPLE DEPENDENT CLAIM PRESENT (37 CFR 1.16(j))					
* If the difference in column 1 is less than zero, enter "0" in column 2.				TOTAL	

APPLICATION AS AMENDED - PART II

		(Column 1) CLAIMS REMAINING AFTER AMENDMENT		(Column 2) HIGHEST NUMBER PREVIOUSLY PAID FOR	(Column 3) PRESENT EXTRA		RATE ($)	ADDITIONAL FEE ($)
AMENDMENT	11/04/2019							
	Total (37 CFR 1.16(i))	* 12	Minus	** 20	= 0		x $50 =	0
	Independent (37 CFR 1.16(h))	* 2	Minus	*** 3	= 0		x $230 =	0
	☐ Application Size Fee (37 CFR 1.16(s))							
	☐ FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM (37 CFR 1.16(j))							
							TOTAL ADD'L FEE	0

		(Column 1) CLAIMS REMAINING AFTER AMENDMENT		(Column 2) HIGHEST NUMBER PREVIOUSLY PAID FOR	(Column 3) PRESENT EXTRA		RATE ($)	ADDITIONAL FEE ($)
AMENDMENT								
	Total (37 CFR 1.16(i))	*	Minus	**	=		x $0 =	
	Independent (37 CFR 1.16(h))	*	Minus	***	=		x $0 =	
	☐ Application Size Fee (37 CFR 1.16(s))							
	☐ FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM (37 CFR 1.16(j))							
							TOTAL ADD'L FEE	

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

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Search Notes	Application/Control No.	Applicant(s)/Patent Under Reexamination
	15/611,970	Liou et al.
	Examiner	Art Unit
	BRYAN EARLES	2625

CPC - Searched*		
Symbol	Date	Examiner
G01C21/165, G01C21/$, G06F1/1694, G06F3/0346	11/19/2018	BE

CPC Combination Sets - Searched*		
Symbol	Date	Examiner

US Classification - Searched*			
Class	Subclass	Date	Examiner
715	821,822,823,824	11/19/2018	BE
702	141,150,151	11/19/2018	BE

* See search history printout included with this form or the SEARCH NOTES box below to determine the scope of the search.

Search Notes		
Search Notes	Date	Examiner
Inventor Search	11/19/2018	BE
715/821,822,823,824	11/19/2018	BE
G01C21/165, G01C21/$, G06F1/1694, G06F3/0346	11/19/2018	BE
EAST Classification/Text Search	11/19/2018	BE
702/141,150,151	11/19/2018	BE
Updated Search	05/21/2019	BE
Updated Search	01/24/2020	BE

/BRYAN EARLES/ Primary Examiner, Art Unit 2625	

Search Notes	Application/Control No.	Applicant(s)/Patent Under Reexamination
	15/611,970	Liou et al.
	Examiner	Art Unit
	BRYAN EARLES	2625

Interference Search			
US Class/CPC Symbol	US Subclass/CPC Group	Date	Examiner

/BRYAN EARLES/ Primary Examiner, Art Unit 2625	

Search Notes	Application/Control No.	Applicant(s)/Patent Under Reexamination
	15/611,970	Liou et al.
	Examiner	Art Unit
	BRYAN EARLES	2625

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Symbol	Date	Examiner
G01C21/165, G01C21/$, G06F1/1694, G06F3/0346	11/19/2018	BE

CPC Combination Sets - Searched*		
Symbol	Date	Examiner

US Classification - Searched*			
Class	Subclass	Date	Examiner
715	821,822,823,824	11/19/2018	BE
702	141,150,151	11/19/2018	BE

* See search history printout included with this form or the SEARCH NOTES box below to determine the scope of the search.

Search Notes		
Search Notes	Date	Examiner
Inventor Search	11/19/2018	BE
715/821,822,823,824	11/19/2018	BE
G01C21/165, G01C21/$, G06F1/1694, G06F3/0346	11/19/2018	BE
EAST Classification/Text Search	11/19/2018	BE
702/141,150,151	11/19/2018	BE

Interference Search			
US Class/CPC Symbol	US Subclass/CPC Group	Date	Examiner

/BRYAN EARLES/ Primary Examiner, Art Unit 2625	

Issue Classification	Application/Control No.	Applicant(s)/Patent Under Reexamination
	15/611,970	Liou et al.
	Examiner	**Art Unit**
	BRYAN EARLES	2625

CPC						
Symbol					**Type**	**Version**
G06F	/	3	/	0346	F	2013-01-01
G01C	/	21	/	165	I	2013-01-01
G06F	/	3	/	0383	I	2013-01-01

CPC Combination Sets								
Symbol					**Type**	**Set**	**Ranking**	**Version**
	/		/					

NONE		Total Claims Allowed:	
(Assistant Examiner)	(Date)	12	
/BRYAN EARLES/ Primary Examiner, Art Unit 2625	17 July 2020	O.G. Print Claim(s)	O.G. Print Figure
(Primary Examiner)	(Date)	1	5

U.S. Patent and Trademark Office — Part of Paper No.: 20200717

Issue Classification	Application/Control No.	Applicant(s)/Patent Under Reexamination
	15/611,970	Liou et al.
	Examiner	**Art Unit**
	BRYAN EARLES	2625

INTERNATIONAL CLASSIFICATION				
CLAIMED				
G06F	/	3	/	0346
G06F	/	3	/	038
G01C	/	21	/	16

NON-CLAIMED				
	/		/	

US ORIGINAL CLASSIFICATION	
CLASS	**SUBCLASS**

CROSS REFERENCES(S)						
CLASS	**SUBCLASS (ONE SUBCLASS PER BLOCK)**					

NONE		**Total Claims Allowed:**	
(Assistant Examiner)	(Date)	12	
/BRYAN EARLES/ Primary Examiner, Art Unit 2625	17 July 2020	O.G. Print Claim(s)	O.G. Print Figure
(Primary Examiner)	(Date)	1	5

U.S. Patent and Trademark Office — Part of Paper No.: 20200717

Issue Classification	Application/Control No.	Applicant(s)/Patent Under Reexamination
	15/611,970	Liou et al.
	Examiner	**Art Unit**
	BRYAN EARLES	2625

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

CLAIMS

Final	Original	Final	Original	Final	Original	Final	Original	Final	Original	Final	Original	Final	Original	Final	Original
1	1	10	12												
2	2	11	15												
3	3	12	16												
4	4														
5	7														
6	8														
7	9														
8	10														
9	11														

NONE		**Total Claims Allowed:**	
(Assistant Examiner)	(Date)	12	
/BRYAN EARLES/ Primary Examiner, Art Unit 2625	17 July 2020	O.G. Print Claim(s)	O.G. Print Figure
(Primary Examiner)	(Date)	1	5

U.S. Patent and Trademark Office — Part of Paper No.: 20200717

Search Notes	Application/Control No.	Applicant(s)/Patent Under Reexamination
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	Examiner	Art Unit
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Symbol	Date	Examiner
G01C21/165, G01C21/$, G06F1/1694, G06F3/0346	11/19/2018	BE

CPC Combination Sets - Searched*		
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702	141,150,151	11/19/2018	BE

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Search Notes	Date	Examiner
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715/821,822,823,824	11/19/2018	BE
G01C21/165, G01C21/$, G06F1/1694, G06F3/0346	11/19/2018	BE
EAST Classification/Text Search	11/19/2018	BE
702/141,150,151	11/19/2018	BE
Updated Search	05/21/2019	BE
Updated Search	01/24/2020	BE
Interference Search	07/17/2020	BE
IPR2018-01258 Reviewed Petition for Inter Partes Review of U.S. Patent No. 8,441,438	07/17/2020	BE

/BRYAN EARLES/ Primary Examiner, Art Unit 2625	

Search Notes	Application/Control No.	Applicant(s)/Patent Under Reexamination
	15/611,970	Liou et al.
	Examiner	Art Unit
	BRYAN EARLES	2625

Interference Search			
US Class/CPC Symbol	US Subclass/CPC Group	Date	Examiner
G06F	1/1694, 3/017, 3/0346	07/17/2020	BE
G01C	21/165	07/17/2020	BE
345	ALL	07/17/2020	BE
715	821-824	07/17/2020	BE

/BRYAN EARLES/ Primary Examiner, Art Unit 2625	

Search Notes	Application/Control No.	Applicant(s)/Patent Under Reexamination
	15/611,970	Liou et al.
	Examiner	Art Unit
	BRYAN EARLES	2625

CPC - Searched*		
Symbol	Date	Examiner
G01C21/165, G01C21/$, G06F1/1694, G06F3/0346	11/19/2018	BE

CPC Combination Sets - Searched*		
Symbol	Date	Examiner

US Classification - Searched*			
Class	Subclass	Date	Examiner
715	821,822,823,824	11/19/2018	BE
702	141,150,151	11/19/2018	BE

* See search history printout included with this form or the SEARCH NOTES box below to determine the scope of the search.

Search Notes		
Search Notes	Date	Examiner
Inventor Search	11/19/2018	BE
715/821,822,823,824	11/19/2018	BE
G01C21/165, G01C21/$, G06F1/1694, G06F3/0346	11/19/2018	BE
EAST Classification/Text Search	11/19/2018	BE
702/141,150,151	11/19/2018	BE
Updated Search	05/21/2019	BE

Interference Search			
US Class/CPC Symbol	US Subclass/CPC Group	Date	Examiner

/BRYAN EARLES/ Primary Examiner, Art Unit 2625	

EAST Search History

EAST Search History (Prior Art)

Ref #	Hits	Search Query	DBs	Default Operator	Plurals	Time Stamp
S111	912	(euler azimuth) with (orientation angle) with (sensitiv$3 sensitivit$3)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2016/12/01 09:02
S122	37	(US-20090182503-$ or US-20090262074-$ or US-20080042973-$ or US-20110109436-$ or US-20080042975-$ or US-20090046056-$ or US-20100161084-$ or US-20050212911-$ or US-20090062005-$ or US-20100169843-$ or US-20090115724-$ or US-20090326857-$ or US-20110199298-$ or US-20070213889-$ or US-20020100178-$).did. or (US-7743519-$ or US-7376527-$ or US-6876926-$ or US-7533569-$ or US-7683883-$ or US-8413077-$ or US-9229540-$ or US-4839838-$ or US-7223173-$ or US-7596466-$ or US-5526022-$ or US-8672763-$ or US-6636826-$ or US-5953683-$ or US-5703623-$ or US-9024772-$ or US-7337549-$ or US-7305315-$ or US-6957156-$ or US-7826999-$ or US-7809505-$ or US-8626465-$).did.	US-PGPUB; USPAT	OR	ON	2016/12/02 23:49
S169	0	(15/265639).APP.	USPAT; USOCR	OR	ON	2018/10/23 09:23
S177	1	(09/726894).APP.	USPAT; USOCR	OR	ON	2018/10/23 09:40
S176	45	("20020093483" | "20020190947" | "20040027330" | "20040061621" | "20040178995" | "4812831" | "5112785" | "5142655" | "5506605" | "5543588" | "5598187" | "5602566" | "5734371" | "5766015" | "6008810" | "6057554" | "6088023" | "6121960" | "6184847" | "6201554" | "6245014" | "6288704" | "6466198" | "6564144" | "6573883" | "6791536" | "6834249").PN. OR ("7990365").URPN.	US-PGPUB; USPAT; USOCR	OR	ON	2018/10/23 09:40
S179	107	("5602566" | "6201554" | "6400376" | "6466198" | "6567068" | "6567101").PN. OR ("6690358").URPN.	US-PGPUB; USPAT; USOCR	OR	ON	2018/10/23 09:41
S178	101	("6690358").URPN.	USPAT	OR	ON	2018/10/23 09:41
S185	2083	(mem mems microelectromechanical) with magnetometer	US-PGPUB; USPAT; USOCR	OR	ON	2018/10/23 09:56

S187	8173	velocit$3 same acceleration same (magnetism flux (magnetic near field))	US-PGPUB; USPAT; USOCR	OR	ON	2018/10/23 09:58
S208	3548	702/141,151.ccls.	US-PGPUB; USPAT; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2018/10/23 13:32
S209	7729	702/141,150,151.ccls.	US-PGPUB; USPAT; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2018/10/23 13:33
S210	2	"8441438".pn.	US-PGPUB; USPAT; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2018/10/23 13:46
L9	0	(12/166930).APP.	USPAT; USOCR	OR	ON	2018/11/19 11:54
L8	52	("20020190947" | "20030001863" | "20030058118" | "20050030286" | "20050246109" | "20060044268" | "20060150731" | "20060163825" | "20070146323" | "5408879" | "5835077" | "6060336" | "6332104" | "6377888" | "6419240" | "6466198" | "6567068" | "6573883" | "6588769" | "6640609" | "6642067" | "6690358" | "6718244" | "6752401" | "6829524" | "6847351" | "6847875" | "6892575" | "6977675" | "6983219" | "6992585" | "7023330" | "7038662" | "7059182" | "7084762" | "7136731" | "7138979" | "7140250" | "7170374" | "7180500" | "7180501" | "7180502" | "7184025" | "7194816" | "7206679" | "7602301").PN. OR ("7966146").URPN.	US-PGPUB; USPAT; USOCR	OR	ON	2018/11/19 11:54
L11	43	("20020158815" | "20030023192" | "20070287911" | "20080080789" | "20080211768" | "20080281555" | "20090009471" | "20090153349" | "20100060573" | "20100149341" | "20100194879" | "5128671" | "5645077" | "5819206" | "5874941" | "6176837" | "7139983" | "7158118" | "7216055" | "7262760" | "7296363" | "7350303" | "7414611" | "7451549" | "7844415").PN. OR ("8223121").URPN.	US-PGPUB; USPAT; USOCR	OR	ON	2018/11/19 12:02
L12	44	("20020188416" | "20030115930" | "20040140962" | "20050162382" | "20050174324" | "20050243062" | "20050270494" | "20060152488" | "20060258465" | "20060274032" | "20060287085" | "20070060228" | "20070176899" | "20070257885" | "20070259717" | "20070265075" | "20080042973" | "20080068336" | "20080076566" | "20080105050" |	US-PGPUB; USPAT; USOCR	OR	ON	2018/11/19 12:06

		"20080125223" | "20080174550" | "20080190201" | "20080204407" | "20080211768" | "20080278445" | "20090183193" | "20090326858" | "20100097316" | "20110307213" | "5138154" | "5181181" | "5440326" | "5698784" | "5825350" | "5898421" | "7138979" | "7405725" | "7414611" | "8223121" | "8277316").PN. OR ("8614672").URPN.				
L14	45	("2008/0042973").URPN.	USPAT	OR	ON	2018/11/19 12:12
L16	68	("4038876" | "4134681" | "4318300" | "4399692" | "4454756" | "4827624" | "4914598" | "5031330" | "5148604" | "5172323" | "5210954" | "5237753" | "5241850" | "5287628" | "5335190" | "5351539" | "5381604" | "5392112" | "5400033" | "5615132" | "5819206" | "6061611" | "6088653" | "6176837" | "6205401" | "6246960" | "6292759" | "6389333" | "6421622" | "6480152" | "6647352").PN. OR ("7216055").URPN.	US-PGPUB; USPAT; USOCR	OR	ON	2018/11/19 12:46
L17	49	("20020158815" | "20030023192" | "20030107888" | "20060033716" | "20060164384" | "20060164386" | "20060250358" | "20070287911" | "20080080789" | "20080211768" | "20080281555" | "20090009471" | "20090040175" | "20090153349" | "20100039381" | "20100060573" | "20100095773" | "20100097316" | "20100123656" | "20100149341" | "20100156786" | "20100194879" | "20110163947" | "20110205156" | "5128671" | "5645077" | "5757360" | "5819206" | "5874941" | "6072467" | "6157894" | "6176837" | "7139983" | "7158118" | "7216055" | "7262760" | "7296363" | "7350303" | "7414611" | "7451549" | "7647185" | "7844415" | "8223121").PN. OR ("8587519").URPN.	US-PGPUB; USPAT; USOCR	OR	ON	2018/11/19 12:50
L20	1	(12/340820).APP.	USPAT; USOCR	OR	ON	2018/11/19 13:14
L32	1	"6820025".pn.	US-PGPUB; USPAT; USOCR	OR	ON	2018/11/19 14:05
L35	1	"20080042973"	US-PGPUB; USOCR	OR	ON	2018/11/19 15:21

EAST Search History (Interference)

Ref #	Hits	Search Query	DBs	Default Operator	Plurals	Time Stamp
S130	197981	G06F1/1694.cpc. G06F3/0346.cpc. "345".clas. 715/821,822,823,824.ccls.	US-PGPUB; USPAT	OR	ON	2017/02/22 09:06
S133	1055179	((suppress$3 or reduc$3 or cancel$3 or subtract$3 or remov$3 or mask$3 or eliminat$3 or filter$3 or curtail$3 or curb$3 or diminish$3 or decreas$3 or	US-PGPUB; USPAT	OR	ON	2017/02/22 09:09

		lessen$3 or lower$3 or cut$3 or minimi$3 or inhibit$3) near3 (noise or fluctuat$3 or transient or distort$3 or cross$1talk$3 or interference or harmonic or perturb$6 or artifact or ripple or spurious or aberration))				
S137	204	((suppress$3 or reduc$3 or cancel$3 or subtract$3 or remov$3 or mask$3 or eliminat$3 or filter$3 or curtail$3 or curb$3 or diminish$3 or decreas$3 or lessen$3 or lower$3 or cut$3 or minimi$3 or inhibit$3) near3 (noise or fluctuat$3 or transient or distort$3 or cross$1talk$3 or interference or harmonic or perturb$6 or artifact or ripple or spurious or aberration) same (euler azimuth attitude)).clm.	US-PGPUB; USPAT	OR	ON	2017/02/22 09:18

11/ 19/ 2018 4:28:53 PM
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Bibliographic Data

Application No: 15/611,970

Foreign Priority claimed: ○ Yes ◉ No

35 USC 119 (a-d) conditions met: ☐ Yes ☑ No ☐ Met After Allowance

Verified and Acknowledged: /BRYAN EARLES/ Examiner's Signature | Initials

Title: ELECTRONIC DEVICE FOR USE IN MOTION DETECTION AND METHOD FOR OBTAINING RESULTANT DEVIATION THEREOF

FILING or 371(c) DATE	CLASS	GROUP ART UNIT	ATTORNEY DOCKET NO.
06/02/2017	345	2625	250303-1021
RULE			

APPLICANTS

CM HK LIMITED, FORTRESS HILL, HONG KONG

INVENTORS

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Zhou Ye Taipei, TAIWAN

Chin-Lung Li Taipei, TAIWAN

CONTINUING DATA

This application is a CON of 13072794 03/28/2011 PAT 9760186

13072794 is a CIP of 12943934 11/11/2010 PAT 8441438

12943934 has PRO of 61292558 01/06/2010

FOREIGN APPLICATIONS

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EAST Search History (Prior Art)

Ref #	Hits	Search Query	DBs	Default Operator	Plurals	Time Stamp
S273	83	(("LIOU") near3 ("Shun-Nan"))".INV.."	US-PGPUB; USPAT; USOCR	OR	ON	2020/07/16 09:36
S272	1,131	(Zhou adj Ye) (Chin$Lung adj Li) (Shun$Nan adj Liou)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2020/07/16 09:36
S277	22	((("Li") near3 ("Chin-Lung"))).INV.	US-PGPUB; USPAT; USOCR	OR	ON	2020/07/16 09:37
S276	211	((("Ye") near3 ("Zhou"))).INV.	US-PGPUB; USPAT	OR	ON	2020/07/16 09:37
S275	34	((("Ye") near3 ("Zhou"))).INV.	EPO; JPO; DERWENT	OR	ON	2020/07/16 09:37
S274	82	((("Liou") near3 ("Shun-Nan"))).INV.	US-PGPUB; USPAT; USOCR	OR	ON	2020/07/16 09:37
L13	3	(eric near3 bachmann).inv.	US-PGPUB; USPAT	OR	ON	2020/07/17 11:16

EAST Search History (Interference)

Ref #	Hits	Search Query	DBs	Default Operator	Plurals	Time Stamp
L2	1,991	((determin$3 determination predict$3 estimat$3 anticipat$3 expect$3 compar$3 comparison) near4 (electro$magnet$3 magnetometer magnet$3) near6 (speed motion movement angular velocit$3 rate)).clm.	US-PGPUB; USPAT	OR	ON	2020/07/17 11:05
L1	1,841	((determin$3 determination predict$3 estimat$3 anticipat$3 expect$3) near4 (electro$magnet$3 magnetometer magnet$3) near6 (speed motion movement angular velocit$3 rate)).clm.	US-PGPUB; USPAT	OR	ON	2020/07/17 11:05
L4	205,043	G06F1/1694.cpc. G06F3/0346.cpc. "345".clas. 715/821,822,823,824.ccls.	US-PGPUB; USPAT	OR	ON	2020/07/17 11:06
L8	209,470	(G06F1/1694 or G06F3/0346 or G01C21/165 or G06F3/0383).cpc. "345".clas. 715/821,822,823,824.ccls.	US-PGPUB; USPAT	OR	ON	2020/07/17 11:10
L10	81	2 and 8	US-PGPUB; USPAT	OR	ON	2020/07/17 11:11

L9	4	((euler azimuth attitude) with (sensitiv$3 sensitivit$3 responsiveness sensitiveness reactivity) with (expect$3 expectation predict$3)).clm.	US-PGPUB; USPAT	OR	ON	2020/07/17 11:11
L12	0	"Term Removed"	USPAT; *No UPAD	OR	ON	2020/07/17 11:14
L11	4	("2011/0208473").URPN.	USPAT	OR	ON	2020/07/17 11:14
L14	939	((determined predict$3 estimat$3) near4 (electro$magnet$3 magnetometer magnet$3) with (speed angular velocit$3 rate)).clm.	US-PGPUB; USPAT	OR	ON	2020/07/17 11:19
L16	64	15 and 8	US-PGPUB; USPAT	OR	ON	2020/07/17 11:20
L15	519	(velocit$3 same acceleration same (magnetism flux electromagnet$3 (magnet$3 near field))).clm.	US-PGPUB; USPAT	OR	ON	2020/07/17 11:20
L17	16	("20090115724" | "20090182503" | "20090262074" | "20100161084" | "20110199298" | "5138154" | "5440326" | "5898421" | "6957156" | "7158118" | "7236156" | "7239301" | "7262760" | "7414611" | "7489298" | "7535456").PN. OR ("9760186").URPN.	US-PGPUB; USPAT	OR	ON	2020/07/17 11:21
L19	28	14 and 15	US-PGPUB; USPAT	OR	ON	2020/07/17 11:22
L18	0	("2011/0175806").URPN.	USPAT	OR	ON	2020/07/17 11:22
L21	52	19 20	US-PGPUB; USPAT	OR	ON	2020/07/17 11:23
L20	30	14 and 8	US-PGPUB; USPAT	OR	ON	2020/07/17 11:23
L22	250	((suppress$3 or reduc$3 or cancel$3 or subtract$3 or remov$3 or mask$3 or eliminat$3 or filter$3 or curtail$3 or curb$3 or diminish$3 or decreas$3 or lessen$3 or lower$3 or cut$3 or minimi$3 or inhibit$3) near3 (noise or fluctuat$3 or transient or distort$3 or cross$1talk$3 or interference or harmonic or perturb$6 or artifact or ripple or spurious or aberration) same (euler azimuth attitude)).clm.	US-PGPUB; USPAT	OR	ON	2020/07/17 11:25

L23	8	22 and 8	US-PGPUB; USPAT	OR	ON	2020/07/17 11:28
L24	2	22 and 14	US-PGPUB; USPAT	OR	ON	2020/07/17 11:29
L25	22	((("CM") near3 ("HK") near3 ("LIMITED"))).AS,AANM.	US-PGPUB; USPAT	OR	ON	2020/07/17 11:30

7/17/2020 11:32:55 AM
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EAST Search History

EAST Search History (Prior Art)

Ref #	Hits	Search Query	DBs	Default Operator	Plurals	Time Stamp
S254	7	((("CM") near3 ("HK") near3 ("LIMITED"))).AS,AANM.	USPAT	OR	ON	2019/12/20 16:27
S253	22	(("Li") near3 ("Chin-Lung"))).INV.	US-PGPUB; USPAT; USOCR	OR	ON	2019/12/20 16:27
S252	33	(("Ye") near3 ("Zhou"))).INV.	EPO; JPO; DERWENT	OR	ON	2019/12/20 16:27
S251	82	(("Liou") near3 ("Shun-Nan"))).INV.	US-PGPUB; USPAT; USOCR	OR	ON	2019/12/20 16:27
S255	17	((("CM") near3 ("HK") near3 ("LIMITED"))).AS,AANM.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2019/12/20 16:57
S262	21	qingxiu near3 du	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2020/01/23 09:10
S263	13	"15611970" "13072794" "12943934"	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2020/01/23 09:14
S264	2	("7414611" "7089148").pn.	US-PGPUB; USPAT	OR	ON	2020/01/23 09:16
S267	1	"15611970"	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2020/01/23 11:11
S268	2	"8441438".pn.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2020/01/23 11:12
S269	2	"7158118".pn.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2020/01/23 12:22

EAST Search History (Interference)

Ref #	Hits	Search Query	DBs	Default Operator	Plurals	Time Stamp
S256	1	((euler azimuth attitude) with (orientation angle angular) with (sensitiv$3 sensitivit$3 responsiveness sensitiveness reactivity) with (expect$3 expectation predict$3)).clm.	US-PGPUB; USPAT	OR	ON	2019/12/20 16:54
S257	4	((euler azimuth attitude) with (sensitiv$3 sensitivit$3 responsiveness sensitiveness reactivity) with (expect$3 expectation predict$3)).clm.	US-PGPUB; USPAT	OR	ON	2019/12/20 16:55
S260	216063	G06F1/1694.cpc. G06F3/017.cpc. G06F3/0346.cpc. "345".clas. 715/821,822,823,824.ccls.	US-PGPUB; USPAT	OR	ON	2019/12/20 16:56
S259	203624	G06F1/1694.cpc. G06F3/0346.cpc.	US-	OR	ON	2019/12/20

		"345".clas. 715/821,822,823,824.ccls.	PGPUB; USPAT			16:56
S258	1764	((determin$3 determination predict$3 estimat$3 anticipat$3 expect$3) near4 (electro$magnet$3 magnetometer magnet$3) near6 (speed motion movement angular velocit$3 rate)).clm.	US-PGPUB; USPAT	OR	ON	2019/12/20 16:56
S261	49	S260 and S258	US-PGPUB; USPAT	OR	ON	2019/12/20 16:57
S265	0	qingxiu near3 du	US-PGPUB; USPAT	OR	ON	2020/01/23 09:09
S266	9	"8441438"	US-PGPUB; USPAT	OR	ON	2020/01/23 09:53
L2	9	"8441438" "15611970"	US-PGPUB; USPAT	OR	ON	2020/01/24 09:32
L1	9	"8441438"	US-PGPUB; USPAT	OR	ON	2020/01/24 09:32

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EAST Search History

EAST Search History (Prior Art)

Ref #	Hits	Search Query	DBs	Default Operator	Plurals	Time Stamp
L1	165824	user near9 (sensitivity sensitiv$3 responsiveness sensitiveness reactivity)	US-PGPUB; USPAT; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2019/05/21 08:43
L4	10	1 and 2	US-PGPUB; USPAT; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2019/05/21 08:45
L2	55	(US-20090182503-$ or US-20090262074-$ or US-20080042973-$ or US-20110109436-$ or US-20080042975-$ or US-20090046056-$ or US-20100161084-$ or US-20050212911-$ or US-20090062005-$ or US-20100169843-$ or US-20090115724-$ or US-20090326857-$ or US-20110199298-$ or US-20070213889-$ or US-20020100178-$ or US-20070299626-$ or US-20170097690-$ or US-20020103610-$ or US-20040095317-$ or US-20090009471-$ or US-20080255795-$ or US-20100113151-$).did. or (US-7743519-$ or US-7376527-$ or US-6876926-$ or US-7533569-$ or US-7683883-$ or US-8413077-$ or US-9229540-$ or US-4839838-$ or US-7223173-$ or US-7596466-$ or US-5526022-$ or US-8672763-$ or US-6636826-$ or US-5953683-$ or US-5703623-$ or US-9024772-$ or US-7305315-$ or US-6957156-$ or US-7826999-$ or US-7809505-$ or US-6480152-$ or US-7688306-$ or US-7990365-$ or US-8994694-$ or US-7966146-$ or US-7714880-$).did. or (US-7844415-$ or US-6377906-$ or US-7089148-$ or US-7451549-$ or US-7216055-$ or US-8587519-$ or US-8267785-$).did.	US-PGPUB; USPAT	OR	ON	2019/05/21 08:45
L8	1	(US-20100161084-$).did.	US-PGPUB	OR	ON	2019/05/21 09:30
L7	3	(US-20110199298-$ or US-20090115724-$).did. or (US-6957156-$).did.	US-PGPUB; USPAT	OR	ON	2019/05/21 09:30
L6	9	(US-20070213889-$ or US-20040095317-$).did. or (US-6636826-$ or US-7305315-$ or US-7216055-$ or US-8267785-$ or US-5953683-$ or US-7089148-$ or US-6377906-$).did.	US-PGPUB; USPAT	OR	ON	2019/05/21 09:30

L5	57641	user near3 (defin$3 set adjust$3 adjustable) near9 (threshold sensitivity sensitiv$3 responsiveness sensitiveness reactivity)	US-PGPUB; USPAT; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2019/05/21 09:30
L10	3	9 and 5	US-PGPUB; USPAT; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2019/05/21 09:31
L9	55	8 7 6 2	US-PGPUB; USPAT; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2019/05/21 09:31

EAST Search History (Interference)

Ref #	Hits	Search Query	DBs	Default Operator	Plurals	Time Stamp
L3	4	"Term Removed"	USPAT	OR	ON	2019/05/21 08:45

5/21/2019 9:45:50 AM
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