EXHIBIT 1003

PTO/AIA/15 (03-13)
Approved for use through 01/31/2014. 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.

UTILITY PATENT APPLICATION TRANSMITTAL

(Only for new nonprovisional applications under 37 CFR 1.53(b))

Attorney Docket No.	LEO-2-CIP
First Named Inventor	Charles A. Leonard
Title	[illegible]
Express Mail Label No.	

APPLICATION ELEMENTS

See MPEP chapter 600 concerning utility patent application contents.

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

1. [✓] **Fee Transmittal Form** (PTO/SB/17 or equivalent)
2. [✓] **Applicant asserts small entity status.** See 37 CFR 1.27
3. [ ] **Applicant certifies micro entity status.** See 37 CFR 1.29. Applicant must attach form PTO/SB/15A or B or equivalent.
4. [✓] **Specification** *(Total Pages* 83 *)* Both the claims and abstract must start on a new page. *(See MPEP § 608.01(a) for information on the preferred arrangement)*
5. [✓] **Drawing(s)** (35 U.S.C. 113) *(Total Sheets* 16 *)*
6. [ ] **Inventor's Oath or Declaration** *(Total Pages* _____ *)* *(including substitute statements under 37 CFR 1.64 and assignments serving as an oath or declaration under 37 CFR 1.63(c))*
   a. [ ] Newly executed (original or copy)
   b. [ ] A copy from a prior application (37 CFR 1.63(d))
7. [✓] **Application Data Sheet** **See note below.* See 37 CFR 1.76 (PTO/AIA/14 or equivalent)
8. **CD-ROM or CD-R** in duplicate, large table, or Computer Program (Appendix)
   [ ] Landscape Table on CD
9. **Nucleotide and/or Amino Acid Sequence Submission** *(If applicable, items a. – c. are required)*
   a. [ ] Computer Readable Form (CRF)
   b. [ ] Specification Sequence Listing on:
      i. [ ] CD-ROM or CD-R (2 copies); or
      ii. [ ] Paper
   c. [ ] Statements verifying identity of above copies

ACCOMPANYING APPLICATION PAPERS

10. [ ] **Assignment Papers** (cover sheet & document(s))
    Name of Assignee _____
11. [ ] **37 CFR 3.73(c) Statement** *(when there is an assignee)* [ ] **Power of Attorney**
12. [ ] **English Translation Document** *(if applicable)*
13. [ ] **Information Disclosure Statement** (PTO/SB/08 or PTO-1449)
    [ ] Copies of citations attached
14. [ ] **Preliminary Amendment**
15. [ ] **Return Receipt Postcard** *(MPEP § 503)* *(Should be specifically itemized)*
16. [ ] **Certified Copy of Priority Document(s)** *(if foreign priority is claimed)*
17. [ ] **Nonpublication Request** Under 35 U.S.C. 122(b)(2)(B)(i). Applicant must attach form PTO/SB/35 or equivalent.
18. [ ] **Other:** _____

**Note.* (1) Benefit claims under 37 CFR 1.78 and foreign priority claims under 1.55 must be included in an Application Data Sheet (ADS).
(2) For applications filed under 35 U.S.C. 111, the application must contain an ADS specifying the applicant if the applicant is an assignee, person to whom the inventor is under an obligation to assign, or person who otherwise shows sufficient proprietary interest in the matter. See 37 CFR 1.46(b).

19. CORRESPONDENCE ADDRESS

[✓] The address associated with Customer Number: 44728 OR [ ] Correspondence address below

Name					
Address					
City		State		Zip Code	
Country		Telephone		Email	

Signature	[signature]	Date	June 9, 2017
Name (Print/Type)	David M. Simon	Registration No. (Attorney/Agent)	52,224

This collection of information is required by 37 CFR 1.5 (b). 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. 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/AIA/14 (07-14)
Approved for use through 04/30/2017. 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 contains a valid OMB control number.

Application Data Sheet 37 CFR 1.76	Attorney Docket Number	LEO-2-CIP
	Application Number	
Title of Invention	EHICLE LEVELING SYSTEMS, DEVICES AND METHODS AND COMPUTER PROGRAM PRODUCTS FOR LEVELING VEHICLES USING SMART DEVICES	

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
	Charles	A.	Leonard	

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

City	Hickory	State/Province	NC	Country of Residence	US

Mailing Address of Inventor:

Address 1	3702 Pinecrest Drive NE		
Address 2			
City	Hickory	State/Province	NC
Postal Code	28601	Country	US

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	44728		
Email Address	docketing@mullinaxpatent.com	Add Email	Remove Email

Application Information:

Title of the Invention	EHICLE LEVELING SYSTEMS, DEVICES AND METHODS AND COMPUTER PROGRAM PRODUCTS FOR LEVELING VEHICLES USING SMART DEVICES		
Attorney Docket Number	LEO-2-CIP	Small Entity Status Claimed	☒
Application Type	Nonprovisional		
Subject Matter	Utility		
Total Number of Drawing Sheets (if any)	16	Suggested Figure for Publication (if any)	

Filing By Reference :

PTO/AIA/14 (07-14)
Approved for use through 04/30/2017. 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 contains a valid OMB control number.

Application Data Sheet 37 CFR 1.76	Attorney Docket Number	LEO-2-CIP
	Application Number	
Title of Invention	VEHICLE LEVELING SYSTEMS, DEVICES AND METHODS AND COMPUTER PROGRAM PRODUCTS FOR LEVELING VEHICLES USING SMART DEVICES	

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

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	44728		

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 this information in the application data sheet constitutes the specific reference required by 35 U.S.C. 119(e) or 120, and 37 CFR 1.78.
When referring to the current application, please leave the application number blank.

Prior Application Status	Pending		Remove
Application Number	Continuity Type	Prior Application Number	Filing Date (YYYY-MM-DD)
	Continuation in part of	14/961787	2015-12-07
Prior Application Status	Expired		Remove
Application Number	Continuity Type	Prior Application Number	Filing Date (YYYY-MM-DD)
14/961787	Claims benefit of provisional	62088115	2014-12-05
Prior Application Status	Expired		Remove

PTO/AIA/14 (07-14)
Approved for use through 04/30/2017. 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 contains a valid OMB control number.

Application Data Sheet 37 CFR 1.76	Attorney Docket Number	LEO-3-CIP
	Application Number	
Title of Invention	VEHICLE LEVELING SYSTEMS, DEVICES AND METHODS AND COMPUTER PROGRAM PRODUCTS FOR LEVELING VEHICLES USING SMART DEVICES	

Application Number	Continuity Type	Prior Application Number	Filing Date (YYYY-MM-DD)
14/961787	Claims benefit of provisional	62101109	2015-01-08

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

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)[1] 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[1]	Filing Date (YYYY-MM-DD)	Access Code[1] (if applicable)

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

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.

Authorization to Permit Access:

☐ Authorization to Permit Access to the Instant Application by the Participating Offices

PTO/AIA/14 (07-14)
Approved for use through 04/30/2017. 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 contains a valid OMB control number.

Application Data Sheet 37 CFR 1.76	Attorney Docket Number	LEO-3-CIP
	Application Number	
Title of Invention	EHICLE LEVELING SYSTEMS, DEVICES AND METHODS AND COMPUTER PROGRAM PRODUCTS FOR LEVELING VEHICLES USING SMART DEVICES	

If 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 World Intellectual Property Office (WIPO), and any other intellectual property offices in which a foreign application claiming priority to the instant patent application is filed access to the instant patent application. See 37 CFR 1.14(c) and (h). This box should not be checked if the applicant does not wish the EPO, JPO, KIPO, WIPO, or other intellectual property office in which a foreign application claiming priority to the instant patent application is filed to have access to the instant patent application.

In accordance with 37 CFR 1.14(h)(3), access will be provided to a copy of the instant patent application with respect to: 1) the instant patent application-as-filed; 2) any foreign application to which the instant patent application claims priority under 35 U.S.C. 119(a)-(d) if a copy of the foreign application that satisfies the certified copy requirement of 37 CFR 1.55 has been filed in the instant patent application; and 3) any U.S. application-as-filed from which benefit is sought in the instant patent application.

In accordance with 37 CFR 1.14(c), access may be provided to information concerning the date o f filing this Authorization.

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

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. ☐

Prefix	Given Name	Middle Name	Family Name	Suffix

PTO/AIA/14 (07-14)
Approved for use through 04/30/2017. 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 contains a valid OMB control number.

Application Data Sheet 37 CFR 1.76	Attorney Docket Number	LEO-2-CIP
	Application Number	
Title of Invention	VEHICLE LEVELING SYSTEMS, DEVICES AND METHODS AND COMPUTER PROGRAM PRODUCTS FOR LEVELING VEHICLES USING SMART DEVICES	

Mailing Address Information For Applicant:			
Address 1			
Address 2			
City		State/Province	
Country		Postal Code	
Phone Number		Fax Number	
Email Address			

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

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.

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.

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 Assignees:			
Address 1			
Address 2			
City		State/Province	
Country		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.

PTO/AIA/14 (07-14)
Approved for use through 04/30/2017. 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 contains a valid OMB control number.

Application Data Sheet 37 CFR 1.76	Attorney Docket Number	LEO-2-CIP
	Application Number	
Title of Invention	VEHICLE LEVELING SYSTEMS, DEVICES AND METHODS AND COMPUTER PROGRAM PRODUCTS FOR LEVELING VEHICLES USING SMART DEVICES	

Signature:

NOTE: This form must be signed in accordance with 37 CFR 1.33. See 37 CFR 1.4 for signature requirements and certifications.

Signature				Date (YYYY-MM-DD)	2017-06-09
First Name	David	Last Name	Sigmon	Registration Number	52224

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

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.**

DESCRIPTION

VEHICLE LEVELING SYSTEMS, DEVICES AND METHODS AND COMPUTER PROGRAM PRODUCTS FOR LEVELING VEHICLES USING SMART DEVICES

RELATED APPLICATIONS

The presently disclosed subject matter claims the benefit of U.S. Patent Application Serial. No. 14/961,787, filed December 7, 2015, which claims the benefit of U.S. Provisional Patent Application Serial. No. 62/088,115, filed December 5, 2014, and U.S. Provisional Patent Application Serial. No. 62/101,109, filed January 8, 2015; the disclosures of these three applications are incorporated herein by reference in their entireties.

TECHNICAL FIELD

The present subject matter relates to leveling systems and processes for leveling vehicles, such as recreational vehicles. The present subject matter also relates to computer program products for leveling vehicles, such as recreational vehicles, using smart devices.

BACKGROUND

Whether in a storage or use state, a recreational vehicle (RV) should be leveled for both practical and technical reasons. Practical reasons include a level floor, proper door swings, stove and sink use, as well as many others. Technical reasons include proper operation of the ammonia based refrigerator, level holding tanks for proper level

detection by electronic means and for the proper operation of the plumbing and various other systems. Some higher end Class A RV's have onboard leveling systems that utilize digital sensors and hydraulic jacks, but most do not have any native leveling capability beyond the raising and lowering of the front of the RV using manual or electric jacks. Level indicators are generally bubble levels attached to both the side and front or rear of the RV. In addition, there are many other vehicles and trailers that require a level position to operate properly such as food vending trucks, mobile medical trailers, transport trailers and in some cases heavy equipment although there are many others.

The described device provides leveling indication for the 2 main axes of the RV (side-to-side and front-to-back). For the purposes of describing both the typical and proposed leveling method, pitch will be defined as the angle of the RV from front to back and roll will be defined as the angle of the RV from side to side.

The typical RV leveling method is described. Once the RV has been moved into the desired location and orientation for use, the driver must exit the RV or tow vehicle to inspect the current level condition of the RV by using the bubble levels attached to the RV. The first step is to level the roll of the RV. Typically this is done by driving or towing the appropriate RV wheels onto a board, block or other object to raise one side of the RV closer to level. Since the bubble levels being used do not give any exact information regarding the amount the RV is out of level, it is an educated guess at best to determine just how high the appropriate wheels must be raised. Typically, this is a trial and error system requiring the driver to make multiple attempts at raising the appropriate wheels the necessary amount to achieve a level position. Each attempt requires the driver to get back into the vehicle to move the wheels off of the previously

placed object being used to raise wheels, exit the vehicle to add or take away from the height of the object being used to raise the wheels, enter the vehicle again to drive or tow the wheels back onto the object being used to raise the wheels and finally exiting the vehicle again to check the new roll orientation relative to level. It is not uncommon for this process to be repeated several times to achieve a level roll orientation. If bubble levels are being used to determine a level orientation, it is common knowledge that a bubble between the lines on a bubble level has an error range of 2-3 degrees. This can be a significant error amount as it relates to RV's and can cause doors, plumbing and other objects and systems within the RV not to operate properly. Once the roll orientation is level, the pitch orientation leveling operation must be completed. Typically, the bubble level mounted to the side of the RV will be used in this process. In the case of a towable RV, this process generally involves using the jack(s) on the front of the RV to raise or lower the front of the RV until a level position is achieved. Since the upward travel of the jack(s) is limited, it is sometimes required to place blocks or some other object under the jack to enable the jack(s) to raise the front of the RV high enough to achieve a level position. Placing blocks or other objects under the jack(s) requires the RV to be reattached to the tow vehicle, the jack(s) raised, blocks or objects placed under the jack(s), the jack(s) lowered onto the blocks or objects and then released from the tow vehicle. In the case of a driveable RV, the same iterative process used to level the roll of the RV is necessary to level the pitch of the RV. This process may require many attempts as in the case of leveling the roll of the RV.

As such, a need exists for a system for easily and inexpensively leveling a recreational vehicle that does require not many attempts to achieve a level balance of the recreational vehicle in both the pitch and the roll directions.

SUMMARY

The present subject matter provides leveling vehicles, such as recreational vehicles, and related systems and processes.

The present subject matter also relates to computer program products for leveling vehicles, such as recreational vehicles, using smart devices. The subject matter described herein may be implemented in software, in combination with hardware and/or firmware. For example, the subject matter described herein may be implemented in software executed by a hardware-enabled processor. In one exemplary implementation, the subject matter described herein of using leveling information for leveling a vehicle, such as a recreational vehicle, may be implemented using a non-transitory computer readable medium having stored thereon executable instructions that when executed by the processor of a computer control the processor to perform steps. Exemplary non-transitory computer readable media suitable for implementing the subject matter described herein include chip memory devices or disk memory devices accessible by a processor, programmable logic devices, and application specific integrated circuits. In addition, a computer readable medium that implements the subject matter described herein may be located on a single computing platform or may be distributed across plural computing platforms. Further, it should be noted that the systems and methods utilize and can comprise recreational vehicle leveling systems, devices and their components and functionality described herein. These recreational

vehicle leveling systems and devices constitute special purpose devices that improve the technological field of providing guidance for and/or mechanisms for leveling recreational vehicles.

While one or more objects of the presently disclosed subject matter having been stated hereinabove, and which is achieved in whole or in part by the presently disclosed subject matter, other objects will become evident as the description proceeds when taken in connection with the accompanying drawings as best described hereinbelow.

BRIEF DESCRIPTION OF THE DRAWINGS

A full and enabling disclosure of the present subject matter including the best mode thereof to one of ordinary skill in the art is set forth more particularly in the remainder of the disclosures and the specification, including reference to the accompanying figures, in which:

Figure 1 illustrates a schematic side view of an embodiment of a vehicle that includes an embodiment of leveling system according to the present subject matter;

Figure 2 illustrates a schematic front view of an embodiment of a vehicle that includes an embodiment of leveling system according to Figure 1;

Figure 3 illustrates a screen shot of an embodiment of a software application on a smart device for use in an embodiment of the leveling system according to the present subject matter;

Figure 4 illustrates another screen shot of an embodiment of a software application on a smart device for use in an embodiment of the leveling system according to the present subject matter;

Figures 5A and 5B illustrate possible additional screen shots of an embodiment of a software application on a smart device for use in an embodiment of the leveling system according to the present subject matter;

Figure 6 illustrates a further screen shot of an embodiment of a software application on a smart device for use in an embodiment of the leveling system according to the present subject matter;

Figure 7A illustrates a schematic front view of an embodiment of a recreational vehicle positioned at a desired location before leveling;

Figure 7B illustrates a schematic front view of the embodiment of the recreational vehicle according to Figure 7A positioned at a desired location after leveling in the roll direction according to the present subject matter;

Figure 8A illustrates a schematic side view of the embodiment of the recreational vehicle according to Figure 7A positioned at a desired location before leveling;

Figure 8B illustrates a schematic side view of the embodiment of the recreational vehicle according to Figure 7A positioned at a desired location after leveling in the pitch direction according to the present subject matter;

Figure 9 illustrates an embodiment of a flowchart of a method of leveling a vehicle according to the present subject matter; and

Figure 10 illustrates an embodiment of a flowchart of a method of leveling a vehicle performed by a software application of a smart device in according to the present subject matter.

Repeat use of reference characters in the present specification and drawings is intended to represent the same or analogous features or elements of the invention.

DETAILED DESCRIPTION

Reference now will be made to the embodiments of the present subject matter, one or more examples of which are set forth below. Each example is provided by way of an explanation of the present subject matter, not as a limitation. In fact, it will be apparent to those skilled in the art that various modifications and variations can be made in the present subject matter without departing from the scope or spirit of the present subject matter. For instance, features illustrated or described as one embodiment can be used on another embodiment to yield still a further embodiment. Thus, it is intended that the present subject matter cover such modifications and variations as come within the scope of the appended claims and their equivalents. It is to be understood by one of ordinary skill in the art that the present discussion is a description of exemplary embodiments only, and is not intended as limiting the broader aspects of the present subject matter, which broader aspects are embodied in exemplary constructions.

Although the terms first, second, right, left, front, back, etc. may be used herein to describe various features, elements, components, regions, layers and/or sections, these features, elements, components, regions, layers and/or sections should not be limited by these terms. These terms are only used to distinguish one feature, element, component, region, layer or section from another feature, element, component, region, layer or section. Thus, a first feature, element, component, region, layer or section

discussed below could be termed a second feature, element, component, region, layer or section without departing from the teachings of the disclosure herein.

Similarly, when a layer or coating is being described in the present disclosure as "on" or "over" another layer or substrate, it is to be understood that the layers can either be directly contacting each other or have another layer or feature between the layers, unless expressly stated to the contrary. Thus, these terms are simply describing the relative position of the layers to each other and do not necessarily mean "on top of" since the relative position above or below depends upon the orientation of the device to the viewer.

Embodiments of the subject matter of the disclosure are described herein with reference to schematic illustrations of embodiments that may be idealized. As such, variations from the shapes and/or positions of features, elements or components within the illustrations as a result of, for example but not limited to, user preferences, manufacturing techniques and/or tolerances are expected. Shapes, sizes and/or positions of features, elements or components illustrated in the figures may also be magnified, minimized, exaggerated, shifted or simplified to facilitate explanation of the subject matter disclosed herein. Thus, the features, elements or components illustrated in the figures are schematic in nature and their shapes and/or positions are not intended to illustrate the precise configuration of the subject matter and are not intended to limit the scope of the subject matter disclosed herein.

It is to be understood that the ranges and limits mentioned herein include all ranges located within the prescribed limits (i.e., subranges). For instance, a range from about 100 to about 200 also includes ranges from 110 to 150, 170 to 190, 153 to 162,

and 145.3 to 149.6. Further, a limit of up to about 7 also includes a limit of up to about 5, up to 3, and up to about 4.5, as well as ranges within the limit, such as from about 1 to about 5, and from about 3.2 to about 6.5 as examples.

"Smart device," or "mobile smart device," as used herein means any mobile electronic device configured with imaging and/or computing capabilities that can process image and sensor data. Such smart devices can include, but are not limited to, at least one of a mobile smartphone, a personal digital assistant (PDA), a computing tablet, a personal media player, or any like mobile electronic device configured with imaging and/or computing capabilities. In some embodiments, the smart device may be provisioned with a hardware-based processor that is configured to execute software programs or applications.

"Vehicle leveling device," and "RV leveling device" as used herein means a sensor device that include at least one of a gyroscope, a digital compass, a tilt sensor, a digital accelerometer or some other digital angle measurement device or sensor therein that includes a software application that permits the sensor device to measure and asset angles of inclination and/or orientation of a recreational vehicle to permit the pitch and roll of the recreational vehicle to be adjusted to level the recreational vehicle. A digital temperature sensor may also be included on the vehicle leveling device and used to collect temperature data necessary to correct variations or irregularities in the data obtained by the above mentioned angle measurement sensors. A computer processor may also be included on the vehicle leveling device and used to perform calculations, security functions, storage management and functions as well as other tasks. Firmware

associated with the desired functionality may be executed by the computer processor of the vehicle leveling device.

"Vehicle" as used herein means both powered vehicles and non-powered vehicles, trailers or the like, and includes but is not limited to cars, trucks, recreational vehicle, recreational vehicle trailers, food vending trucks, mobile medical trailers, transport trailers, boon trucks, backhoes, or the like.

"Mobile smart device software application" as used herein means specific software applications for and used on a mobile smart device that can be in the form of a non-transitory computer readable medium comprising computer executable instructions embodied in a computer readable medium that when executed by a processor of a computer control of the smart device, the smart device can perform specific steps.

"Software" or "Software application" as used herein means software applications for and used on a computer, which can include, but is not limited to a mobile smart device, that can be in the form of a non-transitory computer readable medium comprising computer executable instructions embodied in a computer readable medium that when executed by a processor of a computer control of the computer, the computer can perform specific steps.

The leveling system, method, device, and/or computer program product embodiments described herein refer mainly to recreation vehicles. There are many other vehicles and trailers that require a level position to operate properly such as food vending trucks, mobile medical trailers, transport trailers and in some cases heavy equipment although there are many others. It should be understood that that leveling

system, method, device, and/or computer program product embodiments described herein can be used in conjunction with these other vehicles and/or trailers.

As stated above, the devices, systems, methods and computer program products relate to leveling an RV relative to the two main axes of the RV (side-to-side and front-to-back). As used herein to describe the proposed leveling method and shown in Figures 1 and 2, pitch is defined as the angle of the RV from front to back and roll will be defined as the angle of the RV from side to side. As shown in Figure 1, when adjusting the pitch, an embodiment of an RV **10** can be adjusted in pitch rotational directions **P** depend on the inclination of the RV from front-to-back. For example, if the RV **10** is inclined forward so that a rear section **12** is above a front section **14** proximal to a jack **26** of the RV **10**, then the pitch of RV **10** can be adjusted in the direction of arrow point P_1. If the RV **10** is inclined backward so that the front section **14** is above the rear section **12**, then the pitch can be adjusted in the direction of arrow point P_2. Similarly, as shown in Figure 2, when adjusting the roll, the RV **10** can be adjusted in roll rotational directions **R** depending on the inclination of the RV from side-to-side. For example, if the RV **10** is inclined forward so that a first side section **16** of the RV **10** is above a second side section **18** of the RV **10**, then the roll of RV **10** can be adjusted in the direction of arrow point R_1. If the RV **10** is inclined backward so that the second side section **14** is above the first side section **16**, then the pitch can be adjusted in the direction of arrow point R_2.

To accomplish the adjustments so that, upon parking the RV **10**, the RV **10** will be leveled in both the pitch and roll directions, a leveling system **20** can be provided that provides measurements to determine the amount of adjustment needed in both the

pitch and roll directions. For example, the leveling system **20** can comprise one or more sensor devices **22**, which can comprise a vehicle leveling device, (shown schematically as a box) that can be secured to the RV **10** to sense the inclination and/or orientation of the RV **10** in both the pitch and roll directions. Additionally the leveling system **20** can also comprise a smart device **24** that can be in communication with the sensor device **22**. For example, the smart device **24** can have a specific software application thereon that allows information received from the sensor device **22** about the inclination and/or orientation of the RV **10** to be processed to provide measurements to a user and to determine the amount of adjustments needed to the RV **10**. The smart device **24** and the sensor device can communicate with each other in a variety of ways. For example, in some embodiments, the sensor device **22** and smart device **24** can communicate through a wired connection. In some embodiments, as shown in Figures 1 and 2, the sensor device **22** and smart device **24** can communicate through wireless communications, such as Bluetooth.

As noted above, the sensor device **22** of the RV leveling system **20** is shown schematically, and while it is shown on the exterior front section of the RV **10**, it is noted that the sensor device can located at a variety of location and positions of the RV **10**. For example, the sensor device **22** can be on the rear, sides or at a central location of the RV **10**. Additionally, the sensor device **22** can be on the exterior, interior or inside the framework of the RV **10**. As noted above, the mobile smart device software application may have a screen designed to define the installed orientation of the sensor device so that data from the appropriate axes can be used for pitch and roll calculations. The sensor device **22** can comprise a printed circuit board ("PCB") that can include

various digital sensors including one or more digital accelerometers, one or more digital gyroscopes, a global positioning system ("GPS") sensor, and other sensors required for accomplishing the desired functionality of the RV leveling system. For example, a digital temperature sensor may also be included that can be used to collect temperature data. For instance, the temperature data collected by the digital temperature sensor can be used to correct variations or irregularities in the data obtained by the sensor device **22**. The PCB can also include a processor and stored software, such as firmware, to allow for the processing of data and performing calculations related to the desired functionality of the RV leveling system. The PCB can also include the components for Bluetooth or other wireless communication. The PCB can be battery powered or use other means of power such as AC or DC connections. The sensor device **22** can also comprise a housing or enclosure in which the PCB can be mounted for protection from damage and the environment.

For example, in some embodiments, the PCB of the sensor device **22** can have digital accelerometer that uses multiple axes, for example an X-axis, a Y-axis and a Z-axis that are used to determine movement and position. When installing the sensor device **22** or after installation, whether on the front, the rear, sides or at a central location of the RV **10**, one of the axes of the accelerometer can be assigned to measure the pitch **P** and another of the axes can be assigned to measure the roll **R**. For instance, the orientation of the sensor device **22** relative to the front, the rear, passenger side or drive side upon or after installation can be noted using the software application on either the PCB of sensor device **22** or the smart device **24** so that an appropriate axis can be assigned to determine the pitch angle measurement and an

appropriate axis can be assigned to determine the roll angle measurement. In this manner, the orientation of the sensor device **22** can be identified or assigned relative to the vehicle. The mobile smart device **24** software application may have a screen designed to define the installed orientation of the sensor device **22** so that data from the appropriate axes can be used for pitch and roll calculations.

After the firmware is installed, each PCB, which can include a gyroscope or an accelerometer as described above, can be provided with power, for example, by securing the PCB into a fixture or installing the battery in the PCB, and then subjected to a temperature calibration process. The PCB's can then be placed in a stationary position in an environmental chamber. Such an environmental chamber can expose the PCB to a broad range of temperatures, such as typical temperatures find during use. For example, the environmental chamber can be a freezer that exposes the PCB therein to low temperatures. One reason this action is done is to determine variances in, for example, the measurements obtained from the gyroscope or accelerometer included in the respective PCB. Since the PCB's are stationary position when placed in these environmental chambers, the accelerometer data or gyroscope data should not change but, for example, the accelerometer data or gyroscope data does due to temperature change. The changes in such can be monitored by the firmware on PCB to determine how to compensate for the discrepancy in the accelerometer data or gyroscope data to maintain the level of accuracy of the data readings at different temperatures.

For example for PCB's that include accelerometers, each PCB is soldered slightly differently and each accelerometer is manufactured with slight differences. For

such reasons, each PCB can undergo this temperature calibration process to achieve more accuracy and repeatability. During this process while the PCB is held in a stationary position, the firmware monitors the accelerometer data. When the firmware detects a change in the accelerometer data, a temperature sensor on the PCB is read by the firmware and the accelerometer count (angle) deviation that has occured is recorded along with the temperature in a temperature calibration lookup table by the firmware. After the PCB has been subjected to a range of temperatures and the firmware has recorded all the accelerometer count (angle) deviation in this temperature calibration lookup table, the temperature calibration process is complete. The resulting temperature calibration lookup table can be used each time accelerometer data is used for calculations in the regular use of the sensor device, i.e., the vehicle leveling device, and the vehicle leveling system. So when the vehicle leveling system is in use, accelerometer data is read along with the current temperature from the sensor device. The firmware on the PCB then looks up that temperature in the temperature calibration lookup table. Any angle deviation at that temperature in the temperature calibration lookup table is read and used to correct the current accelerometer angle data. This temperature corrected accelerometer data is then used to calculate the height requirements need to level the vehicle for that reading. As stated above, a similar temperature calibration process can be performed for gyroscopes to create a temperature calibration lookup table for gyroscope data.

In some embodiments, the smart device **24** can have a compatible wireless communication capability such as Bluetooth or other wireless communication protocol to obtain and/or share information from the PCB of the sensor device **22**. The smart

device **24** can comprise software that is capable of communicating with the PCB of the sensor device **22**, storing information obtained from the PCB of the sensor device **22**, manipulating the information obtained from the PCB of the sensor device **22** and/or user input related to the inclination and/or orientation of the RV **10**, and displaying of information obtained from the PCB of the sensor device **22** and user input as well as information generated from the information obtained from the PCB of the sensor device **22** and/or the user input related to the inclination and/or orientation of the RV **10**. In some embodiments, the sensor device **22** can comprise a memory in communication with the processor of the PCB and can be used to store information transmitted from the mobile smart device **24**. In some embodiments, the sensor device **22** can use sensor data and/or stored user data to perform calculations on the sensor device **22** and transmit the calculated data to the mobile smart device **24** for further calculation or display or both. In the some embodiments, the smart device **24** can be a smartphone capable of storing and executing software applications. These calculations can be based off of the determination of the pitch and roll angles using the calibration data to determine the pitch angle measurements and the roll angle measurements. These calculations can include geometric calculations that can convert changes in angles to distance of movement need to obtain a level position of the vehicle in both the roll direction and the pitch direction based on the length and width of the vehicle being leveled. Such geometric calculations can be based on common geometric formulas that would be understood by those skilled in the art.

Figures 3-6 illustrate embodiments of graphical user interface screens of an embodiment of a software application that can be used on the smart device **24**. Figure

3 illustrates a screen **28** of an entry or beginning screen through which a user can enter the software application, which can be used in some embodiments of the software application. In some embodiments of the software application, an entry screen may not be used. As shown in Figure 4, the software application can have the ability to accept user input relating to the RV **10**. For example, the software application can prompt the user to enter information such as the measurements of the RV **10**, for example, the length and the width of the RV **10**, that can be used to correctly calibrate the amount of adjustment needed in the pitch and roll directions. For example, as shown in Figure 4, the software application as shown in a screen **30** can be provide an entry cell **32** for entry of a width of the RV **10** as measured from the outside of a first wheel, or tire, on a first side of the RV **10** to the outside of a second wheel, or tire, on a second side of the RV **10** along an axle of the RV **10**. The screen **30** can also provide an entry cell **34** for entry of a length of the RV **10** as measured from a center point of the rear axle to the jack **26** at the front of the RV **10**. The software application can store this information for use in calculating displayed information at the time of entry or at a later time. In some embodiments, the software application can save the entered information for recall at a later time as needed. In some embodiments, this information can be stored on the RV sensor device **22** after transmission from the smart device **24**. In some embodiments, the software application can individually save information on multiple RV's that can be recalled at a later time as needed.

To begin, an initial level position can be determined for the RV to help determine any inconsistencies inherent in the leveling system, such as inconsistencies due to the installation or placement of the sensor device on the RV that may cause the sensor

readings to be slightly off. The smart device **24** can be used to determine the initial level position using the accelerometer, gyroscope and/or GPS functions therein through a portion of the software application, or a different software application, as shown in Figure 6 and described in more detail below. A typical digital or spirit level can also be used to achieve this initial level position. The smart device **24** can then capture, i.e., save and store the current pitch and roll angle measurements from the sensor device **22**. These measurements will be used as offsets from the initial level position when displaying angles or calculating and displaying adjustment values necessary to move the RV back to the initial level position. Thus, the software application can determine if the measurements from sensor device **22** are slightly off when the RV is at the initial level position and then take those inconsistencies into consideration when taking measurement readings in the future.

In particular, the software application on the smart device **24** can have a calibration function as represented by a "Set Level" button **36** in the screen **30** for the initial set up of the software application. The "Set Level" button **36** can be used to obtain the current sensor readings in the roll and pitch directions from the sensor device **22** when the smart device **24** indicates that the vehicle is in an initial level position. These sensor readings when the RV **10** is at the initial level position may be stored as calibration data on the smart device **24** or the sensor device **22** or both. This calibration data can be used to compensate for any imperfections in the sensor readings that may derive from the installation and/or placement of the sensor device **22** on the vehicle **10**. Once this calibration function is completed, it does not necessarily need to be performed again. Additionally, in some embodiments as shown in Figure 4, the

software application can have a conversion function as represented by the "inches" and "mm" buttons **38A**, **38B** in the screen **30**. These buttons **38A**, **38B** can be used to set and/or change the metrics system used to measure, calibrate, and compute. For example, as shown, the system used for measurements can be set and/or changed between U.S. Customary System ("inches") and the Metric System ("mm").

Once the calibration has been performed, the software application can be used determine the change in roll and the change in pitch needed for the given RV **10** based on measurements from the sensor device **22** at any given location. In some embodiments, the sensor device **22** may use the calibration data as well as other current sensor data, such as the current pitch angle and roll angle measurements and temperature readings from the sensor device **22** or a another temperature sensor device, and perform calculations, such as an accurate calculation of the current angle of the vehicle and the offset that is needed, using the processor and firmware on the PCB of the sensor device **22**. In some embodiments, a user can activate the software application to initiate the measurements to determine the change in roll and pitch by simply opening the software application on the smart device **24** when connected to a wire communication with the sensor device **22** or within range of the sensor device **22** for a wireless communication connection, depending on how communication is setup between the smart device **24** and the sensor device **22**. In some embodiments, the software application can display an interface on a display screen, such as a button, once the software application is opened that can be activated to initiate this determination, or calculation, function.

Figure 5A and 5B show similar screen shots of information that can be displayed in real time or near real time. Once the determination/calculation function is initiated and the change in roll and pitch calculated by the software application or the processor and firmware on the PCB of the sensor device **22**, the determined change in roll and pitch can then be displayed as shown in a screen shot **40** in Figures 5A and 5B. For example, a roll display **42** can be given as shown in Figures 5A and 5B. Similarly, a pitch display **44** can be provided. As shown in Figure 5A, in some embodiments, the roll display **42** can provide, for example, the current angle from level for the roll directions measured in degrees **43A** and the amount of elevation change **45A** in inches or millimeters needed on a given side to level the RV in the roll direction. Alternatively, in some embodiments as shown in Figure 5B, the roll display **42** can provide, for example, the current angle from level for the roll directions measured or expressed as the amount of elevation change **45B** in inches or millimeters needed on a given side to level the RV in the roll direction. Similarly, as shown in Figure 5A, in some embodiments, the pitch display **44** can, for example, provide the current angle from level for the pitch directions measured in degrees **47A** and the amount of elevation change **49A** in inches or millimeters needed on either the front or the back to level the RV in the pitch direction. Alternatively, in some embodiments as shown in Figure 5B, the pitch display **44** can, for example, provide the current angle from level for the pitch directions as measured or expressed in the amount of elevation change **49B** in inches or millimeters needed on either the front or the back to level the RV in the pitch direction.

The software application on the smart device **24** can provide the ability for the user to configure the display resolution to specific height increments for adjustment of. Typically, accelerometer data, even though digitally filtered, can be choppy and cause the display of the calculated height to change between the set filter levels, i.e., the display resolution, for the digital filter that are to be displayed based on the calculations. In some situations, when the display resolution is set to smaller increments, for example, of 0.25 inches, the display of the expected height change can move back and forth between the closest two increments or flicker back and forth between the increments. For example, the display of the calculated height can flicker between 0 inches and 0.25 inches if the native resolution of the digital filter within the sensor device, or vehicle leveling device, is 0.25 inches and the calculated height is a measurement between 0 inches and 0.25 inches.

Typically, RV users use plastic blocks or wooden dimensional lumber as adjustment blocks to drive the RV **10** up on to get to the height required to reach a level position. Typically, these adjustment blocks are of a regular thickness. If the adjustment blocks being used, for example, are all one (1) inch thick then the accuracy of getting to a level position is going to be determined based on this set block thickness, meaning that the change in elevation of height will be in one (1) inch increments. Thus, the software application can include a screen that will allow the input of a increment of resolution by which the digital filter will operate for providing an adjustment of height in the elevation run direction and the pitch direction. For example, if the RV users have one (1) inch blocks, in some embodiments, the user can provide a display resolution can be selected from a menu of a variety of different display resolutions that can match

the height of adjustment provided by the adjustment blocks the RV user may have. In some embodiments, the software application can provide a screen in which the RV user can enter the increment of display resolution for the leveling system to use. Thereby the leveling system and methods provided herein can provide the ability of the RV user to select different display resolutions. Thus, as explained in the example above, the RV user can select the display resolution of one (1) inch and the smart device running the software application would only show calculated heights in one (1) inch increments. By increasing the value of the display resolution, the RV user can obtain more useful information for the obtaining the adjustment in height that they need and the display based on the larger increment of the display resolution can be much more stable and less likely to flicker between incremental numbers due to the wider threshold of rounding in the math. For example, in some embodiments, the display resolution can be set during a configuration or installation of the sensor device.

As the current roll angle changes, the roll angle measurements expressed in degrees **43A** and/or the amount of elevation change **45A**, **45B** will change. As the current pitch angle changes, the pitch angle measurements expressed in degrees **47A** and/or the amount of elevation change **49A**, **49B** will also change. More particularly, for example, for the change in pitch, the amount of elevation change can be affected by the moving of the jack **26** proximal the front section **14** up or down by the requisite distance displayed. The changes in current roll and pitch angles can also be shown in in the graphic image of the vehicle as shown in displays **42** and **44** in real time or near real time.

As shown in the screen **40** in Figures 5A and 5B, the mobile smart device software application can also provide the ability to save a given pitch angle, either on the smart device **24** or on the sensor device **22**, for the purpose of returning to that position at a later time as illustrated by the "save hitch position" button **46** in screen **40**. To reuse the pitch angle that had been saved, a recall can be provided, such as recall button **48**. This functionality can be useful for travel trailers and fifth wheel RV's that must be detached from a tow vehicle when in use. The pitch angle saved when the tow vehicle is detached from the RV will be recalled for pitch angle positioning when reattaching the tow vehicle. This will simplify and increase the speed of reattaching the tow vehicle to the RV.

As mentioned above and described in more detail below, in some embodiments, once the sensor device **22** has been properly mounted to the inside or outside of the RV **10**, the RV **10** can be leveled to an initial level position using the typical method described above or by placing the smart device **24** on the floor or some other horizontal surface of the RV and using a digital level software application, either separate from or integrated into the software application. Figure 6 shows a screen **50**, for example, of the software application that can be used to measure both the pitch and the roll angles using a pitch measuring line **52** and a roll measuring line **54** forming a crosshair **56**. The software application on the smart device **24** can show a display that operates in a similar manner to a spirit level so as to display movement of the pitch and roll angles toward a center bull's eye **60** as the smart device on the horizontal surface is moved toward a leveled position. The progress toward the bull's eye **60** can be measured by the position of the crosshair **56** relative to the area **58** surrounding the bull's eye **60** as

the crosshair **56** approaches the demarcation line **62** as the horizontal surface is moved closer to the leveled position. In this manner, the smart device **24** can be used in this initial leveling to determine an initial level position. As mentioned above, a typical digital or spirit level could also be used to achieve this initial level position. The smart device **24** can then capture, i.e., save and store the current pitch and roll angle measurements from the sensor device **22** or cause (by a transmitted instruction from the smart device **24**) the sensor device **22** to save and store the calibration data of pitch and roll angle measurements on the sensor device **22**. This calibration data will be used as offsets from the initial level position when displaying angles or calculating and displaying adjustment values necessary to move the RV back to the initial level position.

Once measurements are generated using the set level button **36** that relate to the initial level position of the RV, these measurements can be stored on the smart device **24**, or stored in a memory storage location on the PCB sensor device **22** and recalled to the smart device **24** at a desired time. The smart device **24** with the software application running can then be used to calculate and display angles relative to the initial level position and to calculate and display adjustment values necessary to move the RV to the initial level position when the RV is moved to a location for use. In some embodiments, the calculation of angles relative to the initial level position can be performed by the processor and firmware on the PCB of the sensor device **22**. Performing the calibration function on the software application, the smart device **24** can wirelessly connect (or, in some embodiments, connect through a wired connection) to the sensor device **22** and request the current angle measurements for pitch and roll. These measurements can be stored on the smart device **24**, or stored in a memory

storage location on the PCB sensor device **22** and recalled to the smart device **24** at a desired time, for use in calculating displayed information in the subsequent screens such as screen **40** shown in Figure 5 with the roll display **42** and the pitch display **44** as explained below. These stored measurements can be used as offsets from the initial level position based on the angle indications calculated from the various sensors of the sensor device **22**. This is required to establish the relationship between the position of the mounted sensor device **22** and the initial level position in both pitch and roll as measured and/or captured by the smart device **24** or the sensor device **22** as described above.

In some embodiments, if the RV level system is installed during the manufacturing of the RV, then the RV level system can be calibrated at the factory eliminating the need for the user to do it. In such embodiments, the calibration function can be skipped by the user.

In subsequent displays **42**, **44** of the current angles relative to the initial level position on the software application on the smart device **24** as shown in the screen **40** in Figure 5, for example, these stored calibration data measurements will be added or subtracted from the actual, calculated sensor data from the PCB of the sensor device **22** to determine the actual angle relative to the initial level position accounting for the actual mounted orientation of the sensor device **22**. In some embodiments, the displays **42**, **44** can show an image of the vehicle that reflects the actual position of the RV **10** with the actual angles in the respective pitch and roll directions of the RV **10** such that the image of the vehicle moves as the angles in the respective pitch and roll directions of the RV **10** change. Once accurate angle measurements have been calculated and

displayed in the screen **40** of the software application on the smart device **24**, additional calculations regarding the added height needed to achieve the initial level position of the RV can be performed either by the software application of the mobile smart device **24** or by the processor and firmware on the PCB of the sensor device **22**. These calculations regarding the added height needed to achieve the initial level position of the RV can be displayed by the software application on the mobile smart device **24**, for example, in the respective roll display **42** and pitch display **44** or on a different screen in other embodiments. The appropriate side or direction of added or removed height can also be displayed using arrows and/or the calculated height required as shown for example in the respective roll display **42** and pitch display **44** of screen **40** of the described example embodiment of software application. These calculations are achieved by using the stored information about the length and width of the RV **10** and the calculated current angle relative to the initial level position of the RV and using trigonometric formulas to calculate the height and location for the height addition or reduction required to achieve a level position.

For example, as shown in Figure 7A and 8A, an RV **10** can be parked, or positioned, at a desired location. A leveling system **20** on RV **10** (as shown in Figures 1 and 2) can be previously used to determine an initial level position that provides a true level measurement that has been stored on the smart device **24** of the leveling system **20**, or stored in a memory storage location on the PCB sensor device **22**, such as an RV leveling device, and recalled to the smart device **24**, for later use. The RV **10** can have three or more structural supports, such as wheels W_A, W_B and jack **26** on a ground **G** at the desired location. As shown in Figure 7A, the RV **10** leans toward the first side **A** of

RV **10** on first side section **16** at the desired location. Similarly, as shown in Figure 8A, the RV **10** leans toward the front **C** of RV **10** on the front section **14** at the desired location. Thus, the RV **10** is not leveled at the desired location based on the structural supports current position on the ground **G**.

The software application on the smart device **24** of the leveling system can be accessed to initiate the determination of the needed change in the roll and pitch directions to level the RV **10** at the desired location. The smart device **24** can communicate with the sensor device **22** of the leveling system **20** to obtain sensor data used to determine the current angle measurements for the roll and pitch directions off from true level, i.e., the initial level position stored in the smart device. The needed angle change, distance change, and/or direction of change for the roll and pitch directions can be displayed on the smart device **24** as shown in the roll display **42** and pitch display **44** in screen **40** of the software application (see Figure 5). As shown in Figure 7B, the first side **A** of RV **10** can then be raised the needed amount so that the first side **A** and a second side **B** of the **RV 10** can be level with one another in the roll direction based on the information provided in the roll display **42** (see Figure 5). For example, a jack **70**, or other mechanism can be used to raise the first side **A** of RV **10**. Similarly, as shown in Figure 8B, the front side **C** of RV **10** can be raised the needed amount so that the front side **C** and a rear side **D** of the **RV 10** can be level with one another in the pitch direction based on the information provided in the pitch display **44** (see Figure 5). For example, a jack **26** can raise the front side **C** of RV **10** the needed amount.

As another example, the software application on the smart device **24** or the software on sensor device **22** can calculate that an RV is 2 degrees out of level in the roll direction and height needing to be added to the left side of the RV. In this example, the stored width of the RV is 8 feet or 96 inches. Using a trigonometric function, the height needed to achieve a level position can be calculated as 3.3523 inches. Knowing exactly how much height is needed to reach a perfectly level position in both pitch and roll will simplify and reduce the amount of time required to level the RV. Both the software of the sensor device **22** and the smart device software application can dynamically and in near real time update and graphically display the current pitch and roll of the RV representations using a proportional algorithm.

Additionally, in some embodiments, the sensor device **22** can have sensors that are able to detect relative humidity, temperature and barometric pressure. For example, the PCB of the sensor device **22** may have sensors that are able to detect relative humidity, temperature and barometric pressure. The user may desire to mount the sensor device **22** on the exterior or interior of the RV depending on whether they are more interested in measuring the environmental conditions outside or inside the RV. This environmental information will also be wirelessly transmitted to the smart device **24** and displayed for the user.

In some embodiments as stated above, the mobile smart device software application that can be downloaded and run on the smart device **24** can permit input of the RV length and RV width for the purpose of calculating the amount of height needed at the appropriate place to return the RV to a previously defined level position. In some embodiments, this length and width could be pre-programmed for various makes and

models of RV's, eliminating the need for the user to measure and input the length and width dimensions. Instead, the mobile smart device software application can have a screen that lists the make and model of the RV. In some embodiments, the lists of RV's can contain various information about the different makes and models of RV's including pictures and other information. The screen can allow the user to scroll the list or can provide a search mechanism that allows the user to find the exact RV in question or shorten the list of RV's to be viewed. In this manner, the user would simply select the make and model of the RV from a list contained within the mobile smart device software application of the smart device **24**.

RV's typically have control panels that consist of pushbuttons and/or indicator LED's and/or LCD displays. These control panels are used to display data about the condition of various RV systems or to activate various RV systems. Typical data displayed by some RV control panels can include holding tank fluid levels and battery power levels. Typical RV systems that might be activated from some control panels would be power slideouts and starting or stopping the generator. In some embodiments, the smart device **24** can be integrated or in communication with the various RV control panels and systems either through wired or wireless communications. For example, utilizing a wireless communication system or protocol, such as Bluetooth or WiFi, the mobile smart device software application on the smart device **24** can display the data that is generated and displayed on some of the RV control panels such as holding tank levels, battery power levels and the like. In addition, the mobile smart device software application can also be used to activate various RV systems such as power slideouts, starting the generator, stopping the

generator, or the like. The mobile smart device software application could also be used to control more general RV systems such as lighting and entertainment systems. For example, the mobile smart device software application can generate screens that are displayed on the smart device **24** that display the data that is generated and displayed on some of the RV control panels. Additionally, the mobile smart device software application can generate screens that are displayed on the smart device **24** that provide user interfaces, such as buttons that can be used to activate various RV systems by the user, for example, remotely or wirelessly.

In some embodiments, the PCB of the sensor device **22** can contain a GPS sensor allowing the current physical location of a vehicle, such as RV **10**, that the sensor device **22** has been mounted on to be transmitted to the mobile smart device **24** or saved and stored on the sensor device **22**. Positional movements of the vehicle, along with date and time information, can be saved and stored on the mobile smart device **24** or the sensor device **22**. This saved vehicle positional movement information along with saved and corresponding date and time information can be used to determine actual use information regarding the vehicle. For instance, this positional movement information can be used to make determinations on the actual times that the vehicle is used over a given time period, how many days the vehicle is typically used when it is away from the normal storage locations, how many miles the vehicle is typically driven or towed to each use locations, and other information that might be relevant to the manufacturer of the vehicle. Total distance traveled by the vehicle could also be saved and stored on the mobile smart device **24** or sensor device **22** for use by the manufacturer of the vehicle for warranty or other uses. The total number of miles

traveled by a non-drivable vehicle such as a trailer or towable RV is not currently recorded in any other manner and this may be useful information for many purposes such as used value determination, tire warranties, and many others. This saved and stored vehicle location, date, time and usage information could be transmitted from the mobile smart device **24** via the internet to email or computer server addresses or locations designated by the vehicle manufacturer.

Thus, according to the disclosure herein, a method, generally designated **50**, for leveling a vehicle, such as a recreational vehicle, can be provided as shown in Figure 9. To begin, a leveling system can be provide that comprises one or more sensor devices, that can comprise one or more vehicle leveling devices, secured to a vehicle to sense at least one of an inclination or an orientation of the vehicle in both a pitch direction and a roll direction and a smart device in communication with the one or more sensor devices as shown in step **52**. The method can comprise a step **54** of measuring the pitch angle and the roll angle of the vehicle when the vehicle is at rest using the sensor device as shown as Figure 9. To determine the needed movement of the vehicle to achieve a level position based on the measures of the pitch angle and the roll angle, calibration data of pitch angle and roll angle measurements taken by the sensor device when the vehicle was at an initial level position can then be retrieved as shown in step **55**. The method **50** can additionally comprise a step **56** of calculating any needed change in at least one of the pitch direction or the roll direction of the vehicle using the measurements of the pitch angle and the roll angle of the at rest vehicle and the calibration data of pitch and roll angle measurements to obtain a level position of the vehicle. This calculation can be performed by the one or more sensor devices or the

smart device. In step **58**, the calculated change in at least one of the pitch direction or the roll direction of the vehicle can be displayed on the smart device.

In order to initially develop the calculation data, the method described above can also include the step of determining the initial level position for a vehicle to determine any inconsistencies inherent in the leveling system. Depending on the embodiment of the method, this determination step can be performed on the one or more sensor devices or the smart device. In some embodiments, the step of determining an initial level position can comprise receiving measurements of a length and a width of the vehicle. In some embodiments of the method, the step of determining an initial level position can comprise using at least one of an accelerometer, gyroscope, or global positioning system sensor on the smart device to achieve the initial level position. In some embodiments, the step of determining an initial level position can comprise using at least one of a digital level or spirit level can also be used to achieve the initial level position. In some embodiments of the method, the step of determining an initial level position can be performed by during manufacture of the vehicle and the calibration data stored on the sensor device installed during manufacture. In some embodiments, when installing the sensor device or after installation, whether on the front, the rear, sides or at a central location of the vehicle, an axis can of a plurality of axes of the accelerometer on the sensor device can be assigned to measure the pitch of the vehicle and another axis of the plurality axes of the accelerometer on the sensor device can be assigned to measure the roll of the vehicle. For instance, in some such embodiments, the orientation of the sensor device relative to the front, the rear, the passenger side or the drive side of the vehicle can be noted using the software application on either the

sensor device or the smart device so that an appropriate axis can be assigned to determine the pitch angle measurement of the vehicle and an appropriate axis can be assigned to determine the roll angle measurement of the vehicle. The mobile smart device software application may have a screen designed to define the installed orientation of the sensor device so that data from the appropriate axes can be used for pitch and roll calculations. The pitch and roll angle measurements from the sensor device taken at the initial level position can then be captured, i.e., identified and stored or saved, to provide the calibration data of the pitch and roll angle measurements to permit consideration of any inconsistencies determined when taking measurement readings at a future time. For example, the calibration can be calculated and then saved on a sensor processor on the one or more sensor devices or saved on the smart device that is in communication with the one or more sensor devices. In some embodiments of the method, the step of capturing the pitch and roll angle measurements from the sensor device can comprise communicating calibration data from the sensor device of the pitch and roll angle measurements measured by the sensor device when the vehicle is at the initial level position to the smart device and saving the calibration data on the smart device. In some embodiments of the method, the step of capturing the pitch and roll angle measurements from the sensor device can comprise saving the calibration data of the pitch and roll angle measurements measured by the sensor device when the vehicle is at the initial level position on the sensor device. In some such embodiments where the calibration data is saved on the sensor device, the step of saving the calibration data of the pitch and roll angle measurements on the sensor device can comprise transmitting instructions from the

smart device to the sensor device to save and store the calibration data of the pitch and roll angle measurements on the sensor device. In some such embodiments, the method can include recalling the calibration data of the pitch and roll angle measurements from the sensor device to the smart device.

In some embodiments of the method, the step **58** of displaying the calculated change in at least one of the pitch direction or the roll direction of the vehicle can comprise displaying the calculated change in the pitch direction and the roll direction of the vehicle in measurements of distance. In some embodiments of the method, the step **58** of displaying the calculated change in at least one of the pitch direction or the roll direction of the vehicle can comprise displaying the calculated change in the pitch direction and the roll direction of the vehicle as angles.

In some embodiments, the method can additionally comprise providing a conversion function to permit the changing of the system used for measurements c between U.S. Customary System and the Metric System. In some embodiments, the method can additionally comprise saving a given pitch angle measurement on at least one of the smart device or the sensor device to permit later recall for the purpose of returning the vehicle to the given pitch angle position at a later time. In some embodiments, the method can further comprise collecting and storing positional movement information of the vehicle using a global positioning system sensor on the sensor device.

In some embodiments, the method can additionally comprise receiving data at the smart device from one or more vehicle control panels. In some such embodiments, the received data from one or more vehicle control panels can comprise at least one of

data regarding holding tank levels or data regarding battery power levels. In some of these embodiments of the method, the smart device can display the data that is generated and displayed on the one or more vehicle control panels.

In some embodiments, the method can additionally comprise activating one or more systems on the vehicle via the software application of the smart device. As described above, the communication between the smart device and the vehicle can be accomplished using a wireless communication system or protocol, such as Bluetooth or WiFi. For example, the one or more systems activated with the smart device can comprise at least one of a lighting system, an entertainment system, a power slideouts system or a generator system.

As stated above, a software application in the form of a non-transitory computer readable medium can be provided that comprises computer executable instructions embodied in a computer readable medium that when executed by a processor of a computer control the computer to perform the steps similar to the method, generally designated **60**, described above. For the example, as shown in Figure 10, the non-transitory computer readable medium can perform a step **62** of receiving on a smart device a pitch angle measurement and a roll angle measurement of a vehicle when the vehicle is at rest from a sensor device. Additionally, the non-transitory computer readable medium can perform a step **64** of retrieving calibration data of pitch angle and roll angle measurements taken by a sensor device when the vehicle was at an initial level position. The sensor device can comprise a vehicle leveling device or an RV leveling device. The non-transitory computer readable medium can also perform a step **66** of calculating any needed change in at least one of a pitch direction or a roll direction

of the vehicle using the calibration data of the pitch and roll angle measurements to obtain a level position of the vehicle. The non-transitory computer readable medium can further perform a step **68** of displaying on the smart device the calculated change in at least one of the pitch direction or the roll direction of the vehicle needed to obtain the level position of the vehicle.

In order to initially develop the calculation data, the method performed by the software application described above can also include the step of determining the initial level position for a vehicle to determine any inconsistencies inherent in the leveling system. In some embodiments, the step of determining an initial level position can comprise receiving measurements of a length and a width of the vehicle. In some embodiments of the software application, the step of determining an initial level position can comprise using at least one of an accelerometer, gyroscope, or global positioning system sensor on the smart device to achieve the initial level position. In some embodiments of the method, the step of determining an initial level position can be performed by during manufacture of the vehicle and the calibration data stored on the sensor device installed during manufacture.

The software application can then be used to capture, i.e., identified and stored or saved, the pitch and roll angle measurements from the sensor device taken at the initial level position to provide the calibration data of the pitch and roll angle measurements to permit consideration of any inconsistencies determined when taking measurement readings at a future time. For example, the calibration can be calculated and then saved on a sensor processor on the one or more sensor devices or saved on the smart device that is in communication with the one or more sensor devices. In

some embodiments of the software application, the step of capturing the pitch and roll angle measurements from the sensor device can comprise communicating calibration data from the sensor device of the pitch and roll angle measurements measured by the sensor device when the vehicle is at the initial level position to the smart device and saving the calibration data on the smart device. In some embodiments of the software application, the step of capturing the pitch and roll angle measurements from the sensor device can comprise saving the calibration data of the pitch and roll angle measurements measured by the sensor device when the vehicle is at the initial level position on the sensor device. In some such embodiments where the calibration data is saved on the sensor device, the step of saving the calibration data of the pitch and roll angle measurements on the sensor device can comprise transmitting instructions from the smart device to the sensor device to save and store the calibration data of the pitch and roll angle measurements on the sensor device. In some such embodiments, the steps performed by the software application can include recalling the calibration data of the pitch and roll angle measurements from the sensor device to the smart device.

In some embodiments of the software application, the step 68 of displaying the calculated change in at least one of the pitch direction or the roll direction of the vehicle can comprise displaying the calculated change in the pitch direction and the roll direction of the vehicle in measurements of distance. In some embodiments of the software application, the step 68 of displaying the calculated change in at least one of the pitch direction or the roll direction of the vehicle can comprise displaying the calculated change in the pitch direction and the roll direction of the vehicle as angles.

In some embodiments, the steps of the software application can additionally comprise providing a conversion function to permit the changing of the system used for measurements c between U.S. Customary System and the Metric System. In some embodiments, the steps of the software application can additionally comprise saving a given pitch angle measurement on at least one of the smart device or the sensor device to permit later recall for the purpose of returning the vehicle to the given pitch angle position at a later time. In some embodiments, the steps of the software application can further comprise collecting and storing positional movement information of the vehicle using a global positioning system sensor on the sensor device.

In some embodiments, the steps of the software application can additionally comprise receiving data at the smart device from one or more vehicle control panels. In some such embodiments, the received data from one or more vehicle control panels can comprise at least one of data regarding holding tank levels or data regarding battery power levels. In some of these embodiments of the software application, the smart device can display the data that is generated and displayed on the one or more vehicle control panels.

In some embodiments, the steps of the software application can additionally comprise activating one or more systems on the vehicle with the smart device. As described above, the communication between the smart device and the vehicle can be accomplished using a wireless communication system or protocol, such as Bluetooth or WiFi. For example, the one or more systems activated with the smart device can comprise at least one of a lighting system, an entertainment system, a power slideouts system or a generator system.

In some embodiments, the software application can also comprise a method to give the leveling system user control over the battery life of the sensor battery to allow the user to extend the life of the battery in use. For example, in some embodiments, the sensor device, i.e., the vehicle leveling device, can be configured to switch between a "sleep mode," where the sensor device is using a minimal amount of power and an "awake mode," where the sensor device is prepared to perform its variety of actions and can connect with the smart device. Thus, the steps of the software application can additionally comprise steps that activate the battery for use through the detection of motion of the vehicle, such as an RV through communication with the sensor device. The sensor device, i.e., the vehicle leveling device, of the leveling system can use motion detected by the accelerometers to change the state of the sensor device between the sleep mode and the awake mode based on certain conditions and user configuration settings. So, in such embodiments, when the sensor device detects motion, the sensor device can transition from the sleep mode to the awake mode and can be connected to the smart device for communication with the leveling system software application. For example, in some embodiments, when in the awake mode the Bluetooth signal is being broadcast which uses more battery power than the sleep mode where the Bluetooth signal is not being broadcast. When the sensor device detects no motion based on a user defined period of time, the sensor goes into the sleep mode to conserve the battery. Thus, in some embodiments, the software application permits the user to define the amount of time, for example, in minutes and/or hours, after no motion is detected that the sensor device will stay in the awake mode before going to the sleep mode. In this manner, the leveling system user can be allowed to configure the leveling

system to best suit the user's specific use habits. For example, the software application can provide one or more screen displays that can allow the use to select a motion detection option to transition the sensor device between an awake mode and a sleep mode and can further provide a method of conserving battery life of the sensor device.

An additional aspect that can be employed in some embodiments of the sensor device of the leveling system to conserve battery life is an On/Off switch that is a complete battery disconnect from a circuitry perspective within the sensor device. This battery disconnect can allow the user to turn off the system entirely (to increase battery life) when the sensor is in a setting where motion is constantly being observed, such as when driving or towing the RV for many hours during travel. It can also be used to completely disconnect the battery during RV storage periods. Thus, the sensor device can comprise an On/Off switch that permits the disconnection of the battery from the circuitry, for example, from a PCB of the sensor device as described above, of the sensor device to conserve battery life. The sensor can also comprise a sounder device that can be mounted on a PCB of the sensor device that chirps an audible sound when the On/Off switch is moved into the On position. This audible sound can be used to indicate that the currently installed battery is still good. In some embodiments, this audible sound can be used to indicate that the sensor is now in a Bluetooth pairing mode. Pairing mode can be used to associate the original or additional smart device with a given sensor device of the leveling system.

The leveling system and software application can provide a custom pairing mode to associate the sensor device of a given leveling system with a specific smart device. For example, the sensor device of a leveling system can be assigned a serial number.

During use, for example, during configuration of the software application and/or installation of the sensor device, the serial number from the sensor can be recorded on the smart device. Once a smartphone or tablet has been associated with a particular sensor, then it will only communicate with that sensor, for example, until it is changed by the user. In this manner, the sensor device of a leveling system on an RV can be assured to connect to the RV user's smart device and not to other possible sensors within a given camping area. For example, in some embodiments, the software application can provide a screen display that will allow the user to enter the serial number for the sensor device of the leveling system installed on the RV into the smart device. Once the serial number for that sensor device has been entered, the smart device of the user when using the software application will communicate with the sensor device of the leveling system installed on the RV of the user and not some other sensor device within the area where the RV is being set up for use.

Another aspect of the leveling system and the software application for the leveling system that some embodiment may have is the ability of the use to define the driver's side of the vehicle. By being able to define which side of the RV is the driver's side, especially for motorized RV's, the leveling system can be used in a variety of countries regardless of the types of cars used withina particular country and the country's laws regarding which side of road a vehicle is drive on. For example, by allowing the leveling system user to select the driver's side of the his or her RV, the same leveling system and leveling system software application can be in countries that require vehicles to be driven on the right side of the road or in countries that require vehicles to be driven on the left side of the road. For example, in some embodiments,

the software application can include a default setting, for example, that the driver's side of the RV is on left side of the vehicle and the passenger's side is on the right of the vehicle. In some embodiments, the software application can include a screen display that will allow the user to change the default setting of the driver's side or allow the user to select which side is the driver's side and/or passenger side of the RV. Once the driver's side is changed or selected, the references for the driver's side and the passenger's side of the RV are set for use with the particular RV so that software application reads properly for that user. The references can also change for the installation orientation selections to match the currently selected driver's side of the vehicle.

As described above, the vehicle leveling devices and leveling systems can be used on either towable recreational vehicles and motorized recreational vehicles. Another specific embodiment of a leveling system and software application is described with reference to Figures 11 and 12. As another example shown in Figure 11, an embodiment of a motorized RV **70** having a front **71**, a rear **73**, a driver side (first section) **75**, and a passenger side (second section) **77** can be provided that can be adjusted in pitch rotational directions depend on the inclination of the RV **70** from front-to-back and roll rotational directions depending on the inclination of the RV **70** from side-to-side using leveling systems and devices in a similar manner as described above. The RV **70** can comprise a front driver side wheel **72**, a front passenger side wheel **74**, a rear driver side wheel **76**, and a rear passenger side wheel **78**. To accomplish the adjustments so that, upon parking the RV **70**, the RV **70** will be leveled in both the pitch and roll directions, a leveling system **80** can be provided that provides

measurements to determine the amount of adjustment needed in both the pitch and roll directions. For example, the leveling system **80** can comprise one or more sensor devices **82** (shown schematically in dotted lines as a box within the RV **70**) that can be secured to the RV **70** to sense the inclination and/or orientation of the RV **70** in both the pitch and roll directions. The sensor device **82** can comprise a vehicle leveling device.

Additionally, the leveling system **80** can also comprise a smart device **84** that can be in communication with the sensor device **82**. For example, the smart device **84** can have a specific software application thereon that include one or more aspect of the software application described above that allows information received from the sensor device **82** about the inclination and/or orientation of the RV **70** to be processed to provide measurements to a user and to determine the amount of adjustments needed to the RV **70**. The smart device **84** and the sensor device can communicate with each other in a variety of ways. For example, in some embodiments, the sensor device **82** and smart device **84** can communicate through a wired connection. In some embodiments, as shown in Figure 11, the sensor device **82** and smart device **84** can communicate through wireless communications, such as Bluetooth.

Once the leveling system **80** has calculated the change of elevation height needed in the roll direction and the pitch direction, the smart device can determine how much each tire needs to be raised to level the RV **70**. In particular, the software application can display on the smart device the height required to reach a level position for each wheel **72**, **74**, **76**, **78** as shown in Figure 12 at **92**, **94**, **96**, and **98** respectively. These heights are calculated in a similar manner to the calculated roll and pitch elevation heights as described in the embodiments above. Figure 12 is a screen shot of

a display that shows a schematic representation of the motorized RV **70** from above and can be used to display the amount of adjustment in height of each wheel **72**, **74**, **76**, **78** of the motorized RV **70** based on the measurements taken by the vehicle leveling device **84** and the calculations of the changes in height needed in the roll direction and the pitch direction.

For example, referring to Figure 12, if the calculated roll height required is an upward elevation on the passenger side of two and a quarter (2.25) inches and the calculated pitch height required is an upward elevation in the rear of one and a half (1.5) inches, then either the smart device **84** or the vehicle leveling device **82** can calculate the movement needed for each wheel of the RV **70** using this information. Based on these adjustment calculations for the change in the height needed in the roll direction and the pitch direction, the adjustment in height of each wheel **72**, **74**, **76**, **78** can be calculated by either the smart device **84** or the vehicle leveling device **82**. The smart device **84** or the vehicle leveling device **82** can determine which wheel would be considered the pivot point, i.e., the wheel that needs no adjustment for the RV **70** to reach a level position. In some embodiments, the smart device **84** can do these calculations. In some embodiments, the vehicle leveling device, or sensor device, **82** can do these calculations.

In the example above as shown in Figure 12, the driver side front wheel would be the pivot point and the display from the software application on screen of the smart device would show a zero (0) inch height adjustment of the frame of the motorized RV **70** required at or near the driver front wheel **72** (see Figure 11) as shown at **92** in Figure 12, since the motorized RV **70** needs an adjustment of height (two and a quarter (2.25)

inches as explained above) on the passenger side **77** and an adjustment of height (one and a half (1.5) inches as explained above) in the rear **73** of the RV **70**. Based on the measurements made by the vehicle leveling device **82**, the smart device **84** or the vehicle leveling device **82** can also determine the change in elevation of height of the frame of the motorized RV **70** required at or near the other three wheels **74**, **76**, **78**. In this example, the frame of the motorized RV **70** at or near the passenger front wheel **74** would need a two and a quarter (2.25) inches adjustment in height as show at **94** in the display in Figure 12 and the frame of the motorized RV **70** at or near the passenger side rear wheel **78** would need a three and a three quarter (3.75) inches adjustment in height as show at **96** in the display in Figure 12, while the frame of the motorized RV **70** at or near the driver side rear wheel **76** would need a one and a half (1.5) inches adjustment in height as show at **98** in the display in Figure 12.

The adjustment of height to the frame of the motorized RV **70** proximate to each wheel **72**, **74**, **76**, **78** of the RV **70** can be accomplished in different manners. For example, in some embodiments, the wheels **72**, **74**, **76**, **78** of the RV **70** can be placed or driven onto blocks or stacks of blocks. In some embodiments, the RV **70** can have one more jacks that can extend downward from the frame proximate to the wheels **72**, **74**, **76**, **78** of the RV **70** that can be used to adjust the height fo the frame of the RV **70**. In some embodiments, One more jacks can be placed proximate to the wheels **72**, **74**, **76**, **78** of the RV **70** to adjust the height fo the frame of the RV **70**.

Thus, the calculated adjustment proximate to each wheel is the sum of the calculated change in the height in the roll direction and the pitch direction for the given position of the respective wheel. Thus, the calculated change in height of the frame of

the motorized RV **70** proximate to the front driver side wheel **72** is the sum of any calculated adjustment in height at the front **71** of the RV **70** and on the driver side **75** of the RV **70**. Additionally, the calculated change in height of the frame of the motorized RV **70** proximate to the front passenger side wheel **74** is the sum of any calculated adjustment in height at the front **71** of the RV **70** and on the passenger side **77** of the RV **70**. Similarly, the calculated change in height of the frame of the motorized RV **70** proximate to the rear driver side wheel **76** is the sum of any calculated adjustment in height at the rear **73** of the RV **70** and on the driver side **75** of the RV **70**, while the calculated change in height of the frame of the motorized RV **70** proximate to the rear passenger side wheel **78** is the sum of any calculated adjustment in height at the rear **73** of the RV **70** and on the passenger side **77** of the RV **70**.

These and other modifications and variations to the present subject matter may be practiced by those of ordinary skill in the art, without departing from the spirit and scope of the present subject matter, which is more particularly set forth herein above. In addition, it should be understood the aspects of the various embodiments may be interchanged both in whole and in part. Furthermore, those of ordinary skill in the art will appreciate that the foregoing description is by way of example only, and is not intended to limit the present subject matter.

What is claimed is:

1. A leveling system for leveling a vehicle that is at rest, the leveling system comprising:

a sensor devices secured to a vehicle to sense at least one of an inclination or an orientation of the vehicle in both a pitch direction and a roll direction; and

a smart device in communication with the sensor device to allow information received from the sensor device about at least one of the inclination or the orientation of the vehicle in both the pitch direction and the roll direction to be processed to provide measurements to a user and to determine the amount of adjustments in height needed to at least one of the pitch direction or the roll direction to level the vehicle.

2. The system according to claim 1, wherein the sensor device comprises a printed circuit board that comprises at least one of a digital accelerometer or a digital gyroscope that have been temperature calibrated, and the printed circuit board comprises a processor to process data collected by the sensor device and to perform calculations related to the determination the amount of adjustments in height needed to at least one of the pitch direction or the roll direction to level the vehicle.

3. The system according to claim 1, wherein at least one of the sensor device or the smart device is configured to calculate the change of height of a frame of a motorized recreational vehicle proximate to each wheel of the motorized recreational vehicle when the sensor device is installed on the motorized recreational vehicle.

4. The system according to claim 1, wherein the smart device is configured to allow an input of which side of a vehicle to which the sensor device is installed is to be a driver's side of the vehicle.

5. The system according to claim 1, wherein the sensor device comprises an On/Off switch that permits a battery of the sensor device to be disconnected from circuitry of the sensor device.

6. The system according to claim 1, wherein the sensor device is configured to switch between a sleep mode and an awake mode based on the sensor device detecting of motion by a vehicle to which the sensor device is installed.

7. The system according to claim 1, wherein the smart device and the sensor device communicate with each other through a wireless connection and the smart device is configured to receive a serial number of the sensor device so that the smart device communicates with the particular sensor device.

8. The system according to claim 1, wherein the smart device is configured to permit an input of a display resolution by a user such that the display resolution changes in increments input by the user.

9. A method for leveling a recreational vehicle, the method comprising:

providing a leveling system comprising a sensor device secured to a vehicle to sense at least one of an inclination or an orientation of the vehicle in both a pitch direction and a roll direction and a smart device in communication with the sensor device;

measuring the pitch angle and the roll angle of the vehicle when the vehicle is at rest using the sensor device;

retrieving calibration data of pitch angle and roll angle measurements taken by the sensor device when the vehicle was at an initial level position;

calculating any needed change in height to at least one of a rear or front section or first or second side sections of the vehicle to obtain a level position of the vehicle in at least one of the pitch direction or the roll direction of the vehicle using the calibration data of pitch and roll angle measurements; and

displaying the calculated changes in height on the smart device; and

adjusting the height to the at least one of the rear or front section or the first or second side sections of the vehicle to obtain the level position of the vehicle based on the calculated changes in height.

10. The method according to claim 9, further comprising:

determining the initial level position for a vehicle to determine any inconsistencies inherent in the leveling system; and

capturing pitch and roll angle measurements from the sensor device taken at the initial level position to provide the calibration data of the pitch and roll angle

measurements to permit consideration of any inconsistencies determined when taking measurement readings at a future time.

12. The method according to claim 10, wherein the step of calculating any needed change further comprises calculating the change of height of each wheel position of a motorized recreational vehicle when the sensor device is installed on the motorized recreational vehicle.

13. The method according to claim 10, further comprising selecting which side of a vehicle to which the sensor device is installed is to be a driver's side of the vehicle.

14. The method according to claim 10, further comprising switching the sensor device between a sleep mode and an awake mode based on the sensor device detecting of motion by a vehicle to which the sensor device is installed.

15. The method according to claim 10, wherein the smart device and the sensor device communicate with each other through a wireless connection and further comprising entering a serial number of the sensor device into the smart device so that the smart device communicates with the particular sensor device.

16. The method according to claim 10, further comprising inputting a display resolution such that the display resolution changes in specified increments.

17. A non-transitory computer readable medium comprising computer executable instructions embodied in a computer readable medium that when executed by a processor of a computer control the computer to perform steps comprising:

receiving on a smart device a pitch angle measurement and a roll angle measurement of a vehicle when the vehicle is at rest from a sensor device;

retrieving calibration data of pitch angle and roll angle measurements taken by the sensor device when the vehicle was at an initial level position;

calculating any needed change in height to at least one of a rear or front section or first or second side sections of the vehicle to obtain a level position of the vehicle in at least one of a pitch direction or a roll direction of the vehicle using the calibration data of the pitch and roll angle measurements to obtain a level position of the vehicle; and

displaying the calculated changes in height needed to obtain the level position of the vehicle on the smart device.

18. The non-transitory computer readable medium according to claim 17, further comprising calculating a change of height of each wheel position of a motorized recreational vehicle when the sensor device is installed on the motorized recreational vehicle.

19. The non-transitory computer readable medium according to claim 18, displaying the change of height of each wheel position of the motorized recreational vehicle.

ABSTRACT

The present subject matter provides leveling systems and processes for leveling vehicles, such as recreational vehicles. The present subject matter also relates to computer program products for leveling vehicles, such as recreational vehicles, using smart devices. The leveling system can include a sensor device secured to a vehicle to sense at least one of an inclination or an orientation of the vehicle in both a pitch direction and a roll direction. The leveling system can include a smart device in communication with the sensor device to allow information received from the sensor device to be processed to provide measurements to a user and to determine the amount of adjustments needed in height to at least one of the pitch direction or the roll direction to level the vehicle.

Electronic Patent Application Fee Transmittal

Application Number:	
Filing Date:	
Title of Invention:	VEHICLE LEVELING SYSTEMS, DEVICES AND METHODS AND COMPUTER PROGRAM PRODUCTS FOR LEVELING VEHICLES USING SMART DEVICES
First Named Inventor/Applicant Name:	Charles A. Leonard
Filer:	John Bennett Mullinax/David Sigmon
Attorney Docket Number:	

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**

Electronic Acknowledgement Receipt

EFS ID:	29455919
Application Number:	15619261
International Application Number:	
Confirmation Number:	2353
Title of Invention:	VEHICLE LEVELING SYSTEMS, DEVICES AND METHODS AND COMPUTER PROGRAM PRODUCTS FOR LEVELING VEHICLES USING SMART DEVICES
First Named Inventor/Applicant Name:	Charles A. Leonard
Customer Number:	44728
Filer:	John Bennett Mullinax/David Sigmon
Filer Authorized By:	John Bennett Mullinax
Attorney Docket Number:	
Receipt Date:	09-JUN-2017
Filing Date:	
Time Stamp:	18:44:15
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		PatAppLEO2CIP.pdf	11895048 6f9b544ef3fc35d6ce9a46e3a7776dbe3e4ec2f4	yes	59

	Multipart Description/PDF files in .zip description		
	Document Description	**Start**	**End**
	Transmittal of New Application	1	1
	Application Data Sheet	2	7
	Specification	8	53
	Claims	54	58
	Abstract	59	59

Warnings:					
Information:					
2	Drawings-only black and white line drawings	LEO2CIPFigures110.pdf	314754 a742bf05005acc0404da26646272dd27d5406024	no	13
Warnings:					
Information:					
3	Drawings-only black and white line drawings	Figs11and12LEO2CIP.PDF	86067 45e9df56967978477687fa0742de00df109f1a88	no	2
Warnings:					
Information:					
4	Fee Worksheet (SB06)	fee-info.pdf	34969 e54d2356bd4cf0d3342e07f6b342493daf880a6d	no	2
Warnings:					
Information:					
		Total Files Size (in bytes):	12330838		

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.

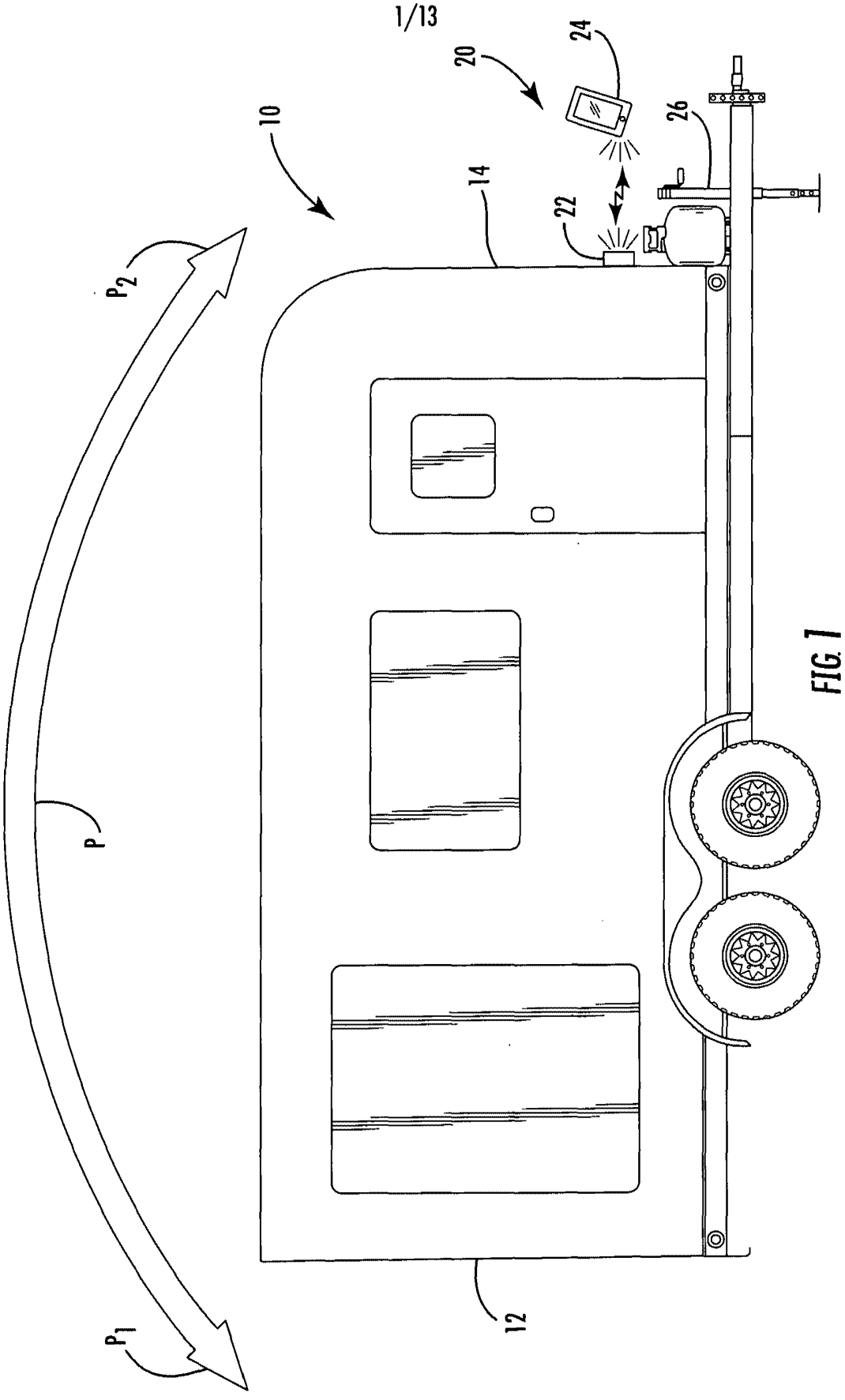


FIG. 1

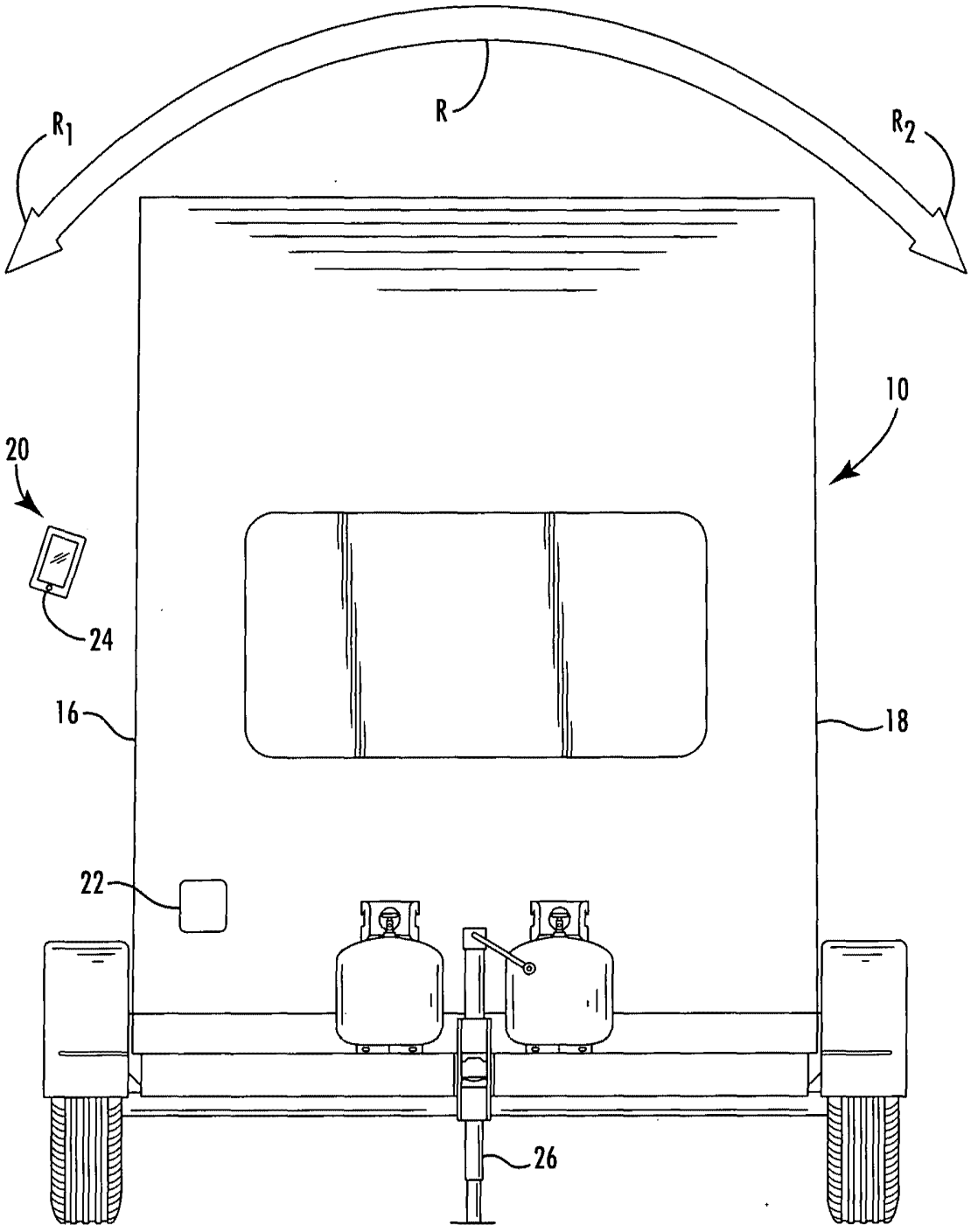


FIG. 2

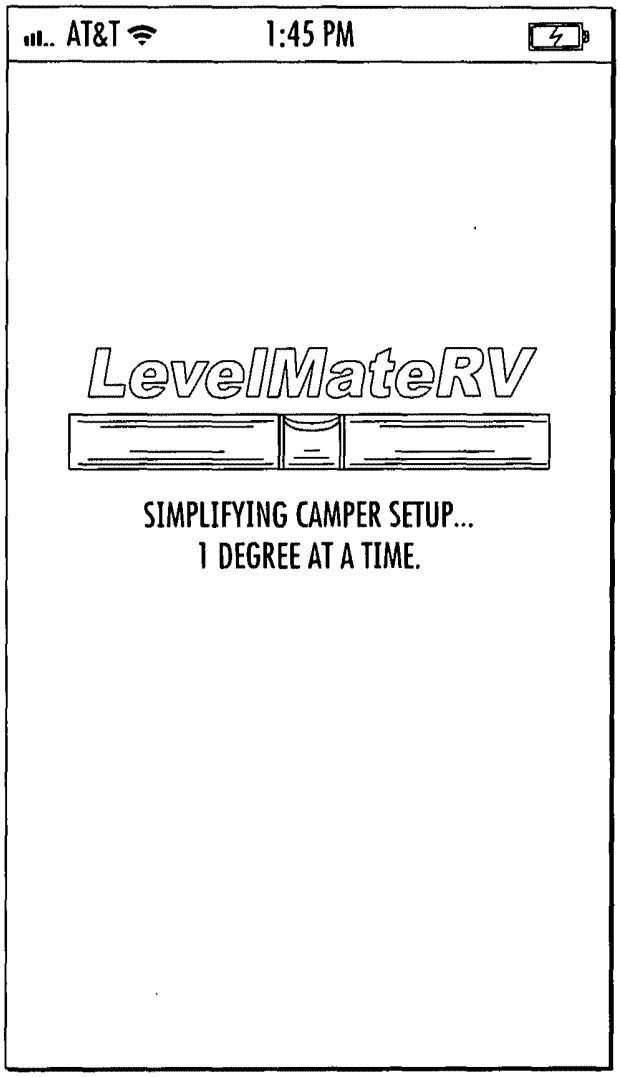

AT&T
1:45 PM
LevelMateRV
SIMPLIFYING CAMPER SETUP...
1 DEGREE AT A TIME.
28

FIG. 3

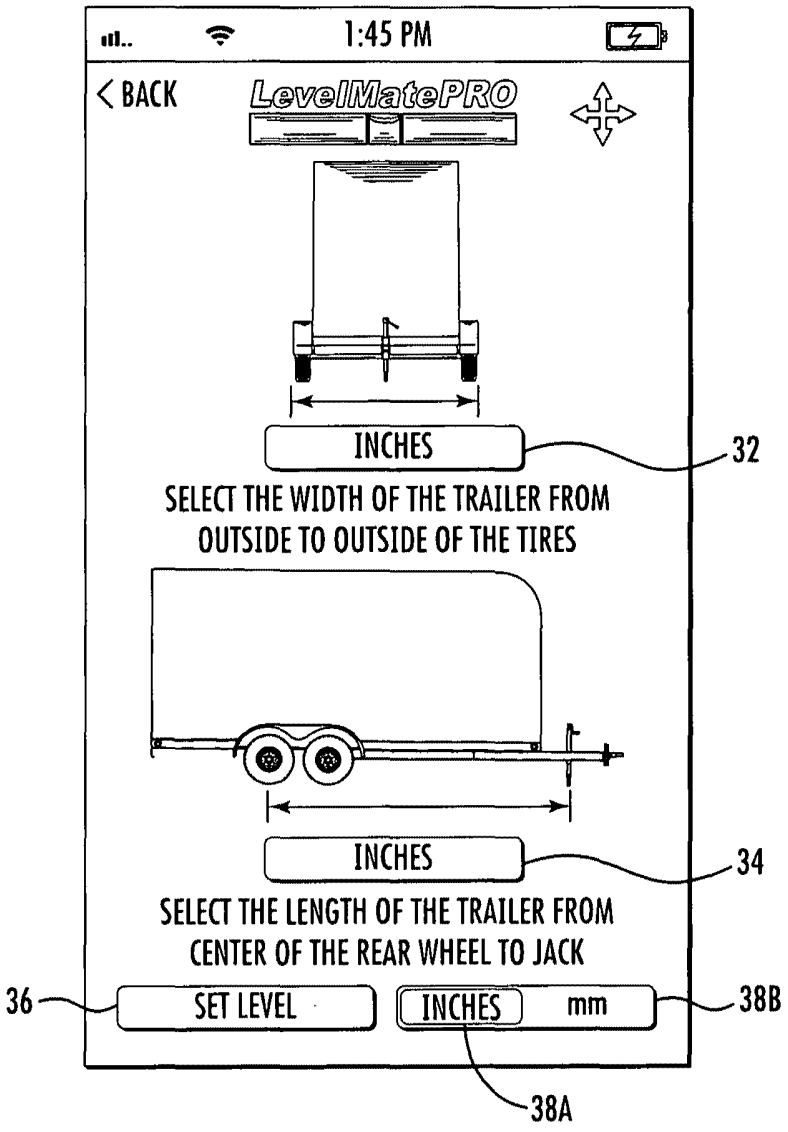

1:45 PM
BACK
LevelMatePRO
INCHES
32
SELECT THE WIDTH OF THE TRAILER FROM
OUTSIDE TO OUTSIDE OF THE TIRES
INCHES
34
SELECT THE LENGTH OF THE TRAILER FROM
CENTER OF THE REAR WHEEL TO JACK
36
SET LEVEL
INCHES
mm
38B
38A

FIG. 4

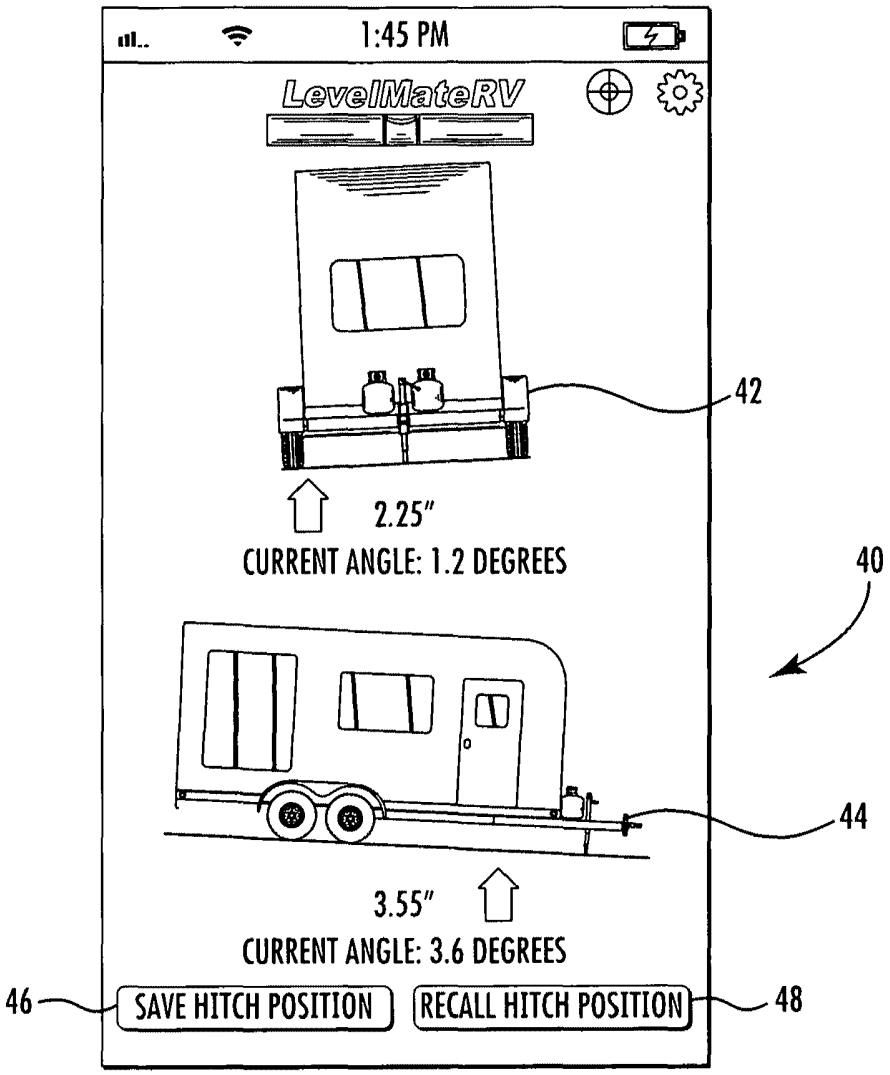

1:45 PM
LevelMateRV
42
2.25"
CURRENT ANGLE: 1.2 DEGREES
40
44
3.55"
CURRENT ANGLE: 3.6 DEGREES
46
SAVE HITCH POSITION
RECALL HITCH POSITION
48

FIG. 5A

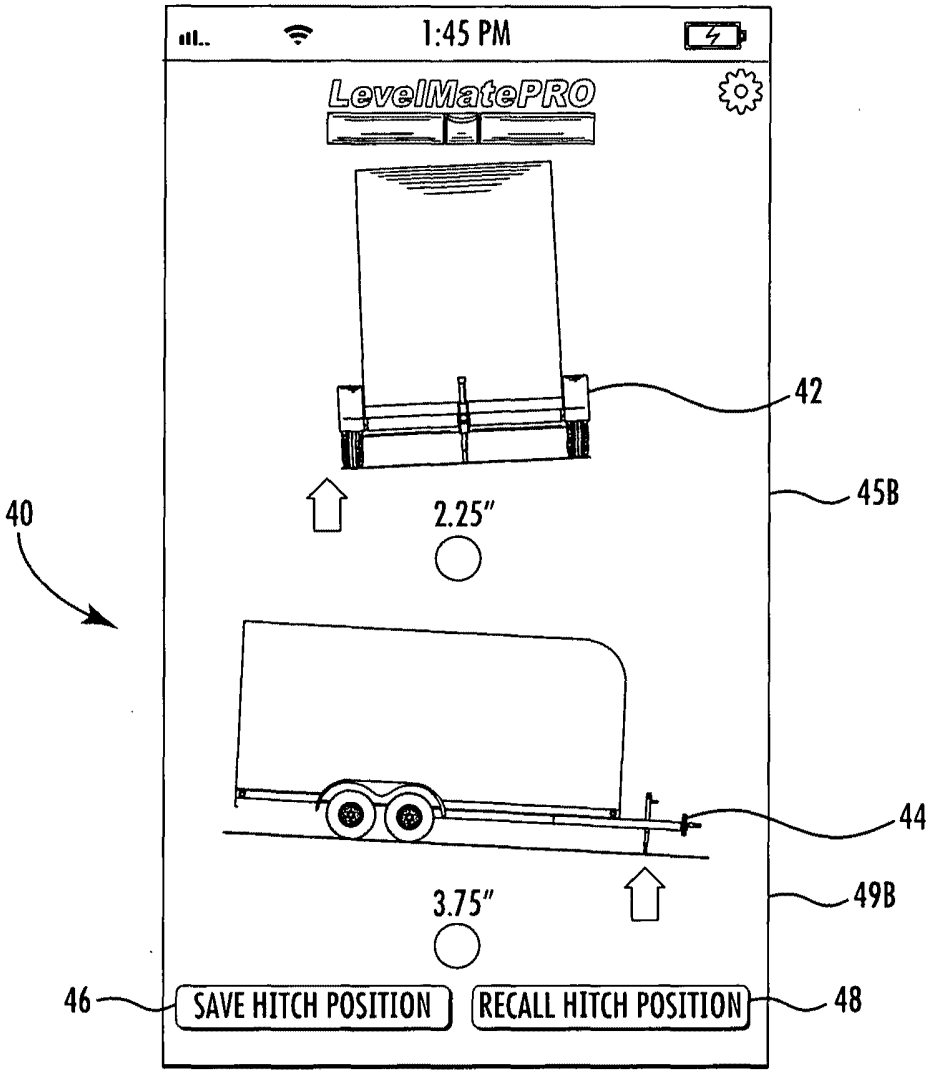

1:45 PM
LevelMatePRO
42
45B
40
2.25"
44
3.75"
49B
46
SAVE HITCH POSITION
RECALL HITCH POSITION
48

FIG. 5B

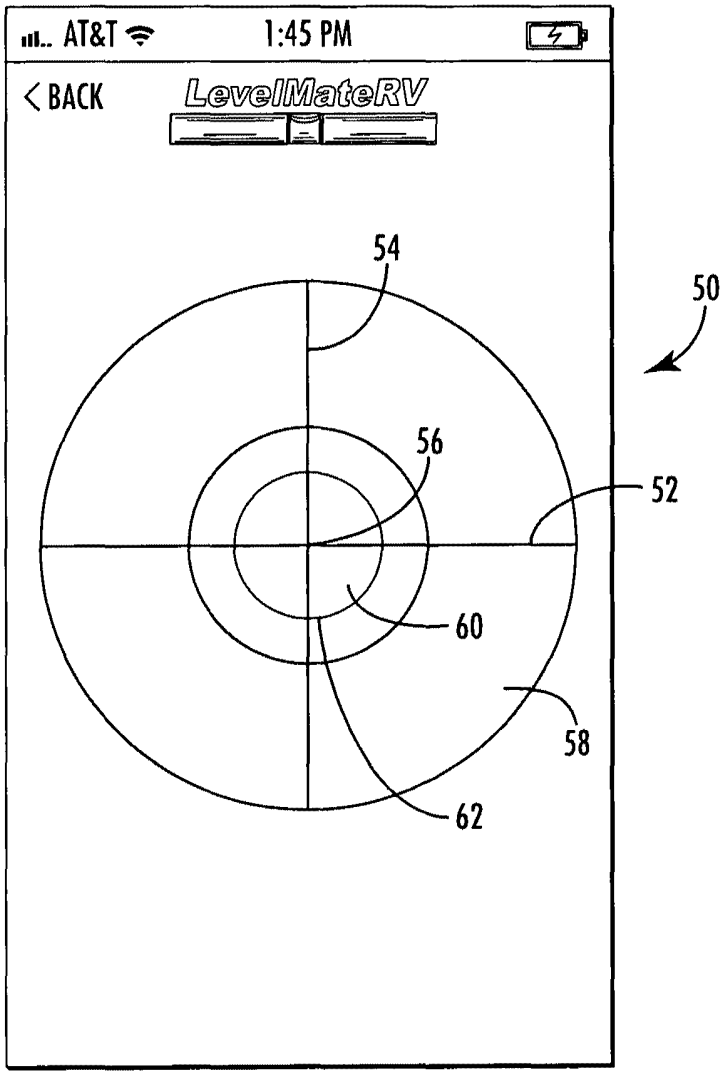


FIG. 6

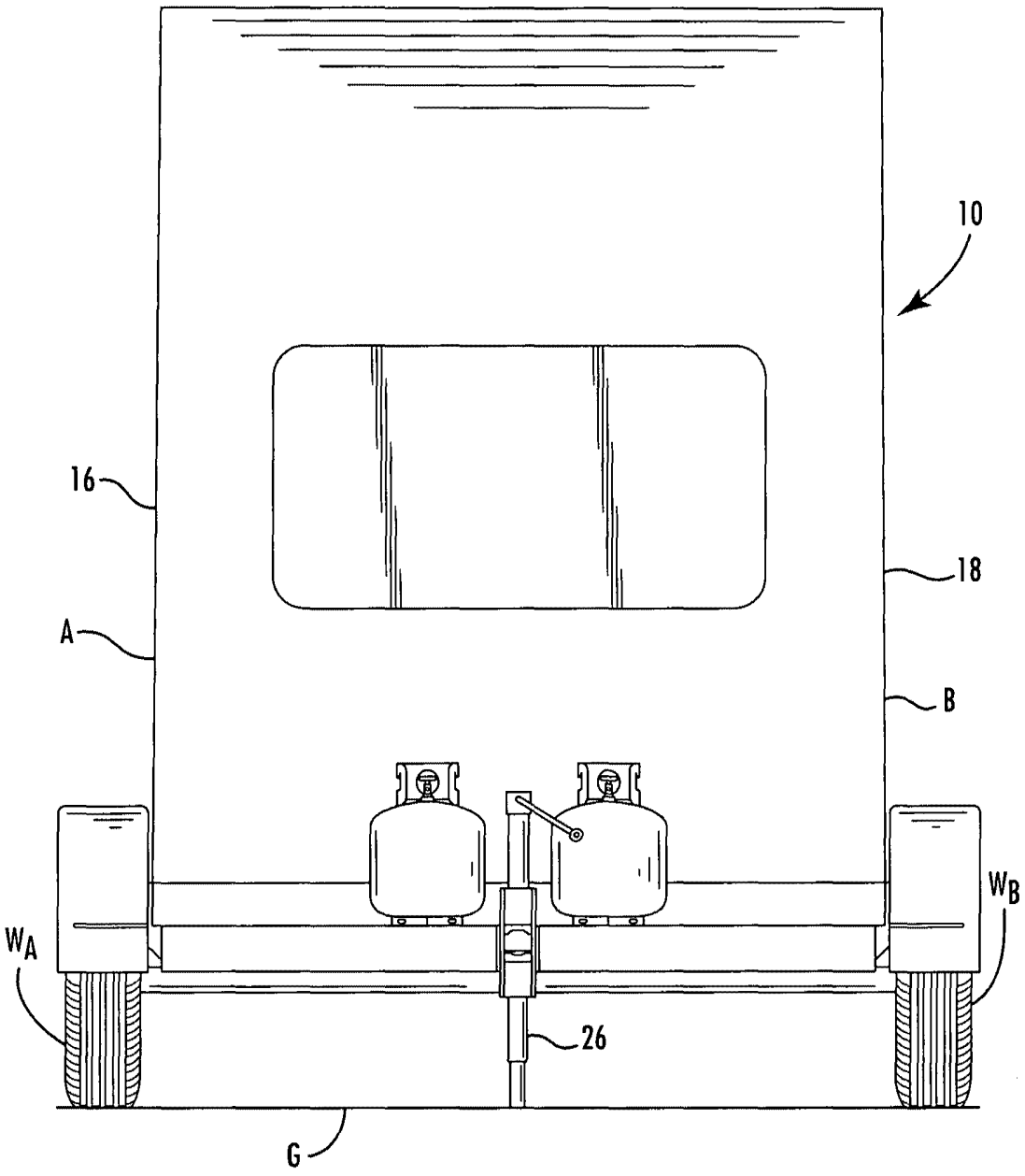


FIG. 7A

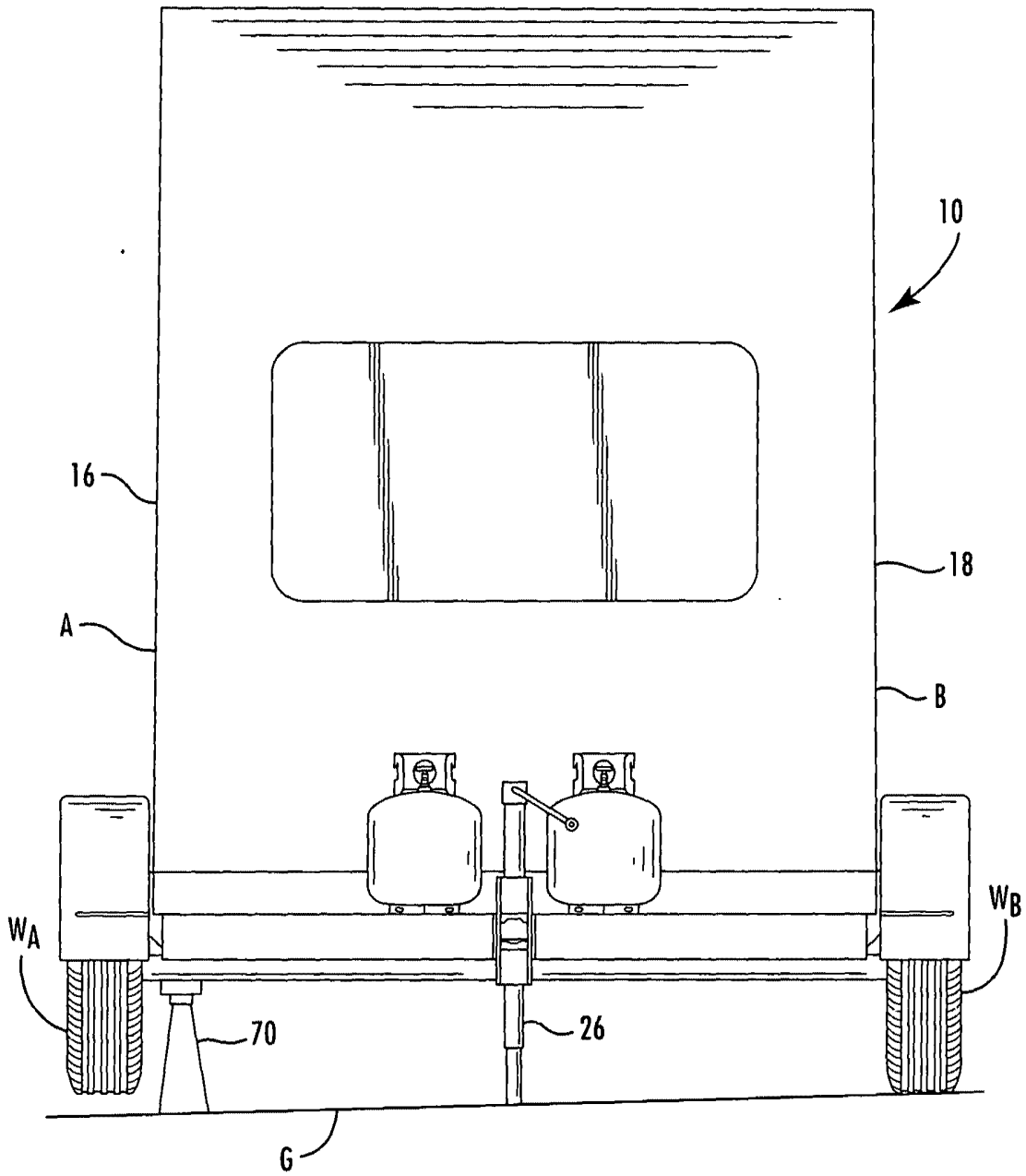


FIG. 7B

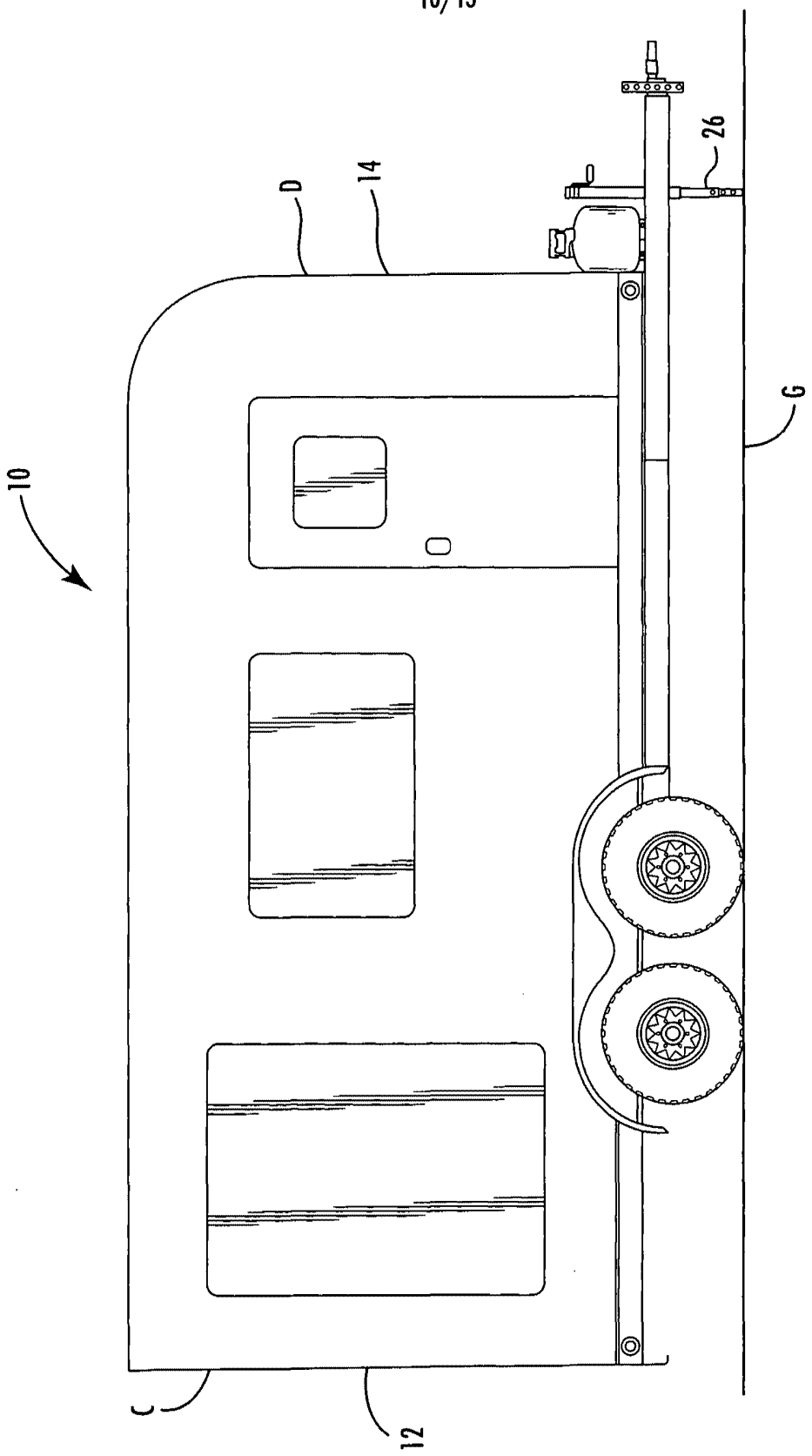


FIG. 8A

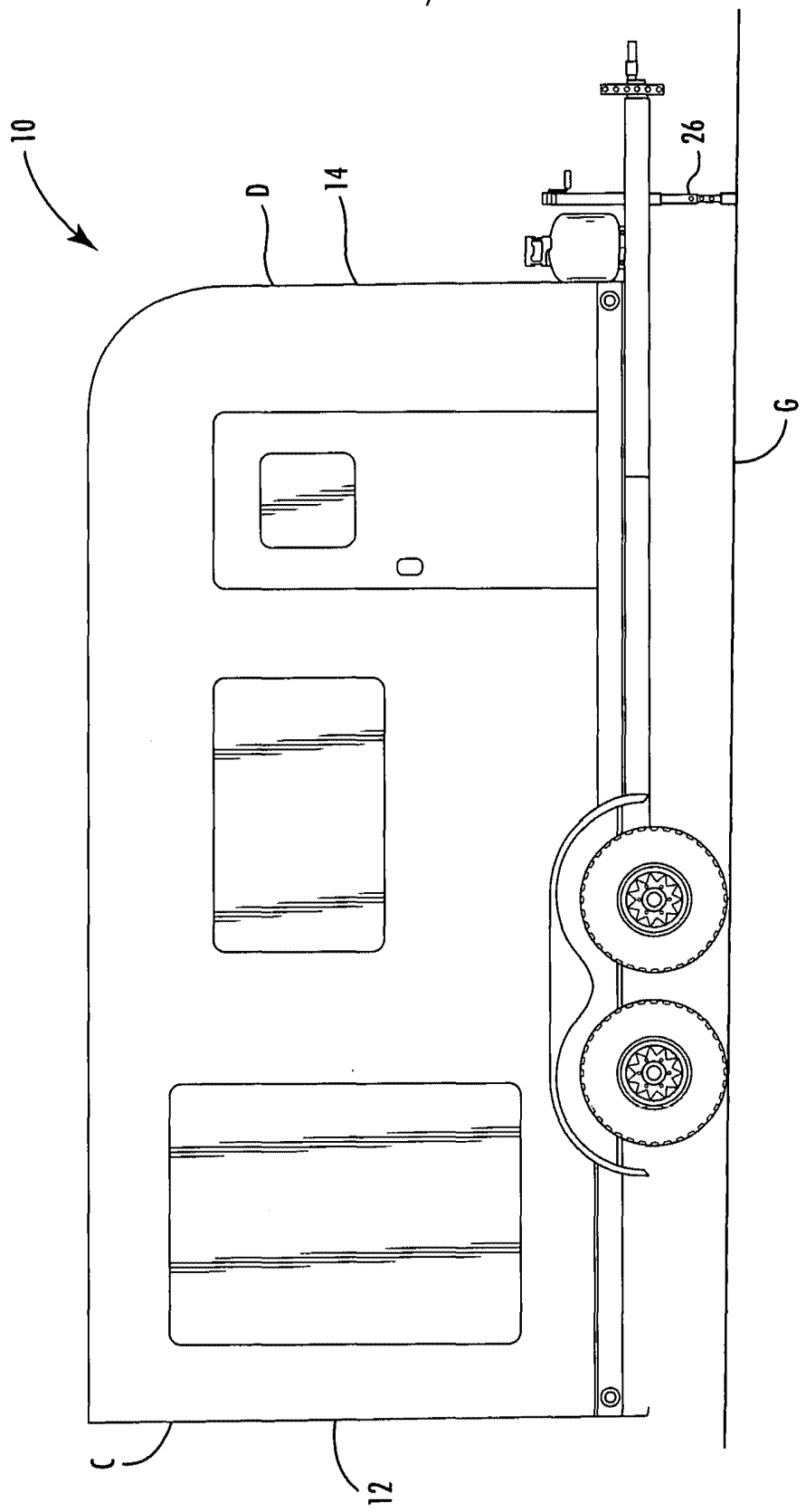


FIG. 8B

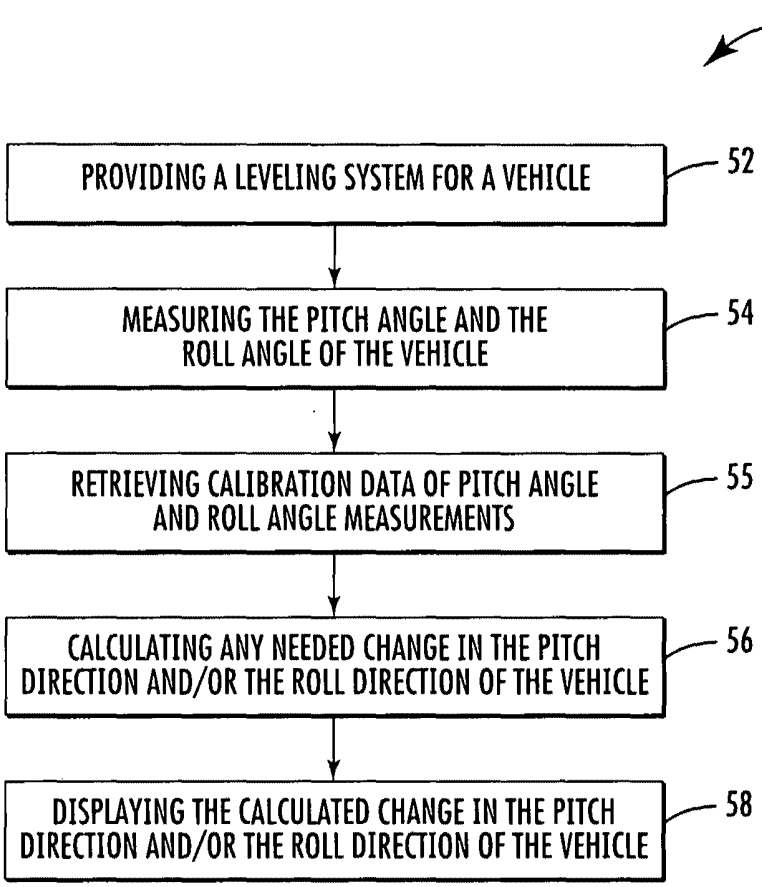

50
PROVIDING A LEVELING SYSTEM FOR A VEHICLE
52
MEASURING THE PITCH ANGLE AND THE ROLL ANGLE OF THE VEHICLE
54
RETRIEVING CALIBRATION DATA OF PITCH ANGLE AND ROLL ANGLE MEASUREMENTS
55
CALCULATING ANY NEEDED CHANGE IN THE PITCH DIRECTION AND/OR THE ROLL DIRECTION OF THE VEHICLE
56
DISPLAYING THE CALCULATED CHANGE IN THE PITCH DIRECTION AND/OR THE ROLL DIRECTION OF THE VEHICLE
58

FIG. 9

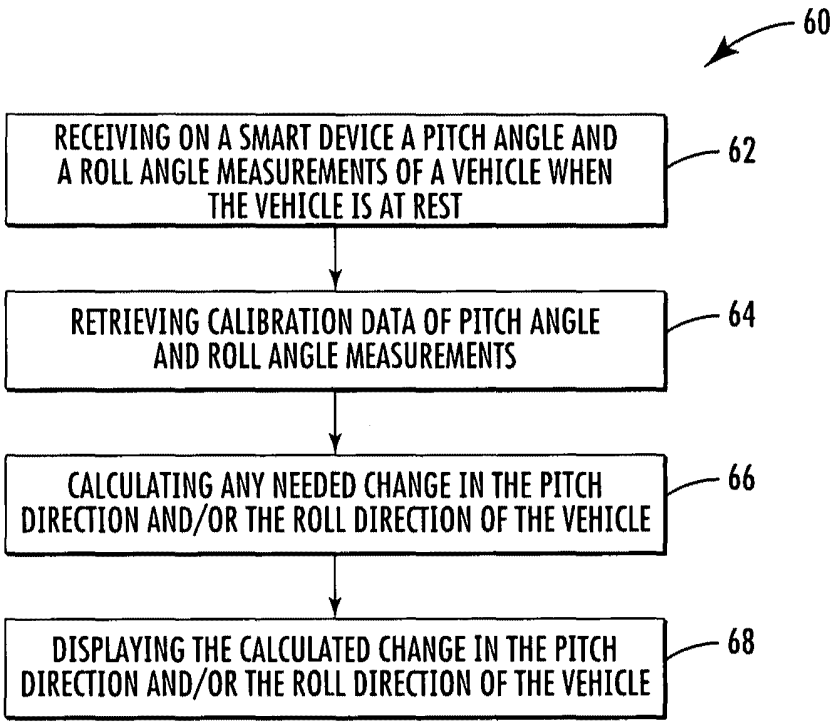

60
RECEIVING ON A SMART DEVICE A PITCH ANGLE AND A ROLL ANGLE MEASUREMENTS OF A VEHICLE WHEN THE VEHICLE IS AT REST
62
RETRIEVING CALIBRATION DATA OF PITCH ANGLE AND ROLL ANGLE MEASUREMENTS
64
CALCULATING ANY NEEDED CHANGE IN THE PITCH DIRECTION AND/OR THE ROLL DIRECTION OF THE VEHICLE
66
DISPLAYING THE CALCULATED CHANGE IN THE PITCH DIRECTION AND/OR THE ROLL DIRECTION OF THE VEHICLE
68

FIG. 10

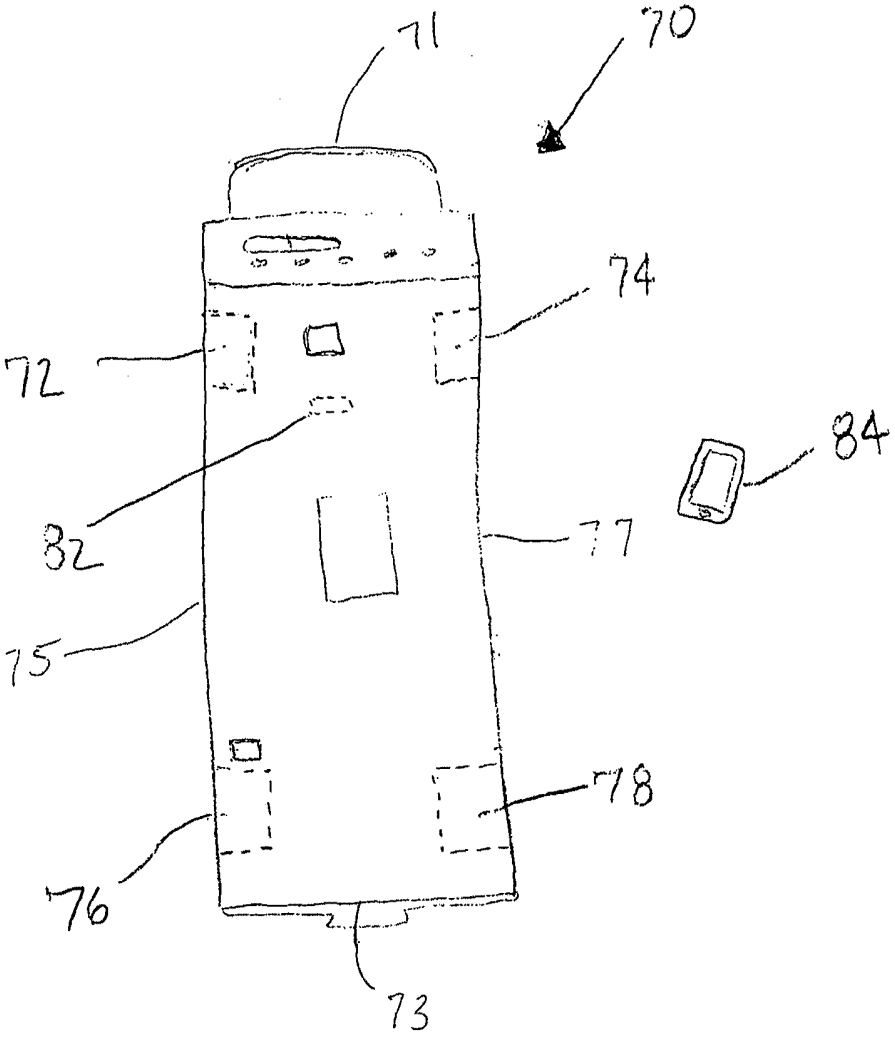


FIG. 11

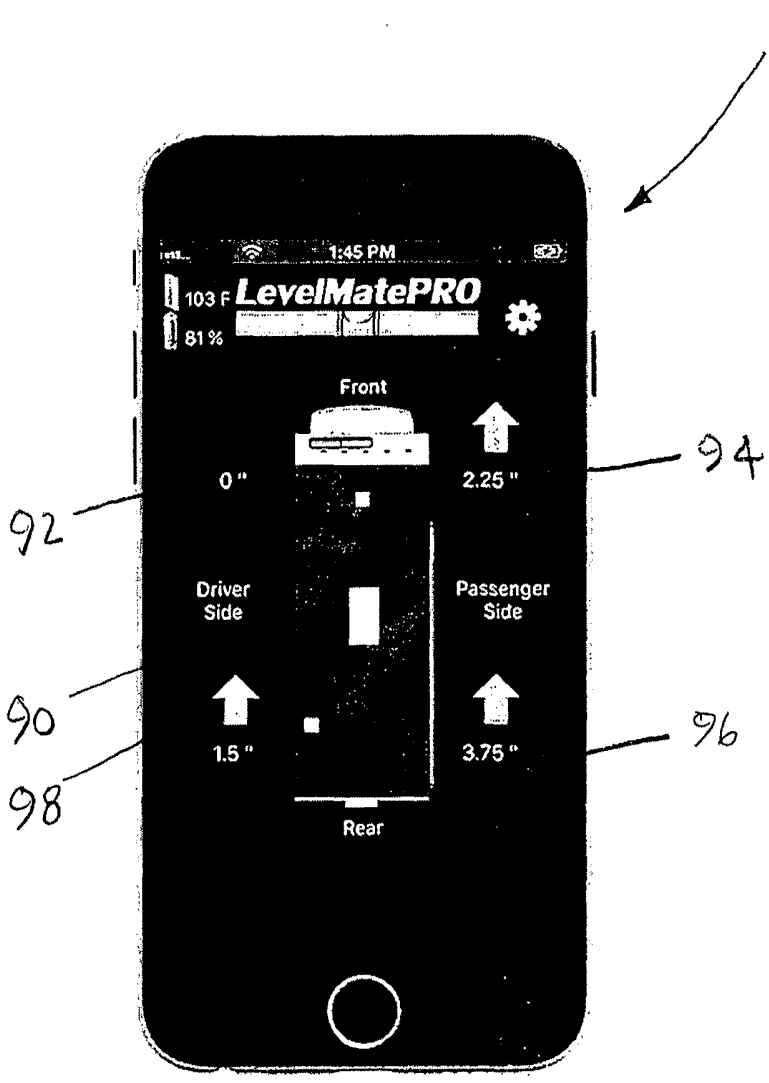

84
1:45 PM
103 F
81 %
LevelMatePRO
Front
0 "
2.25 "
92
94
Driver Side
Passenger Side
90
96
1.5 "
3.75 "
98
Rear

FIG. 12

UNITED STATES PATENT AND TRADEMARK OFFICE

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

APPLICATION NUMBER	FILING or 371(c) DATE	GRP ART UNIT	FIL FEE REC'D	ATTY.DOCKET.NO	TOT CLAIMS	IND CLAIMS
15/619,261	06/09/2017	3766	0.00	LEO-2-CIP	18	3

CONFIRMATION NO. 2353

FILING RECEIPT

44728
J. BENNETT MULLINAX, LLC
P. O. BOX 26029
GREENVILLE, SC 29616-1029

OC000000092309517

Date Mailed: 06/22/2017

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)

Charles A. Leonard, Hickory, NC;

Applicant(s)

Charles A. Leonard, Hickory, NC;

Power of Attorney: None

Domestic Priority data as claimed by applicant

This application is a CIP of 14/961,787 12/07/2015
which claims benefit of 62/088,115 12/05/2014
and claims benefit of 62/101,109 01/08/2015

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.

Permission to Access Application via Priority Document Exchange: No

Permission to Access Search Results: No

Applicant may provide or rescind an authorization for access using Form PTO/SB/39 or Form PTO/SB/69 as appropriate.

If Required, Foreign Filing License Granted: 06/22/2017

ETN1003
80/306

The country code and number of your priority application, to be used for filing abroad under the Paris Convention, is **US 15/619,261**

Projected Publication Date: To Be Determined - pending completion of Missing Parts

Non-Publication Request: No

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

VEHICLE LEVELING SYSTEMS, DEVICES AND METHODS AND COMPUTER PROGRAM PRODUCTS FOR LEVELING VEHICLES USING SMART DEVICES

Preliminary Class

607

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

PROTECTING YOUR INVENTION OUTSIDE THE UNITED STATES

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

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

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

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

For information on preventing theft of your intellectual property (patents, trademarks and copyrights), you may wish to consult the U.S. Government website, http://www.stopfakes.gov. Part of a Department of Commerce initiative, this website includes self-help "toolkits" giving innovators guidance on how to protect intellectual property in specific countries such as China, Korea and Mexico. For questions regarding patent enforcement issues, applicants may call the U.S. Government hotline at 1-866-999-HALT (1-866-999-4258).

LICENSE FOR FOREIGN FILING UNDER

Title 35, United States Code, Section 184

Title 37, Code of Federal Regulations, 5.11 & 5.15

GRANTED

The applicant has been granted a license under 35 U.S.C. 184, if the phrase "IF REQUIRED, FOREIGN FILING LICENSE GRANTED" followed by a date appears on this form. Such licenses are issued in all applications where the conditions for issuance of a license have been met, regardless of whether or not a license may be required as set forth in 37 CFR 5.15. The scope and limitations of this license are set forth in 37 CFR 5.15(a) unless an earlier license has been issued under 37 CFR 5.15(b). The license is subject to revocation upon written notification. The date indicated is the effective date of the license, unless an earlier license of similar scope has been granted under 37 CFR 5.13 or 5.14.

This license is to be retained by the licensee and may be used at any time on or after the effective date thereof unless it is revoked. This license is automatically transferred to any related applications(s) filed under 37 CFR 1.53(d). This license is not retroactive.

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

NOT GRANTED

No license under 35 U.S.C. 184 has been granted at this time, if the phrase "IF REQUIRED, FOREIGN FILING LICENSE GRANTED" DOES NOT appear on this form. Applicant may still petition for a license under 37 CFR 5.12, if a license is desired before the expiration of 6 months from the filing date of the application. If 6 months has lapsed from the filing date of this application and the licensee has not received any indication of a secrecy order under 35 U.S.C. 181, the licensee may foreign file the application pursuant to 37 CFR 5.15(b).

SelectUSA

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 U.S. offers tremendous resources and advantages for those who invest and manufacture goods here. Through SelectUSA, our nation works to promote and facilitate business investment. SelectUSA provides information assistance to the international investor community; serves as an ombudsman for existing and potential investors; advocates on behalf of U.S. cities, states, and regions competing for global investment; and counsels U.S. economic development organizations on investment attraction best practices. To learn more about why the United States is the best country in the world to develop technology, manufacture products, deliver services, and grow your business, visit http://www.SelectUSA.gov or call +1-202-482-6800.

PATENT APPLICATION FEE DETERMINATION RECORD

Substitute for Form PTO-875

Application or Docket Number: 15/619,261

APPLICATION AS FILED - PART I

FOR	(Column 1) NUMBER FILED	(Column 2) NUMBER EXTRA	SMALL ENTITY RATE($)	SMALL ENTITY FEE($)	OR	OTHER THAN SMALL ENTITY RATE($)	OTHER THAN SMALL ENTITY FEE($)
BASIC FEE (37 CFR 1.16(a), (b), or (c))	N/A	N/A	N/A	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))	18 minus 20 =	*	x 40 =	0.00	OR		
INDEPENDENT CLAIMS (37 CFR 1.16(h))	3 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

AMENDMENT A

	(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($)	OTHER THAN SMALL ENTITY ADDITIONAL FEE($)
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	

AMENDMENT B

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

* If the entry in column 1 is less than the entry in column 2, write "0" in column 3.

** If the "Highest Number Previously Paid For" IN THIS SPACE is less than 20, enter "20".

*** If the "Highest Number Previously Paid For" IN THIS SPACE is less than 3, enter "3".

The "Highest Number Previously Paid For" (Total or Independent) is the highest found in the appropriate box in column 1.

UNITED STATES PATENT AND TRADEMARK OFFICE

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

APPLICATION NUMBER	FILING OR 371(C) DATE	FIRST NAMED APPLICANT	ATTY. DOCKET NO./TITLE
15/619,261	06/09/2017	Charles A. Leonard	LEO-2-CIP

CONFIRMATION NO. 2353

44728
J. BENNETT MULLINAX, LLC
P. O. BOX 26029
GREENVILLE, SC 29616-1029

FORMALITIES LETTER

OC00000092309518

Date Mailed: 06/22/2017

NOTICE TO FILE MISSING PARTS OF NONPROVISIONAL APPLICATION

FILED UNDER 37 CFR 1.53(b)

Filing Date Granted

Items Required To Avoid Abandonment:

An application number and filing date have been accorded to this application. The item(s) indicated below, however, are missing. Applicant is given **TWO MONTHS** from the date of this Notice within which to file all required items below to avoid abandonment. Extensions of time may be obtained by filing a petition accompanied by the extension fee under the provisions of 37 CFR 1.136(a).

- The statutory basic filing fee is missing.
- The application search fee must be submitted.
- The application examination fee must be submitted.

The application is informal since it does not comply with the regulations for the reason(s) indicated below.

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

- A substitute specification in compliance with 37 CFR 1.52, 1.121(b)(3), and 1.125, is required. The substitute specification must be submitted with markings and be accompanied by a clean version (without markings) as set forth in 37 CFR 1.125(c) and a statement that the substitute specification contains no new matter (see 37 CFR 1.125(b)). The specification, claims, and/or abstract page(s) submitted is not acceptable and cannot be scanned or properly stored because:
  - The application contains drawings, but the specification does not contain a brief description of the several views of the drawings as required by 37 CFR 1.74 and 37 CFR 1.77(b)(9).

Applicant is cautioned that correction of the above items may cause the specification and drawings page count to exceed 100 pages. If the specification and drawings exceed 100 pages, applicant will need to submit the required application size fee.

- Surcharge as set forth in 37 CFR 1.16(f) must be submitted.
  The surcharge is due for any one of:
  - late submission of the basic filing fee, search fee, or examination fee,
  - late submission of inventor's oath or declaration,
  - filing an application that does not contain at least one claim on filing, or
  - submission of an application filed by reference to a previously filed application.

SUMMARY OF FEES DUE:

The fee(s) required within **TWO MONTHS** from the date of this Notice to avoid abandonment is/are itemized below. Small entity discount is in effect. If applicant is qualified for micro entity status, an acceptable Certification of Micro Entity Status must be submitted to establish micro entity status. (See 37 CFR 1.29 and forms PTO/SB/15A and 15B.)

- $ **70** basic filing fee.
- $ **70** surcharge.
- $ **300** search fee.
- $ **360** examination fee.
- $(**0**) previous unapplied payment amount.
- $ **800** TOTAL FEE BALANCE DUE.

Items Required To Avoid Processing Delays:

Applicant is notified that the above-identified application contains the deficiencies noted below. No period for reply is set forth in this notice for correction of these deficiencies. However, if a deficiency relates to the inventor's oath or declaration, the applicant must file an oath or declaration in compliance with 37 CFR 1.63, or a substitute statement in compliance with 37 CFR 1.64, executed by or with respect to each actual inventor no later than the expiration of the time period set in the "Notice of Allowability" to avoid abandonment. See 37 CFR 1.53(f).

- A properly executed inventor's oath or declaration has not been received for the following inventor(s):
  Charles A. Leonard

Replies must be received in the USPTO within the set time period or must include a proper Certificate of Mailing or Transmission under 37 CFR 1.8 with a mailing or transmission date within the set time period. For more information and a suggested format, see Form PTO/SB/92 and MPEP 512.

Replies should be mailed to:

Mail Stop Missing Parts
Commissioner for Patents
P.O. Box 1450
Alexandria VA 22313-1450

Registered users of EFS-Web may alternatively submit their reply to this notice via EFS-Web, including a copy of this Notice and selecting the document description "Applicant response to Pre-Exam Formalities Notice". https://sportal.uspto.gov/authenticate/AuthenticateUserLocalEPF.html

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

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

Questions about the contents of this notice and the requirements it sets forth should be directed to the Office of Data Management, Application Assistance Unit, at **(571) 272-4000** or **(571) 272-4200** or **1-888-786-0101**.

/amanalac/

PATENT

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Application of: Leonard

Group Art Unit: Not Yet Assigned

Serial No.: 15/619,261

Examiner: Not Yet Assigned

Filed: June 9, 2017

Docket No.: LEO-2-CIP

Confirmation No.: 2353

For: VEHICLE LEVELING SYSTEMS, DEVICES AND METHODS AND COMPUTER PROGRAM PRODUCTS FOR LEVELING VEHICLES USING SMART DEVICES

* *

PRELIMNINARY AMENDMENT

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

Dear Sir:

This first preliminary amendment is being filed in response to the Notice to File Missing Parts dated June 22, 2017. Please enter the following first preliminary amendment therein.

IN THE SPECIFICATION:

A marked-up version and a clean version of a Substitute Specification are included herewith as requested that address the concerns expressed in the Notice to File Missing Parts dated June 22, 2017. In particular, reference to Figures 11 and 12 in the Brief Description of the Drawings section of the application have been included. Applicant submits that no new matter is injected into the application by way of the substitute paragraphs.

IN THE CLAIMS:

Please amend the claims as follows:

1. (Currently Amended) A leveling system for leveling a vehicle that is at rest, the leveling system comprising:

a sensor ~~devices~~ device secured to a vehicle to sense at least one of an inclination or an orientation of the vehicle in both a pitch direction and a roll direction; and

a smart device in communication with the sensor device to allow information received from the sensor device about at least one of the inclination or the orientation of the vehicle in both the pitch direction and the roll direction to be processed to provide measurements to a user and to determine the amount of adjustments in height needed to at least one of the pitch direction or the roll direction to level the vehicle.

2. (Currently Amended) The system according to claim 1, wherein the sensor device comprises a printed circuit board that comprises at least one of a digital accelerometer or a digital gyroscope that have been temperature calibrated, and the printed circuit board comprises a processor to process data collected by the sensor device and to perform calculations related to the determination of the amount of adjustments in height needed to at least one of the pitch direction or the roll direction to level the vehicle.

3. (Original) The system according to claim 1, wherein at least one of the sensor device or the smart device is configured to calculate the change of height of a frame of a motorized recreational vehicle proximate to each wheel of the motorized recreational vehicle when the sensor device is installed on the motorized recreational vehicle.

4. (Original) The system according to claim 1, wherein the smart device is configured to allow an input of which side of a vehicle to which the sensor device is installed is to be a driver's side of the vehicle.

5. (Original) The system according to claim 1, wherein the sensor device comprises an On/Off switch that permits a battery of the sensor device to be disconnected from circuitry of the sensor device.

6. (Currently Amended) The system according to claim 1, wherein the sensor device is configured to switch between a sleep mode and an awake mode based on the sensor device detecting [[of]] motion by a vehicle to which the sensor device is installed.

7. (Original) The system according to claim 1, wherein the smart device and the sensor device communicate with each other through a wireless connection and the smart device is configured to receive a serial number of the sensor device so that the smart device communicates with the particular sensor device.

8. (Original) The system according to claim 1, wherein the smart device is configured to permit an input of a display resolution by a user such that the display resolution changes in increments input by the user.

9. (Currently Amended) A method for leveling a recreational vehicle, the method comprising:

providing a leveling system comprising a sensor device secured to a vehicle to sense at least one of an inclination or an orientation of the vehicle in both a pitch direction and a roll direction and a smart device in communication with the sensor device;

measuring the pitch angle and the roll angle of the vehicle when the vehicle is at rest using the sensor device;

retrieving calibration data of pitch angle and roll angle measurements taken by the sensor device when the vehicle was at an initial level position;

calculating any needed change in height to at least one of a rear or front section or first or second side sections of the vehicle to obtain a level position of the vehicle in at least one of the pitch direction or the roll direction of the vehicle using the calibration data of pitch and roll angle measurements; [[and]]

displaying the calculated changes in height on the smart device; and

adjusting the height to the at least one of the rear or front section or the first or second side sections of the vehicle to obtain the level position of the vehicle based on the calculated changes in height.

10. (Original) The method according to claim 9, further comprising:

determining the initial level position for a vehicle to determine any inconsistencies inherent in the leveling system; and

capturing pitch and roll angle measurements from the sensor device taken at the initial level position to provide the calibration data of the pitch and roll angle measurements to permit consideration of any inconsistencies determined when taking measurement readings at a future time.

11. (Currently Amended) The method according to claim [[10]] 9, wherein the step of calculating any needed change further comprises calculating the change of height of each wheel position of a motorized recreational vehicle when the sensor device is installed on the motorized recreational vehicle.

12. (Currently Amended) The method according to claim [[10]] 9, further comprising selecting which side of a vehicle to which the sensor device is installed is to be a driver's side of the vehicle.

13. (Currently Amended) The method according to claim [[10]] 9, further comprising switching the sensor device between a sleep mode and an awake mode based on the sensor device detecting [[of]] motion by a vehicle to which the sensor device is installed.

14. (Currently Amended) The method according to claim [[10]] 9, wherein the smart device and the sensor device communicate with each other through a wireless connection and further comprising entering a serial number of the sensor device into the smart device so that the smart device communicates with the particular sensor device.

15. (Currently Amended) The method according to claim [[10]] 9, further comprising inputting a display resolution such that the display resolution changes in specified increments.

16. (Original) A non-transitory computer readable medium comprising computer executable instructions embodied in a computer readable medium that when executed by a processor of a computer control the computer to perform steps comprising:

receiving on a smart device a pitch angle measurement and a roll angle measurement of a vehicle when the vehicle is at rest from a sensor device;

retrieving calibration data of pitch angle and roll angle measurements taken by the sensor device when the vehicle was at an initial level position;

calculating any needed change in height to at least one of a rear or front section or first or second side sections of the vehicle to obtain a level position of the vehicle in at least one of a pitch direction or a roll direction of the vehicle using the calibration data of the pitch and roll angle measurements to obtain a level position of the vehicle; and

displaying the calculated changes in height needed to obtain the level position of the vehicle on the smart device.

17. (Currently Amended) The non-transitory computer readable medium according to claim [[17]] 16, further comprising calculating a change of height of each wheel position of a motorized recreational vehicle when the sensor device is installed on the motorized recreational vehicle.

18. (Currently Amended) The non-transitory computer readable medium according to claim [[18]] 17, wherein the step of displaying the calculated changes in height comprises displaying the change of height of each wheel position of the motorized recreational vehicle on the smart device.

REMARKS

The attached substitute specification as requested in the Notice to File missing Parts addresses the concerns expressed therein. Applicant submits that no new matter has been added by way of the substitute specification.

With the above amendments, claims 12-19 have been renumbered 11-18 to address the unintentional skipping of claim 11 in the original claims. Claims 1, 2, 6, 9, 11-15, 17 and 18 (as renumbered) have been amended. Further underlining from some of the original claims has been removed.

The Examiner is encouraged to telephone the undersigned at his/her convenience should any minor issues remain after consideration of the present Amendment, to permit early resolution of same.

Please charge any additional fees required by this submission to Deposit Account No. **50-3172**.

Respectfully submitted,
J. BENNETT MULLINAX, LLC

Date: September 22, 2017

David M. Sigmon
Registration Number: 52,224
P.O. Box 26029
Greenville, SC 29616-1029
(864) 987-9696 (phone)
(864) 987-9686 (fax)

Customer No: 44728

DESCRIPTION

VEHICLE LEVELING SYSTEMS, DEVICES AND METHODS AND COMPUTER PROGRAM PRODUCTS FOR LEVELING VEHICLES USING SMART DEVICES

RELATED APPLICATIONS

The presently disclosed subject matter claims the benefit of U.S. Patent Application Serial. No. 14/961,787, filed December 7, 2015, which claims the benefit of U.S. Provisional Patent Application Serial. No. 62/088,115, filed December 5, 2014, and U.S. Provisional Patent Application Serial. No. 62/101,109, filed January 8, 2015; the disclosures of these three applications are incorporated herein by reference in their entireties.

TECHNICAL FIELD

The present subject matter relates to leveling systems and processes for leveling vehicles, such as recreational vehicles. The present subject matter also relates to computer program products for leveling vehicles, such as recreational vehicles, using smart devices.

BACKGROUND

Whether in a storage or use state, a recreational vehicle (RV) should be leveled for both practical and technical reasons. Practical reasons include a level floor, proper door swings, stove and sink use, as well as many others. Technical reasons include proper operation of the ammonia based refrigerator, level holding tanks for proper level detection by electronic means and for the proper operation of the plumbing and various

other systems. Some higher end Class A RV's have onboard leveling systems that utilize digital sensors and hydraulic jacks, but most do not have any native leveling capability beyond the raising and lowering of the front of the RV using manual or electric jacks. Level indicators are generally bubble levels attached to both the side and front or rear of the RV. In addition, there are many other vehicles and trailers that require a level position to operate properly such as food vending trucks, mobile medical trailers, transport trailers and in some cases heavy equipment although there are many others.

The described device provides leveling indication for the 2 main axes of the RV (side-to-side and front-to-back). For the purposes of describing both the typical and proposed leveling method, pitch will be defined as the angle of the RV from front to back and roll will be defined as the angle of the RV from side to side.

The typical RV leveling method is described. Once the RV has been moved into the desired location and orientation for use, the driver must exit the RV or tow vehicle to inspect the current level condition of the RV by using the bubble levels attached to the RV. The first step is to level the roll of the RV. Typically this is done by driving or towing the appropriate RV wheels onto a board, block or other object to raise one side of the RV closer to level. Since the bubble levels being used do not give any exact information regarding the amount the RV is out of level, it is an educated guess at best to determine just how high the appropriate wheels must be raised. Typically, this is a trial and error system requiring the driver to make multiple attempts at raising the appropriate wheels the necessary amount to achieve a level position. Each attempt requires the driver to get back into the vehicle to move the wheels off of the previously placed object being used to raise wheels, exit the vehicle to add or take away from the

height of the object being used to raise the wheels, enter the vehicle again to drive or tow the wheels back onto the object being used to raise the wheels and finally exiting the vehicle again to check the new roll orientation relative to level. It is not uncommon for this process to be repeated several times to achieve a level roll orientation. If bubble levels are being used to determine a level orientation, it is common knowledge that a bubble between the lines on a bubble level has an error range of 2-3 degrees. This can be a significant error amount as it relates to RV's and can cause doors, plumbing and other objects and systems within the RV not to operate properly. Once the roll orientation is level, the pitch orientation leveling operation must be completed. Typically, the bubble level mounted to the side of the RV will be used in this process. In the case of a towable RV, this process generally involves using the jack(s) on the front of the RV to raise or lower the front of the RV until a level position is achieved. Since the upward travel of the jack(s) is limited, it is sometimes required to place blocks or some other object under the jack to enable the jack(s) to raise the front of the RV high enough to achieve a level position. Placing blocks or other objects under the jack(s) requires the RV to be reattached to the tow vehicle, the jack(s) raised, blocks or objects placed under the jack(s), the jack(s) lowered onto the blocks or objects and then released from the tow vehicle. In the case of a driveable RV, the same iterative process used to level the roll of the RV is necessary to level the pitch of the RV. This process may require many attempts as in the case of leveling the roll of the RV.

As such, a need exists for a system for easily and inexpensively leveling a recreational vehicle that does require not many attempts to achieve a level balance of the recreational vehicle in both the pitch and the roll directions.

SUMMARY

The present subject matter provides leveling vehicles, such as recreational vehicles, and related systems and processes.

The present subject matter also relates to computer program products for leveling vehicles, such as recreational vehicles, using smart devices. The subject matter described herein may be implemented in software, in combination with hardware and/or firmware. For example, the subject matter described herein may be implemented in software executed by a hardware-enabled processor. In one exemplary implementation, the subject matter described herein of using leveling information for leveling a vehicle, such as a recreational vehicle, may be implemented using a non-transitory computer readable medium having stored thereon executable instructions that when executed by the processor of a computer control the processor to perform steps. Exemplary non-transitory computer readable media suitable for implementing the subject matter described herein include chip memory devices or disk memory devices accessible by a processor, programmable logic devices, and application specific integrated circuits. In addition, a computer readable medium that implements the subject matter described herein may be located on a single computing platform or may be distributed across plural computing platforms. Further, it should be noted that the systems and methods utilize and can comprise recreational vehicle leveling systems, devices and their components and functionality described herein. These recreational vehicle leveling systems and devices constitute special purpose devices that improve the technological field of providing guidance for and/or mechanisms for leveling recreational vehicles.

While one or more objects of the presently disclosed subject matter having been stated hereinabove, and which is achieved in whole or in part by the presently disclosed subject matter, other objects will become evident as the description proceeds when taken in connection with the accompanying drawings as best described hereinbelow.

BRIEF DESCRIPTION OF THE DRAWINGS

A full and enabling disclosure of the present subject matter including the best mode thereof to one of ordinary skill in the art is set forth more particularly in the remainder of the disclosures and the specification, including reference to the accompanying figures, in which:

Figure 1 illustrates a schematic side view of an embodiment of a vehicle that includes an embodiment of a leveling system according to the present subject matter;

Figure 2 illustrates a schematic front view of an embodiment of a vehicle that includes an embodiment of the leveling system according to Figure 1;

Figure 3 illustrates a screen shot of an embodiment of a software application on a smart device for use in an embodiment of the leveling system according to the present subject matter;

Figure 4 illustrates another screen shot of an embodiment of a software application on a smart device for use in an embodiment of the leveling system according to the present subject matter;

Figures 5A and 5B illustrate possible additional screen shots of an embodiment of a software application on a smart device for use in an embodiment of the leveling system according to the present subject matter;

Figure 6 illustrates a further screen shot of an embodiment of a software application on a smart device for use in an embodiment of the leveling system according to the present subject matter;

Figure 7A illustrates a schematic front view of an embodiment of a recreational vehicle positioned at a desired location before leveling;

Figure 7B illustrates a schematic front view of the embodiment of the recreational vehicle according to Figure 7A positioned at a desired location after leveling in the roll direction according to the present subject matter;

Figure 8A illustrates a schematic side view of the embodiment of the recreational vehicle according to Figure 7A positioned at a desired location before leveling;

Figure 8B illustrates a schematic side view of the embodiment of the recreational vehicle according to Figure 7A positioned at a desired location after leveling in the pitch direction according to the present subject matter;

Figure 9 illustrates an embodiment of a flowchart of a method of leveling a vehicle according to the present subject matter; [[and]]

Figure 10 illustrates an embodiment of a flowchart of a method of leveling a vehicle performed by a software application of a smart device in according to the present subject matter[[.]];

Figure 11 illustrates a schematic top plan view of an embodiment of a vehicle that includes an embodiment of a leveling system according to the present subject matter; and

Figure 12 illustrates another screen shot of an embodiment of a software application on a smart device for use in an embodiment of the leveling system according to the present subject matter;

Repeat use of reference characters in the present specification and drawings is intended to represent the same or analogous features or elements of the invention.

DETAILED DESCRIPTION

Reference now will be made to the embodiments of the present subject matter, one or more examples of which are set forth below. Each example is provided by way of an explanation of the present subject matter, not as a limitation. In fact, it will be apparent to those skilled in the art that various modifications and variations can be made in the present subject matter without departing from the scope or spirit of the present subject matter. For instance, features illustrated or described as one embodiment can be used on another embodiment to yield still a further embodiment. Thus, it is intended that the present subject matter cover such modifications and variations as come within the scope of the appended claims and their equivalents. It is to be understood by one of ordinary skill in the art that the present discussion is a description of exemplary embodiments only, and is not intended as limiting the broader aspects of the present subject matter, which broader aspects are embodied in exemplary constructions.

Although the terms first, second, right, left, front, back, etc. may be used herein to describe various features, elements, components, regions, layers and/or sections, these features, elements, components, regions, layers and/or sections should not be

limited by these terms. These terms are only used to distinguish one feature, element, component, region, layer or section from another feature, element, component, region, layer or section. Thus, a first feature, element, component, region, layer or section discussed below could be termed a second feature, element, component, region, layer or section without departing from the teachings of the disclosure herein.

Similarly, when a layer or coating is being described in the present disclosure as "on" or "over" another layer or substrate, it is to be understood that the layers can either be directly contacting each other or have another layer or feature between the layers, unless expressly stated to the contrary. Thus, these terms are simply describing the relative position of the layers to each other and do not necessarily mean "on top of" since the relative position above or below depends upon the orientation of the device to the viewer.

Embodiments of the subject matter of the disclosure are described herein with reference to schematic illustrations of embodiments that may be idealized. As such, variations from the shapes and/or positions of features, elements or components within the illustrations as a result of, for example but not limited to, user preferences, manufacturing techniques and/or tolerances are expected. Shapes, sizes and/or positions of features, elements or components illustrated in the figures may also be magnified, minimized, exaggerated, shifted or simplified to facilitate explanation of the subject matter disclosed herein. Thus, the features, elements or components illustrated in the figures are schematic in nature and their shapes and/or positions are not intended to illustrate the precise configuration of the subject matter and are not intended to limit the scope of the subject matter disclosed herein.

It is to be understood that the ranges and limits mentioned herein include all ranges located within the prescribed limits (i.e., subranges). For instance, a range from about 100 to about 200 also includes ranges from 110 to 150, 170 to 190, 153 to 162, and 145.3 to 149.6. Further, a limit of up to about 7 also includes a limit of up to about 5, up to 3, and up to about 4.5, as well as ranges within the limit, such as from about 1 to about 5, and from about 3.2 to about 6.5 as examples.

"Smart device," or "mobile smart device," as used herein means any mobile electronic device configured with imaging and/or computing capabilities that can process image and sensor data. Such smart devices can include, but are not limited to, at least one of a mobile smartphone, a personal digital assistant (PDA), a computing tablet, a personal media player, or any like mobile electronic device configured with imaging and/or computing capabilities. In some embodiments, the smart device may be provisioned with a hardware-based processor that is configured to execute software programs or applications.

"Vehicle leveling device," and "RV leveling device" as used herein means a sensor device that include at least one of a gyroscope, a digital compass, a tilt sensor, a digital accelerometer or some other digital angle measurement device or sensor therein that includes a software application that permits the sensor device to measure and asset angles of inclination and/or orientation of a recreational vehicle to permit the pitch and roll of the recreational vehicle to be adjusted to level the recreational vehicle. A digital temperature sensor may also be included on the vehicle leveling device and used to collect temperature data necessary to correct variations or irregularities in the data obtained by the above mentioned angle measurement sensors. A computer processor

may also be included on the vehicle leveling device and used to perform calculations, security functions, storage management and functions as well as other tasks. Firmware associated with the desired functionality may be executed by the computer processor of the vehicle leveling device.

"Vehicle" as used herein means both powered vehicles and non-powered vehicles, trailers or the like, and includes but is not limited to cars, trucks, recreational vehicle, recreational vehicle trailers, food vending trucks, mobile medical trailers, transport trailers, boon trucks, backhoes, or the like.

"Mobile smart device software application" as used herein means specific software applications for and used on a mobile smart device that can be in the form of a non-transitory computer readable medium comprising computer executable instructions embodied in a computer readable medium that when executed by a processor of a computer control of the smart device, the smart device can perform specific steps.

"Software" or "Software application" as used herein means software applications for and used on a computer, which can include, but is not limited to a mobile smart device, that can be in the form of a non-transitory computer readable medium comprising computer executable instructions embodied in a computer readable medium that when executed by a processor of a computer control of the computer, the computer can perform specific steps.

The leveling system, method, device, and/or computer program product embodiments described herein refer mainly to recreation vehicles. There are many other vehicles and trailers that require a level position to operate properly such as food vending trucks, mobile medical trailers, transport trailers and in some cases heavy

equipment although there are many others. It should be understood that that leveling system, method, device, and/or computer program product embodiments described herein can be used in conjunction with these other vehicles and/or trailers.

As stated above, the devices, systems, methods and computer program products relate to leveling an RV relative to the two main axes of the RV (side-to-side and front-to-back). As used herein to describe the proposed leveling method and shown in Figures 1 and 2, pitch is defined as the angle of the RV from front to back and roll will be defined as the angle of the RV from side to side. As shown in Figure 1, when adjusting the pitch, an embodiment of an RV **10** can be adjusted in pitch rotational directions **P** depend on the inclination of the RV from front-to-back. For example, if the RV **10** is inclined forward so that a rear section **12** is above a front section **14** proximal to a jack **26** of the RV **10**, then the pitch of RV **10** can be adjusted in the direction of arrow point P_1. If the RV **10** is inclined backward so that the front section **14** is above the rear section **12**, then the pitch can be adjusted in the direction of arrow point P_2. Similarly, as shown in Figure 2, when adjusting the roll, the RV **10** can be adjusted in roll rotational directions **R** depending on the inclination of the RV from side-to-side. For example, if the RV **10** is inclined forward so that a first side section **16** of the RV **10** is above a second side section **18** of the RV **10**, then the roll of RV **10** can be adjusted in the direction of arrow point R_1. If the RV **10** is inclined backward so that the second side section **14** is above the first side section **16**, then the pitch can be adjusted in the direction of arrow point R_2.

To accomplish the adjustments so that, upon parking the RV **10**, the RV **10** will be leveled in both the pitch and roll directions, a leveling system **20** can be provided that

provides measurements to determine the amount of adjustment needed in both the pitch and roll directions. For example, the leveling system **20** can comprise one or more sensor devices **22**, which can comprise a vehicle leveling device, (shown schematically as a box) that can be secured to the RV **10** to sense the inclination and/or orientation of the RV **10** in both the pitch and roll directions. Additionally the leveling system **20** can also comprise a smart device **24** that can be in communication with the sensor device **22**. For example, the smart device **24** can have a specific software application thereon that allows information received from the sensor device **22** about the inclination and/or orientation of the RV **10** to be processed to provide measurements to a user and to determine the amount of adjustments needed to the RV **10**. The smart device **24** and the sensor device can communicate with each other in a variety of ways. For example, in some embodiments, the sensor device **22** and smart device **24** can communicate through a wired connection. In some embodiments, as shown in Figures 1 and 2, the sensor device **22** and smart device **24** can communicate through wireless communications, such as Bluetooth.

As noted above, the sensor device **22** of the RV leveling system **20** is shown schematically, and while it is shown on the exterior front section of the RV **10**, it is noted that the sensor device can located at a variety of location and positions of the RV **10**. For example, the sensor device **22** can be on the rear, sides or at a central location of the RV **10**. Additionally, the sensor device **22** can be on the exterior, interior or inside the framework of the RV **10**. As noted above, the mobile smart device software application may have a screen designed to define the installed orientation of the sensor device so that data from the appropriate axes can be used for pitch and roll calculations.

The sensor device **22** can comprise a printed circuit board ("PCB") that can include various digital sensors including one or more digital accelerometers, one or more digital gyroscopes, a global positioning system ("GPS") sensor, and other sensors required for accomplishing the desired functionality of the RV leveling system. For example, a digital temperature sensor may also be included that can be used to collect temperature data. For instance, the temperature data collected by the digital temperature sensor can be used to correct variations or irregularities in the data obtained by the sensor device **22**. The PCB can also include a processor and stored software, such as firmware, to allow for the processing of data and performing calculations related to the desired functionality of the RV leveling system. The PCB can also include the components for Bluetooth or other wireless communication. The PCB can be battery powered or use other means of power such as AC or DC connections. The sensor device **22** can also comprise a housing or enclosure in which the PCB can be mounted for protection from damage and the environment.

For example, in some embodiments, the PCB of the sensor device **22** can have digital accelerometer that uses multiple axes, for example an X-axis, a Y-axis and a Z-axis that are used to determine movement and position. When installing the sensor device **22** or after installation, whether on the front, the rear, sides or at a central location of the RV **10**, one of the axes of the accelerometer can be assigned to measure the pitch **P** and another of the axes can be assigned to measure the roll **R**. For instance, the orientation of the sensor device **22** relative to the front, the rear, passenger side or drive side upon or after installation can be noted using the software application on either the PCB of sensor device **22** or the smart device **24** so that an

appropriate axis can be assigned to determine the pitch angle measurement and an appropriate axis can be assigned to determine the roll angle measurement. In this manner, the orientation of the sensor device **22** can be identified or assigned relative to the vehicle. The mobile smart device **24** software application may have a screen designed to define the installed orientation of the sensor device **22** so that data from the appropriate axes can be used for pitch and roll calculations.

After the firmware is installed, each PCB, which can include a gyroscope or an accelerometer as described above, can be provided with power, for example, by securing the PCB into a fixture or installing the battery in the PCB, and then subjected to a temperature calibration process. The PCB's can then be placed in a stationary position in an environmental chamber. Such an environmental chamber can expose the PCB to a broad range of temperatures, such as typical temperatures find during use. For example, the environmental chamber can be a freezer that exposes the PCB therein to low temperatures. One reason this action is done is to determine variances in, for example, the measurements obtained from the gyroscope or accelerometer included in the respective PCB. Since the PCB's are stationary position when placed in these environmental chambers, the accelerometer data or gyroscope data should not change but, for example, the accelerometer data or gyroscope data does due to temperature change. The changes in such can be monitored by the firmware on PCB to determine how to compensate for the discrepancy in the accelerometer data or gyroscope data to maintain the level of accuracy of the data readings at different temperatures.

For example for PCB's that include accelerometers, each PCB is soldered slightly differently and each accelerometer is manufactured with slight differences. For such reasons, each PCB can undergo this temperature calibration process to achieve more accuracy and repeatability. During this process while the PCB is held in a stationary position, the firmware monitors the accelerometer data. When the firmware detects a change in the accelerometer data, a temperature sensor on the PCB is read by the firmware and the accelerometer count (angle) deviation that has ~~occured~~ occurred is recorded along with the temperature in a temperature calibration lookup table by the firmware. After the PCB has been subjected to a range of temperatures and the firmware has recorded all the accelerometer count (angle) deviation in this temperature calibration lookup table, the temperature calibration process is complete. The resulting temperature calibration lookup table can be used each time accelerometer data is used for calculations in the regular use of the sensor device, i.e., the vehicle leveling device, and the vehicle leveling system. So when the vehicle leveling system is in use, accelerometer data is read along with the current temperature from the sensor device. The firmware on the PCB then looks up that temperature in the temperature calibration lookup table. Any angle deviation at that temperature in the temperature calibration lookup table is read and used to correct the current accelerometer angle data. This temperature corrected accelerometer data is then used to calculate the height requirements need to level the vehicle for that reading. As stated above, a similar temperature calibration process can be performed for gyroscopes to create a temperature calibration lookup table for gyroscope data.

In some embodiments, the smart device **24** can have a compatible wireless communication capability such as Bluetooth or other wireless communication protocol to obtain and/or share information from the PCB of the sensor device **22**. The smart device **24** can comprise software that is capable of communicating with the PCB of the sensor device **22**, storing information obtained from the PCB of the sensor device **22**, manipulating the information obtained from the PCB of the sensor device **22** and/or user input related to the inclination and/or orientation of the RV **10**, and displaying of information obtained from the PCB of the sensor device **22** and user input as well as information generated from the information obtained from the PCB of the sensor device **22** and/or the user input related to the inclination and/or orientation of the RV **10**. In some embodiments, the sensor device **22** can comprise a memory in communication with the processor of the PCB and can be used to store information transmitted from the mobile smart device **24**. In some embodiments, the sensor device **22** can use sensor data and/or stored user data to perform calculations on the sensor device **22** and transmit the calculated data to the mobile smart device **24** for further calculation or display or both. In the some embodiments, the smart device **24** can be a smartphone capable of storing and executing software applications. These calculations can be based off of the determination of the pitch and roll angles using the calibration data to determine the pitch angle measurements and the roll angle measurements. These calculations can include geometric calculations that can convert changes in angles to distance of movement need to obtain a level position of the vehicle in both the roll direction and the pitch direction based on the length and width of the vehicle being

leveled. Such geometric calculations can be based on common geometric formulas that would be understood by those skilled in the art.

Figures 3-6 illustrate embodiments of graphical user interface screens of an embodiment of a software application that can be used on the smart device **24**. Figure 3 illustrates a screen **28** of an entry or beginning screen through which a user can enter the software application, which can be used in some embodiments of the software application. In some embodiments of the software application, an entry screen may not be used. As shown in Figure 4, the software application can have the ability to accept user input relating to the RV **10**. For example, the software application can prompt the user to enter information such as the measurements of the RV **10**, for example, the length and the width of the RV **10**, that can be used to correctly calibrate the amount of adjustment needed in the pitch and roll directions. For example, as shown in Figure 4, the software application as shown in a screen **30** can be provide an entry cell **32** for entry of a width of the RV **10** as measured from the outside of a first wheel, or tire, on a first side of the RV **10** to the outside of a second wheel, or tire, on a second side of the RV **10** along an axle of the RV **10**. The screen **30** can also provide an entry cell **34** for entry of a length of the RV **10** as measured from a center point of the rear axle to the jack **26** at the front of the RV **10**. The software application can store this information for use in calculating displayed information at the time of entry or at a later time. In some embodiments, the software application can save the entered information for recall at a later time as needed. In some embodiments, this information can be stored on the RV sensor device **22** after transmission from the smart device **24**. In some embodiments,

the software application can individually save information on multiple RV's that can be recalled at a later time as needed.

To begin, an initial level position can be determined for the RV to help determine any inconsistencies inherent in the leveling system, such as inconsistencies due to the installation or placement of the sensor device on the RV that may cause the sensor readings to be slightly off. The smart device **24** can be used to determine the initial level position using the accelerometer, gyroscope and/or GPS functions therein through a portion of the software application, or a different software application, as shown in Figure 6 and described in more detail below. A typical digital or spirit level can also be used to achieve this initial level position. The smart device **24** can then capture, i.e., save and store the current pitch and roll angle measurements from the sensor device **22**. These measurements will be used as offsets from the initial level position when displaying angles or calculating and displaying adjustment values necessary to move the RV back to the initial level position. Thus, the software application can determine if the measurements from sensor device **22** are slightly off when the RV is at the initial level position and then take those inconsistencies into consideration when taking measurement readings in the future.

In particular, the software application on the smart device **24** can have a calibration function as represented by a "Set Level" button **36** in the screen **30** for the initial set up of the software application. The "Set Level" button **36** can be used to obtain the current sensor readings in the roll and pitch directions from the sensor device **22** when the smart device **24** indicates that the vehicle is in an initial level position. These sensor readings when the RV **10** is at the initial level position may be stored as

calibration data on the smart device **24** or the sensor device **22** or both. This calibration data can be used to compensate for any imperfections in the sensor readings that may derive from the installation and/or placement of the sensor device **22** on the vehicle **10**. Once this calibration function is completed, it does not necessarily need to be performed again. Additionally, in some embodiments as shown in Figure **4**, the software application can have a conversion function as represented by the "inches" and "mm" buttons **38A**, **38B** in the screen **30**. These buttons **38A**, **38B** can be used to set and/or change the metrics system used to measure, calibrate, and compute. For example, as shown, the system used for measurements can be set and/or changed between U.S. Customary System ("inches") and the Metric System ("mm").

Once the calibration has been performed, the software application can be used determine the change in roll and the change in pitch needed for the given RV **10** based on measurements from the sensor device **22** at any given location. In some embodiments, the sensor device **22** may use the calibration data as well as other current sensor data, such as the current pitch angle and roll angle measurements and temperature readings from the sensor device **22** or a another temperature sensor device, and perform calculations, such as an accurate calculation of the current angle of the vehicle and the offset that is needed, using the processor and firmware on the PCB of the sensor device **22**. In some embodiments, a user can activate the software application to initiate the measurements to determine the change in roll and pitch by simply opening the software application on the smart device **24** when connected to a wire communication with the sensor device **22** or within range of the sensor device **22** for a wireless communication connection, depending on how communication is setup

between the smart device **24** and the sensor device **22**. In some embodiments, the software application can display an interface on a display screen, such as a button, once the software application is opened that can be activated to initiate this determination, or calculation, function.

Figure 5A and 5B show similar screen shots of information that can be displayed in real time or near real time. Once the determination/calculation function is initiated and the change in roll and pitch calculated by the software application or the processor and firmware on the PCB of the sensor device **22**, the determined change in roll and pitch can then be displayed as shown in a screen shot **40** in Figures 5A and 5B. For example, a roll display **42** can be given as shown in Figures 5A and 5B. Similarly, a pitch display **44** can be provided. As shown in Figure 5A, in some embodiments, the roll display **42** can provide, for example, the current angle from level for the roll directions measured in degrees **43A** and the amount of elevation change **45A** in inches or millimeters needed on a given side to level the RV in the roll direction. Alternatively, in some embodiments as shown in Figure 5B, the roll display **42** can provide, for example, the current angle from level for the roll directions measured or expressed as the amount of elevation change **45B** in inches or millimeters needed on a given side to level the RV in the roll direction. Similarly, as shown in Figure 5A, in some embodiments, the pitch display **44** can, for example, provide the current angle from level for the pitch directions measured in degrees **47A** and the amount of elevation change **49A** in inches or millimeters needed on either the front or the back to level the RV in the pitch direction. Alternatively, in some embodiments as shown in Figure 5B, the pitch display **44** can, for example, provide the current angle from level for the pitch

directions as measured or expressed in the amount of elevation change **49B** in inches or millimeters needed on either the front or the back to level the RV in the pitch direction.

The software application on the smart device **24** can provide the ability for the user to configure the display resolution to specific height increments for adjustment of. Typically, accelerometer data, even though digitally filtered, can be choppy and cause the display of the calculated height to change between the set filter levels, i.e., the display resolution, for the digital filter that are to be displayed based on the calculations. In some situations, when the display resolution is set to smaller increments, for example, of 0.25 inches, the display of the expected height change can move back and forth between the closest two increments or flicker back and forth between the increments. For example, the display of the calculated height can flicker between 0 inches and 0.25 inches if the native resolution of the digital filter within the sensor device, or vehicle leveling device, is 0.25 inches and the calculated height is a measurement between 0 inches and 0.25 inches.

Typically, RV users use plastic blocks or wooden dimensional lumber as adjustment blocks to drive the RV **10** up on to get to the height required to reach a level position. Typically, these adjustment blocks are of a regular thickness. If the adjustment blocks being used, for example, are all one (1) inch thick then the accuracy of getting to a level position is going to be determined based on this set block thickness, meaning that the change in elevation of height will be in one (1) inch increments. Thus, the software application can include a screen that will allow the input of [[a]] an increment of resolution by which the digital filter will operate for providing an adjustment

of height in the elevation run direction and the pitch direction. For example, if the RV users have one (1) inch blocks, in some embodiments, the user can provide a display resolution can be selected from a menu of a variety of different display resolutions that can match the height of adjustment provided by the adjustment blocks the RV user may have. In some embodiments, the software application can provide a screen in which the RV user can enter the increment of display resolution for the leveling system to use. Thereby the leveling system and methods provided herein can provide the ability of the RV user to select different display resolutions. Thus, as explained in the example above, the RV user can select the display resolution of one (1) inch and the smart device running the software application would only show calculated heights in one (1) inch increments. By increasing the value of the display resolution, the RV user can obtain more useful information for the obtaining the adjustment in height that they need and the display based on the larger increment of the display resolution can be much more stable and less likely to flicker between incremental numbers due to the wider threshold of rounding in the math. For example, in some embodiments, the display resolution can be set during a configuration or installation of the sensor device.

As the current roll angle changes, the roll angle measurements expressed in degrees **43A** and/or the amount of elevation change **45A**, **45B** will change. As the current pitch angle changes, the pitch angle measurements expressed in degrees **47A** and/or the amount of elevation change **49A**, **49B** will also change. More particularly, for example, for the change in pitch, the amount of elevation change can be affected by the moving of the jack **26** proximal the front section **14** up or down by the requisite distance displayed. The changes in current roll and pitch angles can also be shown in in the

graphic image of the vehicle as shown in displays **42** and **44** in real time or near real time.

As shown in the screen **40** in Figures 5A and 5B, the mobile smart device software application can also provide the ability to save a given pitch angle, either on the smart device **24** or on the sensor device **22**, for the purpose of returning to that position at a later time as illustrated by the "save hitch position" button **46** in screen **40**. To reuse the pitch angle that had been saved, a recall can be provided, such as recall button **48**. This functionality can be useful for travel trailers and fifth wheel RV's that must be detached from a tow vehicle when in use. The pitch angle saved when the tow vehicle is detached from the RV will be recalled for pitch angle positioning when reattaching the tow vehicle. This will simplify and increase the speed of reattaching the tow vehicle to the RV.

As mentioned above and described in more detail below, in some embodiments, once the sensor device **22** has been properly mounted to the inside or outside of the RV **10**, the RV **10** can be leveled to an initial level position using the typical method described above or by placing the smart device **24** on the floor or some other horizontal surface of the RV and using a digital level software application, either separate from or integrated into the software application. Figure 6 shows a screen **50**, for example, of the software application that can be used to measure both the pitch and the roll angles using a pitch measuring line **52** and a roll measuring line **54** forming a crosshair **56**. The software application on the smart device **24** can show a display that operates in a similar manner to a spirit level so as to display movement of the pitch and roll angles toward a center bull's eye **60** as the smart device on the horizontal surface is moved

toward a leveled position. The progress toward the bull's eye **60** can be measured by the position of the crosshair **56** relative to the area **58** surrounding the bull's eye **60** as the crosshair **56** approaches the demarcation line **62** as the horizontal surface is moved closer to the leveled position. In this manner, the smart device **24** can be used in this initial leveling to determine an initial level position. As mentioned above, a typical digital or spirit level could also be used to achieve this initial level position. The smart device **24** can then capture, i.e., save and store the current pitch and roll angle measurements from the sensor device **22** or cause (by a transmitted instruction from the smart device **24**) the sensor device **22** to save and store the calibration data of pitch and roll angle measurements on the sensor device **22**. This calibration data will be used as offsets from the initial level position when displaying angles or calculating and displaying adjustment values necessary to move the RV back to the initial level position.

Once measurements are generated using the set level button **36** that relate to the initial level position of the RV, these measurements can be stored on the smart device **24**, or stored in a memory storage location on the PCB sensor device **22** and recalled to the smart device **24** at a desired time. The smart device **24** with the software application running can then be used to calculate and display angles relative to the initial level position and to calculate and display adjustment values necessary to move the RV to the initial level position when the RV is moved to a location for use. In some embodiments, the calculation of angles relative to the initial level position can be performed by the processor and firmware on the PCB of the sensor device **22**. Performing the calibration function on the software application, the smart device **24** can wirelessly connect (or, in some embodiments, connect through a wired connection) to

the sensor device **22** and request the current angle measurements for pitch and roll. These measurements can be stored on the smart device **24**, or stored in a memory storage location on the PCB sensor device **22** and recalled to the smart device **24** at a desired time, for use in calculating displayed information in the subsequent screens such as screen **40** shown in Figure 5 with the roll display **42** and the pitch display **44** as explained below. These stored measurements can be used as offsets from the initial level position based on the angle indications calculated from the various sensors of the sensor device **22**. This is required to establish the relationship between the position of the mounted sensor device **22** and the initial level position in both pitch and roll as measured and/or captured by the smart device **24** or the sensor device **22** as described above.

In some embodiments, if the RV level system is installed during the manufacturing of the RV, then the RV level system can be calibrated at the factory eliminating the need for the user to do it. In such embodiments, the calibration function can be skipped by the user.

In subsequent displays **42**, **44** of the current angles relative to the initial level position on the software application on the smart device **24** as shown in the screen **40** in Figure 5, for example, these stored calibration data measurements will be added or subtracted from the actual, calculated sensor data from the PCB of the sensor device **22** to determine the actual angle relative to the initial level position accounting for the actual mounted orientation of the sensor device **22**. In some embodiments, the displays **42**, **44** can show an image of the vehicle that reflects the actual position of the RV **10** with the actual angles in the respective pitch and roll directions of the RV **10** such that

the image of the vehicle moves as the angles in the respective pitch and roll directions of the RV **10** change. Once accurate angle measurements have been calculated and displayed in the screen **40** of the software application on the smart device **24**, additional calculations regarding the added height needed to achieve the initial level position of the RV can be performed either by the software application of the mobile smart device **24** or by the processor and firmware on the PCB of the sensor device **22**. These calculations regarding the added height needed to achieve the initial level position of the RV can be displayed by the software application on the mobile smart device **24**, for example, in the respective roll display **42** and pitch display **44** or on a different screen in other embodiments. The appropriate side or direction of added or removed height can also be displayed using arrows and/or the calculated height required as shown for example in the respective roll display **42** and pitch display **44** of screen **40** of the described example embodiment of software application. These calculations are achieved by using the stored information about the length and width of the RV **10** and the calculated current angle relative to the initial level position of the RV and using trigonometric formulas to calculate the height and location for the height addition or reduction required to achieve a level position.

For example, as shown in Figure 7A and 8A, an RV **10** can be parked, or positioned, at a desired location. A leveling system **20** on RV **10** (as shown in Figures 1 and 2) can be previously used to determine an initial level position that provides a true level measurement that has been stored on the smart device **24** of the leveling system **20**, or stored in a memory storage location on the PCB sensor device **22**, such as an RV leveling device, and recalled to the smart device **24**, for later use. The RV **10** can have

three or more structural supports, such as wheels W_A, W_B and jack **26** on a ground **G** at the desired location. As shown in Figure 7A, the RV **10** leans toward the first side **A** of RV **10** on first side section **16** at the desired location. Similarly, as shown in Figure 8A, the RV **10** leans toward the front **C** of RV **10** on the front section **14** at the desired location. Thus, the RV **10** is not leveled at the desired location based on the structural supports current position on the ground **G**.

The software application on the smart device **24** of the leveling system can be accessed to initiate the determination of the needed change in the roll and pitch directions to level the RV **10** at the desired location. The smart device **24** can communicate with the sensor device **22** of the leveling system **20** to obtain sensor data used to determine the current angle measurements for the roll and pitch directions off from true level, i.e., the initial level position stored in the smart device. The needed angle change, distance change, and/or direction of change for the roll and pitch directions can be displayed on the smart device **24** as shown in the roll display **42** and pitch display **44** in screen **40** of the software application (see Figure 5). As shown in Figure 7B, the first side **A** of RV **10** can then be raised the needed amount so that the first side **A** and a second side **B** of the **RV 10** can be level with one another in the roll direction based on the information provided in the roll display **42** (see Figure 5). For example, a jack **70**, or other mechanism can be used to raise the first side **A** of RV **10**. Similarly, as shown in Figure 8B, the front side **C** of RV **10** can be raised the needed amount so that the front side **C** and a rear side **D** of the **RV 10** can be level with one another in the pitch direction based on the information provided in the pitch display **44**

(see Figure 5). For example, a jack **26** can raise the front side **C** of RV **10** the needed amount.

As another example, the software application on the smart device **24** or the software on sensor device **22** can calculate that an RV is 2 degrees out of level in the roll direction and height needing to be added to the left side of the RV. In this example, the stored width of the RV is 8 feet or 96 inches. Using a trigonometric function, the height needed to achieve a level position can be calculated as 3.3523 inches. Knowing exactly how much height is needed to reach a perfectly level position in both pitch and roll will simplify and reduce the amount of time required to level the RV. Both the software of the sensor device **22** and the smart device software application can dynamically and in near real time update and graphically display the current pitch and roll of the RV representations using a proportional algorithm.

Additionally, in some embodiments, the sensor device **22** can have sensors that are able to detect relative humidity, temperature and barometric pressure. For example, the PCB of the sensor device **22** may have sensors that are able to detect relative humidity, temperature and barometric pressure. The user may desire to mount the sensor device **22** on the exterior or interior of the RV depending on whether they are more interested in measuring the environmental conditions outside or inside the RV. This environmental information will also be wirelessly transmitted to the smart device **24** and displayed for the user.

In some embodiments as stated above, the mobile smart device software application that can be downloaded and run on the smart device **24** can permit input of the RV length and RV width for the purpose of calculating the amount of height needed

at the appropriate place to return the RV to a previously defined level position. In some embodiments, this length and width could be pre-programmed for various makes and models of RV's, eliminating the need for the user to measure and input the length and width dimensions. Instead, the mobile smart device software application can have a screen that lists the make and model of the RV. In some embodiments, the lists of RV's can contain various information about the different makes and models of RV's including pictures and other information. The screen can allow the user to scroll the list or can provide a search mechanism that allows the user to find the exact RV in question or shorten the list of RV's to be viewed. In this manner, the user would simply select the make and model of the RV from a list contained within the mobile smart device software application of the smart device **24**.

RV's typically have control panels that consist of pushbuttons and/or indicator LED's and/or LCD displays. These control panels are used to display data about the condition of various RV systems or to activate various RV systems. Typical data displayed by some RV control panels can include holding tank fluid levels and battery power levels. Typical RV systems that might be activated from some control panels would be power slideouts and starting or stopping the generator. In some embodiments, the smart device **24** can be integrated or in communication with the various RV control panels and systems either through wired or wireless communications. For example, utilizing a wireless communication system or protocol, such as Bluetooth or WiFi, the mobile smart device software application on the smart device **24** can display the data that is generated and displayed on some of the RV control panels such as holding tank levels, battery power levels and the like. In

addition, the mobile smart device software application can also be used to activate various RV systems such as power slideouts, starting the generator, stopping the generator, or the like. The mobile smart device software application could also be used to control more general RV systems such as lighting and entertainment systems. For example, the mobile smart device software application can generate screens that are displayed on the smart device **24** that display the data that is generated and displayed on some of the RV control panels. Additionally, the mobile smart device software application can generate screens that are displayed on the smart device **24** that provide user interfaces, such as buttons that can be used to activate various RV systems by the user, for example, remotely or wirelessly.

In some embodiments, the PCB of the sensor device **22** can contain a GPS sensor allowing the current physical location of a vehicle, such as RV **10**, that the sensor device **22** has been mounted on to be transmitted to the mobile smart device **24** or saved and stored on the sensor device **22**. Positional movements of the vehicle, along with date and time information, can be saved and stored on the mobile smart device **24** or the sensor device **22**. This saved vehicle positional movement information along with saved and corresponding date and time information can be used to determine actual use information regarding the vehicle. For instance, this positional movement information can be used to make determinations on the actual times that the vehicle is used over a given time period, how many days the vehicle is typically used when it is away from the normal storage locations, how many miles the vehicle is typically driven or towed to each use locations, and other information that might be relevant to the manufacturer of the vehicle. Total distance traveled by the vehicle could

also be saved and stored on the mobile smart device **24** or sensor device **22** for use by the manufacturer of the vehicle for warranty or other uses. The total number of miles traveled by a non-drivable vehicle such as a trailer or towable RV is not currently recorded in any other manner and this may be useful information for many purposes such as used value determination, tire warranties, and many others. This saved and stored vehicle location, date, time and usage information could be transmitted from the mobile smart device **24** via the internet to email or computer server addresses or locations designated by the vehicle manufacturer.

Thus, according to the disclosure herein, a method, generally designated **50**, for leveling a vehicle, such as a recreational vehicle, can be provided as shown in Figure 9. To begin, a leveling system can be provide that comprises one or more sensor devices, that can comprise one or more vehicle leveling devices, secured to a vehicle to sense at least one of an inclination or an orientation of the vehicle in both a pitch direction and a roll direction and a smart device in communication with the one or more sensor devices as shown in step **52**. The method can comprise a step **54** of measuring the pitch angle and the roll angle of the vehicle when the vehicle is at rest using the sensor device as shown as Figure 9. To determine the needed movement of the vehicle to achieve a level position based on the measures of the pitch angle and the roll angle, calibration data of pitch angle and roll angle measurements taken by the sensor device when the vehicle was at an initial level position can then be retrieved as shown in step **55**. The method **50** can additionally comprise a step **56** of calculating any needed change in at least one of the pitch direction or the roll direction of the vehicle using the measurements of the pitch angle and the roll angle of the at rest vehicle and the

calibration data of pitch and roll angle measurements to obtain a level position of the vehicle. This calculation can be performed by the one or more sensor devices or the smart device. In step **58**, the calculated change in at least one of the pitch direction or the roll direction of the vehicle can be displayed on the smart device.

In order to initially develop the calculation data, the method described above can also include the step of determining the initial level position for a vehicle to determine any inconsistencies inherent in the leveling system. Depending on the embodiment of the method, this determination step can be performed on the one or more sensor devices or the smart device. In some embodiments, the step of determining an initial level position can comprise receiving measurements of a length and a width of the vehicle. In some embodiments of the method, the step of determining an initial level position can comprise using at least one of an accelerometer, gyroscope, or global positioning system sensor on the smart device to achieve the initial level position. In some embodiments, the step of determining an initial level position can comprise using at least one of a digital level or spirit level can also be used to achieve the initial level position. In some embodiments of the method, the step of determining an initial level position can be performed by during manufacture of the vehicle and the calibration data stored on the sensor device installed during manufacture. In some embodiments, when installing the sensor device or after installation, whether on the front, the rear, sides or at a central location of the vehicle, an axis can of a plurality of axes of the accelerometer on the sensor device can be assigned to measure the pitch of the vehicle and another axis of the plurality axes of the accelerometer on the sensor device can be assigned to measure the roll of the vehicle. For instance, in some such embodiments,

the orientation of the sensor device relative to the front, the rear, the passenger side or the drive side of the vehicle can be noted using the software application on either the sensor device or the smart device so that an appropriate axis can be assigned to determine the pitch angle measurement of the vehicle and an appropriate axis can be assigned to determine the roll angle measurement of the vehicle. The mobile smart device software application may have a screen designed to define the installed orientation of the sensor device so that data from the appropriate axes can be used for pitch and roll calculations. The pitch and roll angle measurements from the sensor device taken at the initial level position can then be captured, i.e., identified and stored or saved, to provide the calibration data of the pitch and roll angle measurements to permit consideration of any inconsistencies determined when taking measurement readings at a future time. For example, the calibration can be calculated and then saved on a sensor processor on the one or more sensor devices or saved on the smart device that is in communication with the one or more sensor devices. In some embodiments of the method, the step of capturing the pitch and roll angle measurements from the sensor device can comprise communicating calibration data from the sensor device of the pitch and roll angle measurements measured by the sensor device when the vehicle is at the initial level position to the smart device and saving the calibration data on the smart device. In some embodiments of the method, the step of capturing the pitch and roll angle measurements from the sensor device can comprise saving the calibration data of the pitch and roll angle measurements measured by the sensor device when the vehicle is at the initial level position on the sensor device. In some such embodiments where the calibration data is saved on the

sensor device, the step of saving the calibration data of the pitch and roll angle measurements on the sensor device can comprise transmitting instructions from the smart device to the sensor device to save and store the calibration data of the pitch and roll angle measurements on the sensor device. In some such embodiments, the method can include recalling the calibration data of the pitch and roll angle measurements from the sensor device to the smart device.

In some embodiments of the method, the step **58** of displaying the calculated change in at least one of the pitch direction or the roll direction of the vehicle can comprise displaying the calculated change in the pitch direction and the roll direction of the vehicle in measurements of distance. In some embodiments of the method, the step **58** of displaying the calculated change in at least one of the pitch direction or the roll direction of the vehicle can comprise displaying the calculated change in the pitch direction and the roll direction of the vehicle as angles.

In some embodiments, the method can additionally comprise providing a conversion function to permit the changing of the system used for measurements c between U.S. Customary System and the Metric System. In some embodiments, the method can additionally comprise saving a given pitch angle measurement on at least one of the smart device or the sensor device to permit later recall for the purpose of returning the vehicle to the given pitch angle position at a later time. In some embodiments, the method can further comprise collecting and storing positional movement information of the vehicle using a global positioning system sensor on the sensor device.

In some embodiments, the method can additionally comprise receiving data at the smart device from one or more vehicle control panels. In some such embodiments, the received data from one or more vehicle control panels can comprise at least one of data regarding holding tank levels or data regarding battery power levels. In some of these embodiments of the method, the smart device can display the data that is generated and displayed on the one or more vehicle control panels.

In some embodiments, the method can additionally comprise activating one or more systems on the vehicle via the software application of the smart device. As described above, the communication between the smart device and the vehicle can be accomplished using a wireless communication system or protocol, such as Bluetooth or WiFi. For example, the one or more systems activated with the smart device can comprise at least one of a lighting system, an entertainment system, a power slideouts system or a generator system.

As stated above, a software application in the form of a non-transitory computer readable medium can be provided that comprises computer executable instructions embodied in a computer readable medium that when executed by a processor of a computer control the computer to perform the steps similar to the method, generally designated **60**, described above. For the example, as shown in Figure 10, the non-transitory computer readable medium can perform a step **62** of receiving on a smart device a pitch angle measurement and a roll angle measurement of a vehicle when the vehicle is at rest from a sensor device. Additionally, the non-transitory computer readable medium can perform a step **64** of retrieving calibration data of pitch angle and roll angle measurements taken by a sensor device when the vehicle was at an initial

level position. The sensor device can comprise a vehicle leveling device or an RV leveling device. The non-transitory computer readable medium can also perform a step **66** of calculating any needed change in at least one of a pitch direction or a roll direction of the vehicle using the calibration data of the pitch and roll angle measurements to obtain a level position of the vehicle. The non-transitory computer readable medium can further perform a step **68** of displaying on the smart device the calculated change in at least one of the pitch direction or the roll direction of the vehicle needed to obtain the level position of the vehicle.

In order to initially develop the calculation data, the method performed by the software application described above can also include the step of determining the initial level position for a vehicle to determine any inconsistencies inherent in the leveling system. In some embodiments, the step of determining an initial level position can comprise receiving measurements of a length and a width of the vehicle. In some embodiments of the software application, the step of determining an initial level position can comprise using at least one of an accelerometer, gyroscope, or global positioning system sensor on the smart device to achieve the initial level position. In some embodiments of the method, the step of determining an initial level position can be performed by during manufacture of the vehicle and the calibration data stored on the sensor device installed during manufacture.

The software application can then be used to capture, i.e., identified and stored or saved, the pitch and roll angle measurements from the sensor device taken at the initial level position to provide the calibration data of the pitch and roll angle measurements to permit consideration of any inconsistencies determined when taking

measurement readings at a future time. For example, the calibration can be calculated and then saved on a sensor processor on the one or more sensor devices or saved on the smart device that is in communication with the one or more sensor devices. In some embodiments of the software application, the step of capturing the pitch and roll angle measurements from the sensor device can comprise communicating calibration data from the sensor device of the pitch and roll angle measurements measured by the sensor device when the vehicle is at the initial level position to the smart device and saving the calibration data on the smart device. In some embodiments of the software application, the step of capturing the pitch and roll angle measurements from the sensor device can comprise saving the calibration data of the pitch and roll angle measurements measured by the sensor device when the vehicle is at the initial level position on the sensor device. In some such embodiments where the calibration data is saved on the sensor device, the step of saving the calibration data of the pitch and roll angle measurements on the sensor device can comprise transmitting instructions from the smart device to the sensor device to save and store the calibration data of the pitch and roll angle measurements on the sensor device. In some such embodiments, the steps performed by the software application can include recalling the calibration data of the pitch and roll angle measurements from the sensor device to the smart device.

In some embodiments of the software application, the step 68 of displaying the calculated change in at least one of the pitch direction or the roll direction of the vehicle can comprise displaying the calculated change in the pitch direction and the roll direction of the vehicle in measurements of distance. In some embodiments of the software application, the step 68 of displaying the calculated change in at least one of

the pitch direction or the roll direction of the vehicle can comprise displaying the calculated change in the pitch direction and the roll direction of the vehicle as angles.

In some embodiments, the steps of the software application can additionally comprise providing a conversion function to permit the changing of the system used for measurements c between U.S. Customary System and the Metric System. In some embodiments, the steps of the software application can additionally comprise saving a given pitch angle measurement on at least one of the smart device or the sensor device to permit later recall for the purpose of returning the vehicle to the given pitch angle position at a later time. In some embodiments, the steps of the software application can further comprise collecting and storing positional movement information of the vehicle using a global positioning system sensor on the sensor device.

In some embodiments, the steps of the software application can additionally comprise receiving data at the smart device from one or more vehicle control panels. In some such embodiments, the received data from one or more vehicle control panels can comprise at least one of data regarding holding tank levels or data regarding battery power levels. In some of these embodiments of the software application, the smart device can display the data that is generated and displayed on the one or more vehicle control panels.

In some embodiments, the steps of the software application can additionally comprise activating one or more systems on the vehicle with the smart device. As described above, the communication between the smart device and the vehicle can be accomplished using a wireless communication system or protocol, such as Bluetooth or WiFi. For example, the one or more systems activated with the smart device can

comprise at least one of a lighting system, an entertainment system, a power slideouts system or a generator system.

In some embodiments, the software application can also comprise a method to give the leveling system user control over the battery life of the sensor battery to allow the user to extend the life of the battery in use. For example, in some embodiments, the sensor device, i.e., the vehicle leveling device, can be configured to switch between a "sleep mode," where the sensor device is using a minimal amount of power and an "awake mode," where the sensor device is prepared to perform its variety of actions and can connect with the smart device. Thus, the steps of the software application can additionally comprise steps that activate the battery for use through the detection of motion of the vehicle, such as an RV through communication with the sensor device. The sensor device, i.e., the vehicle leveling device, of the leveling system can use motion detected by the accelerometers to change the state of the sensor device between the sleep mode and the awake mode based on certain conditions and user configuration settings. So, in such embodiments, when the sensor device detects motion, the sensor device can transition from the sleep mode to the awake mode and can be connected to the smart device for communication with the leveling system software application. For example, in some embodiments, when in the awake mode the Bluetooth signal is being broadcast which uses more battery power than the sleep mode where the Bluetooth signal is not being broadcast. When the sensor device detects no motion based on a user defined period of time, the sensor goes into the sleep mode to conserve the battery. Thus, in some embodiments, the software application permits the user to define the amount of time, for example, in minutes and/or hours, after no motion

is detected that the sensor device will stay in the awake mode before going to the sleep mode. In this manner, the leveling system user can be allowed to configure the leveling system to best suit the user's specific use habits. For example, the software application can provide one or more screen displays that can allow the use to select a motion detection option to transition the sensor device between an awake mode and a sleep mode and can further provide a method of conserving battery life of the sensor device.

An additional aspect that can be employed in some embodiments of the sensor device of the leveling system to conserve battery life is an On/Off switch that is a complete battery disconnect from a circuitry perspective within the sensor device. This battery disconnect can allow the user to turn off the system entirely (to increase battery life) when the sensor is in a setting where motion is constantly being observed, such as when driving or towing the RV for many hours during travel. It can also be used to completely disconnect the battery during RV storage periods. Thus, the sensor device can comprise an On/Off switch that permits the disconnection of the battery from the circuitry, for example, from a PCB of the sensor device as described above, of the sensor device to conserve battery life. The sensor can also comprise a sounder device that can be mounted on a PCB of the sensor device that chirps an audible sound when the On/Off switch is moved into the On position. This audible sound can be used to indicate that the currently installed battery is still good. In some embodiments, this audible sound can be used to indicate that the sensor is now in a Bluetooth pairing mode. Pairing mode can be used to associate the original or additional smart device with a given sensor device of the leveling system.

The leveling system and software application can provide a custom pairing mode to associate the sensor device of a given leveling system with a specific smart device. For example, the sensor device of a leveling system can be assigned a serial number. During use, for example, during configuration of the software application and/or installation of the sensor device, the serial number from the sensor can be recorded on the smart device. Once a smartphone or tablet has been associated with a particular sensor, then it will only communicate with that sensor, for example, until it is changed by the user. In this manner, the sensor device of a leveling system on an RV can be assured to connect to the RV user's smart device and not to other possible sensors within a given camping area. For example, in some embodiments, the software application can provide a screen display that will allow the user to enter the serial number for the sensor device of the leveling system installed on the RV into the smart device. Once the serial number for that sensor device has been entered, the smart device of the user when using the software application will communicate with the sensor device of the leveling system installed on the RV of the user and not some other sensor device within the area where the RV is being set up for use.

Another aspect of the leveling system and the software application for the leveling system that some embodiment may have is the ability of the use to define the driver's side of the vehicle. By being able to define which side of the RV is the driver's side, especially for motorized RV's, the leveling system can be used in a variety of countries regardless of the types of cars used within a particular country and the country's laws regarding which side of road a vehicle is drive on. For example, by allowing the leveling system user to select the driver's side of the his or her RV, the

same leveling system and leveling system software application can be in countries that require vehicles to be driven on the right side of the road or in countries that require vehicles to be driven on the left side of the road. For example, in some embodiments, the software application can include a default setting, for example, that the driver's side of the RV is on left side of the vehicle and the passenger's side is on the right of the vehicle. In some embodiments, the software application can include a screen display that will allow the user to change the default setting of the driver's side or allow the user to select which side is the driver's side and/or passenger side of the RV. Once the driver's side is changed or selected, the references for the driver's side and the passenger's side of the RV are set for use with the particular RV so that software application reads properly for that user. The references can also change for the installation orientation selections to match the currently selected driver's side of the vehicle.

As described above, the vehicle leveling devices and leveling systems can be used on either towable recreational vehicles and motorized recreational vehicles. Another specific embodiment of a leveling system and software application is described with reference to Figures 11 and 12. As another example shown in Figure 11, an embodiment of a motorized RV **70** having a front **71**, a rear **73**, a driver side (first section) **75**, and a passenger side (second section) **77** can be provided that can be adjusted in pitch rotational directions depend on the inclination of the RV **70** from front-to-back and roll rotational directions depending on the inclination of the RV **70** from side-to-side using leveling systems and devices in a similar manner as described above. The RV **70** can comprise a front driver side wheel **72**, a front passenger side

wheel **74**, a rear driver side wheel **76**, and a rear passenger side wheel **78**. To accomplish the adjustments so that, upon parking the RV **70**, the RV **70** will be leveled in both the pitch and roll directions, a leveling system **80** can be provided that provides measurements to determine the amount of adjustment needed in both the pitch and roll directions. For example, the leveling system **80** can comprise one or more sensor devices **82** (shown schematically in dotted lines as a box within the RV **70**) that can be secured to the RV **70** to sense the inclination and/or orientation of the RV **70** in both the pitch and roll directions. The sensor device **82** can comprise a vehicle leveling device.

Additionally, the leveling system **80** can also comprise a smart device **84** that can be in communication with the sensor device **82**. For example, the smart device **84** can have a specific software application thereon that include one or more aspect of the software application described above that allows information received from the sensor device **82** about the inclination and/or orientation of the RV **70** to be processed to provide measurements to a user and to determine the amount of adjustments needed to the RV **70**. The smart device **84** and the sensor device can communicate with each other in a variety of ways. For example, in some embodiments, the sensor device **82** and smart device **84** can communicate through a wired connection. In some embodiments, as shown in Figure 11, the sensor device **82** and smart device **84** can communicate through wireless communications, such as Bluetooth.

Once the leveling system **80** has calculated the change of elevation height needed in the roll direction and the pitch direction, the smart device can determine how much each tire needs to be raised to level the RV **70**. In particular, the software application can display on the smart device the height required to reach a level position

for each wheel **72**, **74**, **76**, **78** as shown in Figure 12 at **92**, **94**, **96**, and **98** respectively. These heights are calculated in a similar manner to the calculated roll and pitch elevation heights as described in the embodiments above. Figure 12 is a screen shot of a display that shows a schematic representation of the motorized RV **70** from above and can be used to display the amount of adjustment in height of each wheel **72**, **74**, **76**, **78** of the motorized RV **70** based on the measurements taken by the vehicle leveling device **84** and the calculations of the changes in height needed in the roll direction and the pitch direction.

For example, referring to Figure 12, if the calculated roll height required is an upward elevation on the passenger side of two and a quarter (2.25) inches and the calculated pitch height required is an upward elevation in the rear of one and a half (1.5) inches, then either the smart device **84** or the vehicle leveling device **82** can calculate the movement needed for each wheel of the RV **70** using this information. Based on these adjustment calculations for the change in the height needed in the roll direction and the pitch direction, the adjustment in height of each wheel **72**, **74**, **76**, **78** can be calculated by either the smart device **84** or the vehicle leveling device **82**. The smart device **84** or the vehicle leveling device **82** can determine which wheel would be considered the pivot point, i.e., the wheel that needs no adjustment for the RV **70** to reach a level position. In some embodiments, the smart device **84** can do these calculations. In some embodiments, the vehicle leveling device, or sensor device, **82** can do these calculations.

In the example above as shown in Figure 12, the driver side front wheel would be the pivot point and the display from the software application on screen of the smart

device would show a zero (0) inch height adjustment of the frame of the motorized RV **70** required at or near the driver front wheel **72** (see Figure 11) as shown at **92** in Figure 12, since the motorized RV **70** needs an adjustment of height (two and a quarter (2.25) inches as explained above) on the passenger side **77** and an adjustment of height (one and a half (1.5) inches as explained above) in the rear **73** of the RV **70**. Based on the measurements made by the vehicle leveling device **82**, the smart device **84** or the vehicle leveling device **82** can also determine the change in elevation of height of the frame of the motorized RV **70** required at or near the other three wheels **74**, **76**, **78**. In this example, the frame of the motorized RV **70** at or near the passenger front wheel **74** would need a two and a quarter (2.25) inches adjustment in height as show at **94** in the display in Figure 12 and the frame of the motorized RV **70** at or near the passenger side rear wheel **78** would need a three and a three quarter (3.75) inches adjustment in height as show at **96** in the display in Figure 12, while the frame of the motorized RV **70** at or near the driver side rear wheel **76** would need a one and a half (1.5) inches adjustment in height as show at **98** in the display in Figure 12.

The adjustment of height to the frame of the motorized RV **70** proximate to each wheel **72**, **74**, **76**, **78** of the RV **70** can be accomplished in different manners. For example, in some embodiments, the wheels **72**, **74**, **76**, **78** of the RV **70** can be placed or driven onto blocks or stacks of blocks. In some embodiments, the RV **70** can have one more jacks that can extend downward from the frame proximate to the wheels **72**, **74**, **76**, **78** of the RV **70** that can be used to adjust the height [[fo]] of the frame of the RV **70**. In some embodiments, one or more jacks can be placed proximate to the wheels **72**, **74**, **76**, **78** of the RV **70** to adjust the height [[fo]] of the frame of the RV **70**.

Thus, the calculated adjustment proximate to each wheel is the sum of the calculated change in the height in the roll direction and the pitch direction for the given position of the respective wheel. Thus, the calculated change in height of the frame of the motorized RV **70** proximate to the front driver side wheel **72** is the sum of any calculated adjustment in height at the front **71** of the RV **70** and on the driver side **75** of the RV **70**. Additionally, the calculated change in height of the frame of the motorized RV **70** proximate to the front passenger side wheel **74** is the sum of any calculated adjustment in height at the front **71** of the RV **70** and on the passenger side **77** of the RV **70**. Similarly, the calculated change in height of the frame of the motorized RV **70** proximate to the rear driver side wheel **76** is the sum of any calculated adjustment in height at the rear **73** of the RV **70** and on the driver side **75** of the RV **70**, while the calculated change in height of the frame of the motorized RV **70** proximate to the rear passenger side wheel **78** is the sum of any calculated adjustment in height at the rear **73** of the RV **70** and on the passenger side **77** of the RV **70**.

These and other modifications and variations to the present subject matter may be practiced by those of ordinary skill in the art, without departing from the spirit and scope of the present subject matter, which is more particularly set forth herein above. In addition, it should be understood the aspects of the various embodiments may be interchanged both in whole and in part. Furthermore, those of ordinary skill in the art will appreciate that the foregoing description is by way of example only, and is not intended to limit the present subject matter.

DESCRIPTION

VEHICLE LEVELING SYSTEMS, DEVICES AND METHODS AND COMPUTER PROGRAM PRODUCTS FOR LEVELING VEHICLES USING SMART DEVICES

RELATED APPLICATIONS

The presently disclosed subject matter claims the benefit of U.S. Patent Application Serial. No. 14/961,787, filed December 7, 2015, which claims the benefit of U.S. Provisional Patent Application Serial. No. 62/088,115, filed December 5, 2014, and U.S. Provisional Patent Application Serial. No. 62/101,109, filed January 8, 2015; the disclosures of these three applications are incorporated herein by reference in their entireties.

TECHNICAL FIELD

The present subject matter relates to leveling systems and processes for leveling vehicles, such as recreational vehicles. The present subject matter also relates to computer program products for leveling vehicles, such as recreational vehicles, using smart devices.

BACKGROUND

Whether in a storage or use state, a recreational vehicle (RV) should be leveled for both practical and technical reasons. Practical reasons include a level floor, proper door swings, stove and sink use, as well as many others. Technical reasons include proper operation of the ammonia based refrigerator, level holding tanks for proper level detection by electronic means and for the proper operation of the plumbing and various

other systems. Some higher end Class A RV's have onboard leveling systems that utilize digital sensors and hydraulic jacks, but most do not have any native leveling capability beyond the raising and lowering of the front of the RV using manual or electric jacks. Level indicators are generally bubble levels attached to both the side and front or rear of the RV. In addition, there are many other vehicles and trailers that require a level position to operate properly such as food vending trucks, mobile medical trailers, transport trailers and in some cases heavy equipment although there are many others.

The described device provides leveling indication for the 2 main axes of the RV (side-to-side and front-to-back). For the purposes of describing both the typical and proposed leveling method, pitch will be defined as the angle of the RV from front to back and roll will be defined as the angle of the RV from side to side.

The typical RV leveling method is described. Once the RV has been moved into the desired location and orientation for use, the driver must exit the RV or tow vehicle to inspect the current level condition of the RV by using the bubble levels attached to the RV. The first step is to level the roll of the RV. Typically this is done by driving or towing the appropriate RV wheels onto a board, block or other object to raise one side of the RV closer to level. Since the bubble levels being used do not give any exact information regarding the amount the RV is out of level, it is an educated guess at best to determine just how high the appropriate wheels must be raised. Typically, this is a trial and error system requiring the driver to make multiple attempts at raising the appropriate wheels the necessary amount to achieve a level position. Each attempt requires the driver to get back into the vehicle to move the wheels off of the previously placed object being used to raise wheels, exit the vehicle to add or take away from the

height of the object being used to raise the wheels, enter the vehicle again to drive or tow the wheels back onto the object being used to raise the wheels and finally exiting the vehicle again to check the new roll orientation relative to level. It is not uncommon for this process to be repeated several times to achieve a level roll orientation. If bubble levels are being used to determine a level orientation, it is common knowledge that a bubble between the lines on a bubble level has an error range of 2-3 degrees. This can be a significant error amount as it relates to RV's and can cause doors, plumbing and other objects and systems within the RV not to operate properly. Once the roll orientation is level, the pitch orientation leveling operation must be completed. Typically, the bubble level mounted to the side of the RV will be used in this process. In the case of a towable RV, this process generally involves using the jack(s) on the front of the RV to raise or lower the front of the RV until a level position is achieved. Since the upward travel of the jack(s) is limited, it is sometimes required to place blocks or some other object under the jack to enable the jack(s) to raise the front of the RV high enough to achieve a level position. Placing blocks or other objects under the jack(s) requires the RV to be reattached to the tow vehicle, the jack(s) raised, blocks or objects placed under the jack(s), the jack(s) lowered onto the blocks or objects and then released from the tow vehicle. In the case of a driveable RV, the same iterative process used to level the roll of the RV is necessary to level the pitch of the RV. This process may require many attempts as in the case of leveling the roll of the RV.

As such, a need exists for a system for easily and inexpensively leveling a recreational vehicle that does require not many attempts to achieve a level balance of the recreational vehicle in both the pitch and the roll directions.

SUMMARY

The present subject matter provides leveling vehicles, such as recreational vehicles, and related systems and processes.

The present subject matter also relates to computer program products for leveling vehicles, such as recreational vehicles, using smart devices. The subject matter described herein may be implemented in software, in combination with hardware and/or firmware. For example, the subject matter described herein may be implemented in software executed by a hardware-enabled processor. In one exemplary implementation, the subject matter described herein of using leveling information for leveling a vehicle, such as a recreational vehicle, may be implemented using a non-transitory computer readable medium having stored thereon executable instructions that when executed by the processor of a computer control the processor to perform steps. Exemplary non-transitory computer readable media suitable for implementing the subject matter described herein include chip memory devices or disk memory devices accessible by a processor, programmable logic devices, and application specific integrated circuits. In addition, a computer readable medium that implements the subject matter described herein may be located on a single computing platform or may be distributed across plural computing platforms. Further, it should be noted that the systems and methods utilize and can comprise recreational vehicle leveling systems, devices and their components and functionality described herein. These recreational vehicle leveling systems and devices constitute special purpose devices that improve the technological field of providing guidance for and/or mechanisms for leveling recreational vehicles.

While one or more objects of the presently disclosed subject matter having been stated hereinabove, and which is achieved in whole or in part by the presently disclosed subject matter, other objects will become evident as the description proceeds when taken in connection with the accompanying drawings as best described hereinbelow.

BRIEF DESCRIPTION OF THE DRAWINGS

A full and enabling disclosure of the present subject matter including the best mode thereof to one of ordinary skill in the art is set forth more particularly in the remainder of the disclosures and the specification, including reference to the accompanying figures, in which:

Figure 1 illustrates a schematic side view of an embodiment of a vehicle that includes an embodiment of a leveling system according to the present subject matter;

Figure 2 illustrates a schematic front view of an embodiment of a vehicle that includes an embodiment of the leveling system according to Figure 1;

Figure 3 illustrates a screen shot of an embodiment of a software application on a smart device for use in an embodiment of the leveling system according to the present subject matter;

Figure 4 illustrates another screen shot of an embodiment of a software application on a smart device for use in an embodiment of the leveling system according to the present subject matter;

Figures 5A and 5B illustrate possible additional screen shots of an embodiment of a software application on a smart device for use in an embodiment of the leveling system according to the present subject matter;

Figure 6 illustrates a further screen shot of an embodiment of a software application on a smart device for use in an embodiment of the leveling system according to the present subject matter;

Figure 7A illustrates a schematic front view of an embodiment of a recreational vehicle positioned at a desired location before leveling;

Figure 7B illustrates a schematic front view of the embodiment of the recreational vehicle according to Figure 7A positioned at a desired location after leveling in the roll direction according to the present subject matter;

Figure 8A illustrates a schematic side view of the embodiment of the recreational vehicle according to Figure 7A positioned at a desired location before leveling;

Figure 8B illustrates a schematic side view of the embodiment of the recreational vehicle according to Figure 7A positioned at a desired location after leveling in the pitch direction according to the present subject matter;

Figure 9 illustrates an embodiment of a flowchart of a method of leveling a vehicle according to the present subject matter;

Figure 10 illustrates an embodiment of a flowchart of a method of leveling a vehicle performed by a software application of a smart device in according to the present subject matter;

Figure 11 illustrates a schematic top plan view of an embodiment of a vehicle that includes an embodiment of a leveling system according to the present subject matter; and

Figure 12 illustrates another screen shot of an embodiment of a software application on a smart device for use in an embodiment of the leveling system according to the present subject matter;

Repeat use of reference characters in the present specification and drawings is intended to represent the same or analogous features or elements of the invention.

DETAILED DESCRIPTION

Reference now will be made to the embodiments of the present subject matter, one or more examples of which are set forth below. Each example is provided by way of an explanation of the present subject matter, not as a limitation. In fact, it will be apparent to those skilled in the art that various modifications and variations can be made in the present subject matter without departing from the scope or spirit of the present subject matter. For instance, features illustrated or described as one embodiment can be used on another embodiment to yield still a further embodiment. Thus, it is intended that the present subject matter cover such modifications and variations as come within the scope of the appended claims and their equivalents. It is to be understood by one of ordinary skill in the art that the present discussion is a description of exemplary embodiments only, and is not intended as limiting the broader aspects of the present subject matter, which broader aspects are embodied in exemplary constructions.

Although the terms first, second, right, left, front, back, etc. may be used herein to describe various features, elements, components, regions, layers and/or sections, these features, elements, components, regions, layers and/or sections should not be

limited by these terms. These terms are only used to distinguish one feature, element, component, region, layer or section from another feature, element, component, region, layer or section. Thus, a first feature, element, component, region, layer or section discussed below could be termed a second feature, element, component, region, layer or section without departing from the teachings of the disclosure herein.

Similarly, when a layer or coating is being described in the present disclosure as "on" or "over" another layer or substrate, it is to be understood that the layers can either be directly contacting each other or have another layer or feature between the layers, unless expressly stated to the contrary. Thus, these terms are simply describing the relative position of the layers to each other and do not necessarily mean "on top of" since the relative position above or below depends upon the orientation of the device to the viewer.

Embodiments of the subject matter of the disclosure are described herein with reference to schematic illustrations of embodiments that may be idealized. As such, variations from the shapes and/or positions of features, elements or components within the illustrations as a result of, for example but not limited to, user preferences, manufacturing techniques and/or tolerances are expected. Shapes, sizes and/or positions of features, elements or components illustrated in the figures may also be magnified, minimized, exaggerated, shifted or simplified to facilitate explanation of the subject matter disclosed herein. Thus, the features, elements or components illustrated in the figures are schematic in nature and their shapes and/or positions are not intended to illustrate the precise configuration of the subject matter and are not intended to limit the scope of the subject matter disclosed herein.

It is to be understood that the ranges and limits mentioned herein include all ranges located within the prescribed limits (i.e., subranges). For instance, a range from about 100 to about 200 also includes ranges from 110 to 150, 170 to 190, 153 to 162, and 145.3 to 149.6. Further, a limit of up to about 7 also includes a limit of up to about 5, up to 3, and up to about 4.5, as well as ranges within the limit, such as from about 1 to about 5, and from about 3.2 to about 6.5 as examples.

"Smart device," or "mobile smart device," as used herein means any mobile electronic device configured with imaging and/or computing capabilities that can process image and sensor data. Such smart devices can include, but are not limited to, at least one of a mobile smartphone, a personal digital assistant (PDA), a computing tablet, a personal media player, or any like mobile electronic device configured with imaging and/or computing capabilities. In some embodiments, the smart device may be provisioned with a hardware-based processor that is configured to execute software programs or applications.

"Vehicle leveling device," and "RV leveling device" as used herein means a sensor device that include at least one of a gyroscope, a digital compass, a tilt sensor, a digital accelerometer or some other digital angle measurement device or sensor therein that includes a software application that permits the sensor device to measure and asset angles of inclination and/or orientation of a recreational vehicle to permit the pitch and roll of the recreational vehicle to be adjusted to level the recreational vehicle. A digital temperature sensor may also be included on the vehicle leveling device and used to collect temperature data necessary to correct variations or irregularities in the data obtained by the above mentioned angle measurement sensors. A computer processor

may also be included on the vehicle leveling device and used to perform calculations, security functions, storage management and functions as well as other tasks. Firmware associated with the desired functionality may be executed by the computer processor of the vehicle leveling device.

"Vehicle" as used herein means both powered vehicles and non-powered vehicles, trailers or the like, and includes but is not limited to cars, trucks, recreational vehicle, recreational vehicle trailers, food vending trucks, mobile medical trailers, transport trailers, boon trucks, backhoes, or the like.

"Mobile smart device software application" as used herein means specific software applications for and used on a mobile smart device that can be in the form of a non-transitory computer readable medium comprising computer executable instructions embodied in a computer readable medium that when executed by a processor of a computer control of the smart device, the smart device can perform specific steps.

"Software" or "Software application" as used herein means software applications for and used on a computer, which can include, but is not limited to a mobile smart device, that can be in the form of a non-transitory computer readable medium comprising computer executable instructions embodied in a computer readable medium that when executed by a processor of a computer control of the computer, the computer can perform specific steps.

The leveling system, method, device, and/or computer program product embodiments described herein refer mainly to recreation vehicles. There are many other vehicles and trailers that require a level position to operate properly such as food vending trucks, mobile medical trailers, transport trailers and in some cases heavy

equipment although there are many others. It should be understood that that leveling system, method, device, and/or computer program product embodiments described herein can be used in conjunction with these other vehicles and/or trailers.

As stated above, the devices, systems, methods and computer program products relate to leveling an RV relative to the two main axes of the RV (side-to-side and front-to-back). As used herein to describe the proposed leveling method and shown in Figures 1 and 2, pitch is defined as the angle of the RV from front to back and roll will be defined as the angle of the RV from side to side. As shown in Figure 1, when adjusting the pitch, an embodiment of an RV **10** can be adjusted in pitch rotational directions **P** depend on the inclination of the RV from front-to-back. For example, if the RV **10** is inclined forward so that a rear section **12** is above a front section **14** proximal to a jack **26** of the RV **10**, then the pitch of RV **10** can be adjusted in the direction of arrow point P_1. If the RV **10** is inclined backward so that the front section **14** is above the rear section **12**, then the pitch can be adjusted in the direction of arrow point P_2. Similarly, as shown in Figure 2, when adjusting the roll, the RV **10** can be adjusted in roll rotational directions **R** depending on the inclination of the RV from side-to-side. For example, if the RV **10** is inclined forward so that a first side section **16** of the RV **10** is above a second side section **18** of the RV **10**, then the roll of RV **10** can be adjusted in the direction of arrow point R_1. If the RV **10** is inclined backward so that the second side section **14** is above the first side section **16**, then the pitch can be adjusted in the direction of arrow point R_2.

To accomplish the adjustments so that, upon parking the RV **10**, the RV **10** will be leveled in both the pitch and roll directions, a leveling system **20** can be provided that

provides measurements to determine the amount of adjustment needed in both the pitch and roll directions. For example, the leveling system **20** can comprise one or more sensor devices **22**, which can comprise a vehicle leveling device, (shown schematically as a box) that can be secured to the RV **10** to sense the inclination and/or orientation of the RV **10** in both the pitch and roll directions. Additionally the leveling system **20** can also comprise a smart device **24** that can be in communication with the sensor device **22**. For example, the smart device **24** can have a specific software application thereon that allows information received from the sensor device **22** about the inclination and/or orientation of the RV **10** to be processed to provide measurements to a user and to determine the amount of adjustments needed to the RV **10**. The smart device **24** and the sensor device can communicate with each other in a variety of ways. For example, in some embodiments, the sensor device **22** and smart device **24** can communicate through a wired connection. In some embodiments, as shown in Figures 1 and 2, the sensor device **22** and smart device **24** can communicate through wireless communications, such as Bluetooth.

As noted above, the sensor device **22** of the RV leveling system **20** is shown schematically, and while it is shown on the exterior front section of the RV **10**, it is noted that the sensor device can located at a variety of location and positions of the RV **10**. For example, the sensor device **22** can be on the rear, sides or at a central location of the RV **10**. Additionally, the sensor device **22** can be on the exterior, interior or inside the framework of the RV **10**. As noted above, the mobile smart device software application may have a screen designed to define the installed orientation of the sensor device so that data from the appropriate axes can be used for pitch and roll calculations.

The sensor device **22** can comprise a printed circuit board ("PCB") that can include various digital sensors including one or more digital accelerometers, one or more digital gyroscopes, a global positioning system ("GPS") sensor, and other sensors required for accomplishing the desired functionality of the RV leveling system. For example, a digital temperature sensor may also be included that can be used to collect temperature data. For instance, the temperature data collected by the digital temperature sensor can be used to correct variations or irregularities in the data obtained by the sensor device **22**. The PCB can also include a processor and stored software, such as firmware, to allow for the processing of data and performing calculations related to the desired functionality of the RV leveling system. The PCB can also include the components for Bluetooth or other wireless communication. The PCB can be battery powered or use other means of power such as AC or DC connections. The sensor device **22** can also comprise a housing or enclosure in which the PCB can be mounted for protection from damage and the environment.

For example, in some embodiments, the PCB of the sensor device **22** can have digital accelerometer that uses multiple axes, for example an X-axis, a Y-axis and a Z-axis that are used to determine movement and position. When installing the sensor device **22** or after installation, whether on the front, the rear, sides or at a central location of the RV **10**, one of the axes of the accelerometer can be assigned to measure the pitch **P** and another of the axes can be assigned to measure the roll **R**. For instance, the orientation of the sensor device **22** relative to the front, the rear, passenger side or drive side upon or after installation can be noted using the software application on either the PCB of sensor device **22** or the smart device **24** so that an

appropriate axis can be assigned to determine the pitch angle measurement and an appropriate axis can be assigned to determine the roll angle measurement. In this manner, the orientation of the sensor device **22** can be identified or assigned relative to the vehicle. The mobile smart device **24** software application may have a screen designed to define the installed orientation of the sensor device **22** so that data from the appropriate axes can be used for pitch and roll calculations.

After the firmware is installed, each PCB, which can include a gyroscope or an accelerometer as described above, can be provided with power, for example, by securing the PCB into a fixture or installing the battery in the PCB, and then subjected to a temperature calibration process. The PCB's can then be placed in a stationary position in an environmental chamber. Such an environmental chamber can expose the PCB to a broad range of temperatures, such as typical temperatures find during use. For example, the environmental chamber can be a freezer that exposes the PCB therein to low temperatures. One reason this action is done is to determine variances in, for example, the measurements obtained from the gyroscope or accelerometer included in the respective PCB. Since the PCB's are stationary position when placed in these environmental chambers, the accelerometer data or gyroscope data should not change but, for example, the accelerometer data or gyroscope data does due to temperature change. The changes in such can be monitored by the firmware on PCB to determine how to compensate for the discrepancy in the accelerometer data or gyroscope data to maintain the level of accuracy of the data readings at different temperatures.

For example for PCB's that include accelerometers, each PCB is soldered slightly differently and each accelerometer is manufactured with slight differences. For such reasons, each PCB can undergo this temperature calibration process to achieve more accuracy and repeatability. During this process while the PCB is held in a stationary position, the firmware monitors the accelerometer data. When the firmware detects a change in the accelerometer data, a temperature sensor on the PCB is read by the firmware and the accelerometer count (angle) deviation that has occurred is recorded along with the temperature in a temperature calibration lookup table by the firmware. After the PCB has been subjected to a range of temperatures and the firmware has recorded all the accelerometer count (angle) deviation in this temperature calibration lookup table, the temperature calibration process is complete. The resulting temperature calibration lookup table can be used each time accelerometer data is used for calculations in the regular use of the sensor device, i.e., the vehicle leveling device, and the vehicle leveling system. So when the vehicle leveling system is in use, accelerometer data is read along with the current temperature from the sensor device. The firmware on the PCB then looks up that temperature in the temperature calibration lookup table. Any angle deviation at that temperature in the temperature calibration lookup table is read and used to correct the current accelerometer angle data. This temperature corrected accelerometer data is then used to calculate the height requirements need to level the vehicle for that reading. As stated above, a similar temperature calibration process can be performed for gyroscopes to create a temperature calibration lookup table for gyroscope data.

In some embodiments, the smart device **24** can have a compatible wireless communication capability such as Bluetooth or other wireless communication protocol to obtain and/or share information from the PCB of the sensor device **22**. The smart device **24** can comprise software that is capable of communicating with the PCB of the sensor device **22**, storing information obtained from the PCB of the sensor device **22**, manipulating the information obtained from the PCB of the sensor device **22** and/or user input related to the inclination and/or orientation of the RV **10**, and displaying of information obtained from the PCB of the sensor device **22** and user input as well as information generated from the information obtained from the PCB of the sensor device **22** and/or the user input related to the inclination and/or orientation of the RV **10**. In some embodiments, the sensor device **22** can comprise a memory in communication with the processor of the PCB and can be used to store information transmitted from the mobile smart device **24**. In some embodiments, the sensor device **22** can use sensor data and/or stored user data to perform calculations on the sensor device **22** and transmit the calculated data to the mobile smart device **24** for further calculation or display or both. In the some embodiments, the smart device **24** can be a smartphone capable of storing and executing software applications. These calculations can be based off of the determination of the pitch and roll angles using the calibration data to determine the pitch angle measurements and the roll angle measurements. These calculations can include geometric calculations that can convert changes in angles to distance of movement need to obtain a level position of the vehicle in both the roll direction and the pitch direction based on the length and width of the vehicle being

leveled. Such geometric calculations can be based on common geometric formulas that would be understood by those skilled in the art.

Figures 3-6 illustrate embodiments of graphical user interface screens of an embodiment of a software application that can be used on the smart device **24**. Figure 3 illustrates a screen **28** of an entry or beginning screen through which a user can enter the software application, which can be used in some embodiments of the software application. In some embodiments of the software application, an entry screen may not be used. As shown in Figure 4, the software application can have the ability to accept user input relating to the RV **10**. For example, the software application can prompt the user to enter information such as the measurements of the RV **10**, for example, the length and the width of the RV **10**, that can be used to correctly calibrate the amount of adjustment needed in the pitch and roll directions. For example, as shown in Figure 4, the software application as shown in a screen **30** can be provide an entry cell **32** for entry of a width of the RV **10** as measured from the outside of a first wheel, or tire, on a first side of the RV **10** to the outside of a second wheel, or tire, on a second side of the RV **10** along an axle of the RV **10**. The screen **30** can also provide an entry cell **34** for entry of a length of the RV **10** as measured from a center point of the rear axle to the jack **26** at the front of the RV **10**. The software application can store this information for use in calculating displayed information at the time of entry or at a later time. In some embodiments, the software application can save the entered information for recall at a later time as needed. In some embodiments, this information can be stored on the RV sensor device **22** after transmission from the smart device **24**. In some embodiments,

the software application can individually save information on multiple RV's that can be recalled at a later time as needed.

To begin, an initial level position can be determined for the RV to help determine any inconsistencies inherent in the leveling system, such as inconsistencies due to the installation or placement of the sensor device on the RV that may cause the sensor readings to be slightly off. The smart device **24** can be used to determine the initial level position using the accelerometer, gyroscope and/or GPS functions therein through a portion of the software application, or a different software application, as shown in Figure 6 and described in more detail below. A typical digital or spirit level can also be used to achieve this initial level position. The smart device **24** can then capture, i.e., save and store the current pitch and roll angle measurements from the sensor device **22**. These measurements will be used as offsets from the initial level position when displaying angles or calculating and displaying adjustment values necessary to move the RV back to the initial level position. Thus, the software application can determine if the measurements from sensor device **22** are slightly off when the RV is at the initial level position and then take those inconsistencies into consideration when taking measurement readings in the future.

In particular, the software application on the smart device **24** can have a calibration function as represented by a "Set Level" button **36** in the screen **30** for the initial set up of the software application. The "Set Level" button **36** can be used to obtain the current sensor readings in the roll and pitch directions from the sensor device **22** when the smart device **24** indicates that the vehicle is in an initial level position. These sensor readings when the RV **10** is at the initial level position may be stored as

calibration data on the smart device **24** or the sensor device **22** or both. This calibration data can be used to compensate for any imperfections in the sensor readings that may derive from the installation and/or placement of the sensor device **22** on the vehicle **10**. Once this calibration function is completed, it does not necessarily need to be performed again. Additionally, in some embodiments as shown in Figure 4, the software application can have a conversion function as represented by the "inches" and "mm" buttons **38A**, **38B** in the screen **30**. These buttons **38A**, **38B** can be used to set and/or change the metrics system used to measure, calibrate, and compute. For example, as shown, the system used for measurements can be set and/or changed between U.S. Customary System ("inches") and the Metric System ("mm").

Once the calibration has been performed, the software application can be used determine the change in roll and the change in pitch needed for the given RV **10** based on measurements from the sensor device **22** at any given location. In some embodiments, the sensor device **22** may use the calibration data as well as other current sensor data, such as the current pitch angle and roll angle measurements and temperature readings from the sensor device **22** or a another temperature sensor device, and perform calculations, such as an accurate calculation of the current angle of the vehicle and the offset that is needed, using the processor and firmware on the PCB of the sensor device **22**. In some embodiments, a user can activate the software application to initiate the measurements to determine the change in roll and pitch by simply opening the software application on the smart device **24** when connected to a wire communication with the sensor device **22** or within range of the sensor device **22** for a wireless communication connection, depending on how communication is setup

between the smart device **24** and the sensor device **22**. In some embodiments, the software application can display an interface on a display screen, such as a button, once the software application is opened that can be activated to initiate this determination, or calculation, function.

Figure 5A and 5B show similar screen shots of information that can be displayed in real time or near real time. Once the determination/calculation function is initiated and the change in roll and pitch calculated by the software application or the processor and firmware on the PCB of the sensor device **22**, the determined change in roll and pitch can then be displayed as shown in a screen shot **40** in Figures 5A and 5B. For example, a roll display **42** can be given as shown in Figures 5A and 5B. Similarly, a pitch display **44** can be provided. As shown in Figure 5A, in some embodiments, the roll display **42** can provide, for example, the current angle from level for the roll directions measured in degrees **43A** and the amount of elevation change **45A** in inches or millimeters needed on a given side to level the RV in the roll direction. Alternatively, in some embodiments as shown in Figure 5B, the roll display **42** can provide, for example, the current angle from level for the roll directions measured or expressed as the amount of elevation change **45B** in inches or millimeters needed on a given side to level the RV in the roll direction. Similarly, as shown in Figure 5A, in some embodiments, the pitch display **44** can, for example, provide the current angle from level for the pitch directions measured in degrees **47A** and the amount of elevation change **49A** in inches or millimeters needed on either the front or the back to level the RV in the pitch direction. Alternatively, in some embodiments as shown in Figure 5B, the pitch display **44** can, for example, provide the current angle from level for the pitch

directions as measured or expressed in the amount of elevation change **49B** in inches or millimeters needed on either the front or the back to level the RV in the pitch direction.

The software application on the smart device **24** can provide the ability for the user to configure the display resolution to specific height increments for adjustment of. Typically, accelerometer data, even though digitally filtered, can be choppy and cause the display of the calculated height to change between the set filter levels, i.e., the display resolution, for the digital filter that are to be displayed based on the calculations. In some situations, when the display resolution is set to smaller increments, for example, of 0.25 inches, the display of the expected height change can move back and forth between the closest two increments or flicker back and forth between the increments. For example, the display of the calculated height can flicker between 0 inches and 0.25 inches if the native resolution of the digital filter within the sensor device, or vehicle leveling device, is 0.25 inches and the calculated height is a measurement between 0 inches and 0.25 inches.

Typically, RV users use plastic blocks or wooden dimensional lumber as adjustment blocks to drive the RV **10** up on to get to the height required to reach a level position. Typically, these adjustment blocks are of a regular thickness. If the adjustment blocks being used, for example, are all one (1) inch thick then the accuracy of getting to a level position is going to be determined based on this set block thickness, meaning that the change in elevation of height will be in one (1) inch increments. Thus, the software application can include a screen that will allow the input of an increment of resolution by which the digital filter will operate for providing an adjustment of height in

the elevation run direction and the pitch direction. For example, if the RV users have one (1) inch blocks, in some embodiments, the user can provide a display resolution can be selected from a menu of a variety of different display resolutions that can match the height of adjustment provided by the adjustment blocks the RV user may have. In some embodiments, the software application can provide a screen in which the RV user can enter the increment of display resolution for the leveling system to use. Thereby the leveling system and methods provided herein can provide the ability of the RV user to select different display resolutions. Thus, as explained in the example above, the RV user can select the display resolution of one (1) inch and the smart device running the software application would only show calculated heights in one (1) inch increments. By increasing the value of the display resolution, the RV user can obtain more useful information for the obtaining the adjustment in height that they need and the display based on the larger increment of the display resolution can be much more stable and less likely to flicker between incremental numbers due to the wider threshold of rounding in the math. For example, in some embodiments, the display resolution can be set during a configuration or installation of the sensor device.

As the current roll angle changes, the roll angle measurements expressed in degrees **43A** and/or the amount of elevation change **45A**, **45B** will change. As the current pitch angle changes, the pitch angle measurements expressed in degrees **47A** and/or the amount of elevation change **49A**, **49B** will also change. More particularly, for example, for the change in pitch, the amount of elevation change can be affected by the moving of the jack **26** proximal the front section **14** up or down by the requisite distance displayed. The changes in current roll and pitch angles can also be shown in in the

graphic image of the vehicle as shown in displays **42** and **44** in real time or near real time.

As shown in the screen **40** in Figures 5A and 5B, the mobile smart device software application can also provide the ability to save a given pitch angle, either on the smart device **24** or on the sensor device **22**, for the purpose of returning to that position at a later time as illustrated by the "save hitch position" button **46** in screen **40**. To reuse the pitch angle that had been saved, a recall can be provided, such as recall button **48**. This functionality can be useful for travel trailers and fifth wheel RV's that must be detached from a tow vehicle when in use. The pitch angle saved when the tow vehicle is detached from the RV will be recalled for pitch angle positioning when reattaching the tow vehicle. This will simplify and increase the speed of reattaching the tow vehicle to the RV.

As mentioned above and described in more detail below, in some embodiments, once the sensor device **22** has been properly mounted to the inside or outside of the RV **10**, the RV **10** can be leveled to an initial level position using the typical method described above or by placing the smart device **24** on the floor or some other horizontal surface of the RV and using a digital level software application, either separate from or integrated into the software application. Figure 6 shows a screen **50**, for example, of the software application that can be used to measure both the pitch and the roll angles using a pitch measuring line **52** and a roll measuring line **54** forming a crosshair **56**. The software application on the smart device **24** can show a display that operates in a similar manner to a spirit level so as to display movement of the pitch and roll angles toward a center bull's eye **60** as the smart device on the horizontal surface is moved

toward a leveled position. The progress toward the bull's eye **60** can be measured by the position of the crosshair **56** relative to the area **58** surrounding the bull's eye **60** as the crosshair **56** approaches the demarcation line **62** as the horizontal surface is moved closer to the leveled position. In this manner, the smart device **24** can be used in this initial leveling to determine an initial level position. As mentioned above, a typical digital or spirit level could also be used to achieve this initial level position. The smart device **24** can then capture, i.e., save and store the current pitch and roll angle measurements from the sensor device **22** or cause (by a transmitted instruction from the smart device **24**) the sensor device **22** to save and store the calibration data of pitch and roll angle measurements on the sensor device **22**. This calibration data will be used as offsets from the initial level position when displaying angles or calculating and displaying adjustment values necessary to move the RV back to the initial level position.

Once measurements are generated using the set level button **36** that relate to the initial level position of the RV, these measurements can be stored on the smart device **24**, or stored in a memory storage location on the PCB sensor device **22** and recalled to the smart device **24** at a desired time. The smart device **24** with the software application running can then be used to calculate and display angles relative to the initial level position and to calculate and display adjustment values necessary to move the RV to the initial level position when the RV is moved to a location for use. In some embodiments, the calculation of angles relative to the initial level position can be performed by the processor and firmware on the PCB of the sensor device **22**. Performing the calibration function on the software application, the smart device **24** can wirelessly connect (or, in some embodiments, connect through a wired connection) to

the sensor device **22** and request the current angle measurements for pitch and roll. These measurements can be stored on the smart device **24**, or stored in a memory storage location on the PCB sensor device **22** and recalled to the smart device **24** at a desired time, for use in calculating displayed information in the subsequent screens such as screen **40** shown in Figure 5 with the roll display **42** and the pitch display **44** as explained below. These stored measurements can be used as offsets from the initial level position based on the angle indications calculated from the various sensors of the sensor device **22**. This is required to establish the relationship between the position of the mounted sensor device **22** and the initial level position in both pitch and roll as measured and/or captured by the smart device **24** or the sensor device **22** as described above.

In some embodiments, if the RV level system is installed during the manufacturing of the RV, then the RV level system can be calibrated at the factory eliminating the need for the user to do it. In such embodiments, the calibration function can be skipped by the user.

In subsequent displays **42**, **44** of the current angles relative to the initial level position on the software application on the smart device **24** as shown in the screen **40** in Figure 5, for example, these stored calibration data measurements will be added or subtracted from the actual, calculated sensor data from the PCB of the sensor device **22** to determine the actual angle relative to the initial level position accounting for the actual mounted orientation of the sensor device **22**. In some embodiments, the displays **42**, **44** can show an image of the vehicle that reflects the actual position of the RV **10** with the actual angles in the respective pitch and roll directions of the RV **10** such that

the image of the vehicle moves as the angles in the respective pitch and roll directions of the RV **10** change. Once accurate angle measurements have been calculated and displayed in the screen **40** of the software application on the smart device **24**, additional calculations regarding the added height needed to achieve the initial level position of the RV can be performed either by the software application of the mobile smart device **24** or by the processor and firmware on the PCB of the sensor device **22**. These calculations regarding the added height needed to achieve the initial level position of the RV can be displayed by the software application on the mobile smart device **24**, for example, in the respective roll display **42** and pitch display **44** or on a different screen in other embodiments. The appropriate side or direction of added or removed height can also be displayed using arrows and/or the calculated height required as shown for example in the respective roll display **42** and pitch display **44** of screen **40** of the described example embodiment of software application. These calculations are achieved by using the stored information about the length and width of the RV **10** and the calculated current angle relative to the initial level position of the RV and using trigonometric formulas to calculate the height and location for the height addition or reduction required to achieve a level position.

For example, as shown in Figure 7A and 8A, an RV **10** can be parked, or positioned, at a desired location. A leveling system **20** on RV **10** (as shown in Figures 1 and 2) can be previously used to determine an initial level position that provides a true level measurement that has been stored on the smart device **24** of the leveling system **20**, or stored in a memory storage location on the PCB sensor device **22**, such as an RV leveling device, and recalled to the smart device **24**, for later use. The RV **10** can have

three or more structural supports, such as wheels W_A, W_B and jack **26** on a ground **G** at the desired location. As shown in Figure 7A, the RV **10** leans toward the first side **A** of RV **10** on first side section **16** at the desired location. Similarly, as shown in Figure 8A, the RV **10** leans toward the front **C** of RV **10** on the front section **14** at the desired location. Thus, the RV **10** is not leveled at the desired location based on the structural supports current position on the ground **G**.

The software application on the smart device **24** of the leveling system can be accessed to initiate the determination of the needed change in the roll and pitch directions to level the RV **10** at the desired location. The smart device **24** can communicate with the sensor device **22** of the leveling system **20** to obtain sensor data used to determine the current angle measurements for the roll and pitch directions off from true level, i.e., the initial level position stored in the smart device. The needed angle change, distance change, and/or direction of change for the roll and pitch directions can be displayed on the smart device **24** as shown in the roll display **42** and pitch display **44** in screen **40** of the software application (see Figure 5). As shown in Figure 7B, the first side **A** of RV **10** can then be raised the needed amount so that the first side **A** and a second side **B** of the **RV 10** can be level with one another in the roll direction based on the information provided in the roll display **42** (see Figure 5). For example, a jack **70**, or other mechanism can be used to raise the first side **A** of RV **10**. Similarly, as shown in Figure 8B, the front side **C** of RV **10** can be raised the needed amount so that the front side **C** and a rear side **D** of the **RV 10** can be level with one another in the pitch direction based on the information provided in the pitch display **44**

(see Figure 5). For example, a jack **26** can raise the front side C of RV **10** the needed amount.

As another example, the software application on the smart device **24** or the software on sensor device **22** can calculate that an RV is 2 degrees out of level in the roll direction and height needing to be added to the left side of the RV. In this example, the stored width of the RV is 8 feet or 96 inches. Using a trigonometric function, the height needed to achieve a level position can be calculated as 3.3523 inches. Knowing exactly how much height is needed to reach a perfectly level position in both pitch and roll will simplify and reduce the amount of time required to level the RV. Both the software of the sensor device **22** and the smart device software application can dynamically and in near real time update and graphically display the current pitch and roll of the RV representations using a proportional algorithm.

Additionally, in some embodiments, the sensor device **22** can have sensors that are able to detect relative humidity, temperature and barometric pressure. For example, the PCB of the sensor device **22** may have sensors that are able to detect relative humidity, temperature and barometric pressure. The user may desire to mount the sensor device **22** on the exterior or interior of the RV depending on whether they are more interested in measuring the environmental conditions outside or inside the RV. This environmental information will also be wirelessly transmitted to the smart device **24** and displayed for the user.

In some embodiments as stated above, the mobile smart device software application that can be downloaded and run on the smart device **24** can permit input of the RV length and RV width for the purpose of calculating the amount of height needed

at the appropriate place to return the RV to a previously defined level position. In some embodiments, this length and width could be pre-programmed for various makes and models of RV's, eliminating the need for the user to measure and input the length and width dimensions. Instead, the mobile smart device software application can have a screen that lists the make and model of the RV. In some embodiments, the lists of RV's can contain various information about the different makes and models of RV's including pictures and other information. The screen can allow the user to scroll the list or can provide a search mechanism that allows the user to find the exact RV in question or shorten the list of RV's to be viewed. In this manner, the user would simply select the make and model of the RV from a list contained within the mobile smart device software application of the smart device **24**.

RV's typically have control panels that consist of pushbuttons and/or indicator LED's and/or LCD displays. These control panels are used to display data about the condition of various RV systems or to activate various RV systems. Typical data displayed by some RV control panels can include holding tank fluid levels and battery power levels. Typical RV systems that might be activated from some control panels would be power slideouts and starting or stopping the generator. In some embodiments, the smart device **24** can be integrated or in communication with the various RV control panels and systems either through wired or wireless communications. For example, utilizing a wireless communication system or protocol, such as Bluetooth or WiFi, the mobile smart device software application on the smart device **24** can display the data that is generated and displayed on some of the RV control panels such as holding tank levels, battery power levels and the like. In

addition, the mobile smart device software application can also be used to activate various RV systems such as power slideouts, starting the generator, stopping the generator, or the like. The mobile smart device software application could also be used to control more general RV systems such as lighting and entertainment systems. For example, the mobile smart device software application can generate screens that are displayed on the smart device **24** that display the data that is generated and displayed on some of the RV control panels. Additionally, the mobile smart device software application can generate screens that are displayed on the smart device **24** that provide user interfaces, such as buttons that can be used to activate various RV systems by the user, for example, remotely or wirelessly.

In some embodiments, the PCB of the sensor device **22** can contain a GPS sensor allowing the current physical location of a vehicle, such as RV **10**, that the sensor device **22** has been mounted on to be transmitted to the mobile smart device **24** or saved and stored on the sensor device **22**. Positional movements of the vehicle, along with date and time information, can be saved and stored on the mobile smart device **24** or the sensor device **22**. This saved vehicle positional movement information along with saved and corresponding date and time information can be used to determine actual use information regarding the vehicle. For instance, this positional movement information can be used to make determinations on the actual times that the vehicle is used over a given time period, how many days the vehicle is typically used when it is away from the normal storage locations, how many miles the vehicle is typically driven or towed to each use locations, and other information that might be relevant to the manufacturer of the vehicle. Total distance traveled by the vehicle could

also be saved and stored on the mobile smart device **24** or sensor device **22** for use by the manufacturer of the vehicle for warranty or other uses. The total number of miles traveled by a non-drivable vehicle such as a trailer or towable RV is not currently recorded in any other manner and this may be useful information for many purposes such as used value determination, tire warranties, and many others. This saved and stored vehicle location, date, time and usage information could be transmitted from the mobile smart device **24** via the internet to email or computer server addresses or locations designated by the vehicle manufacturer.

Thus, according to the disclosure herein, a method, generally designated **50**, for leveling a vehicle, such as a recreational vehicle, can be provided as shown in Figure 9. To begin, a leveling system can be provide that comprises one or more sensor devices, that can comprise one or more vehicle leveling devices, secured to a vehicle to sense at least one of an inclination or an orientation of the vehicle in both a pitch direction and a roll direction and a smart device in communication with the one or more sensor devices as shown in step **52**. The method can comprise a step **54** of measuring the pitch angle and the roll angle of the vehicle when the vehicle is at rest using the sensor device as shown as Figure 9. To determine the needed movement of the vehicle to achieve a level position based on the measures of the pitch angle and the roll angle, calibration data of pitch angle and roll angle measurements taken by the sensor device when the vehicle was at an initial level position can then be retrieved as shown in step **55**. The method **50** can additionally comprise a step **56** of calculating any needed change in at least one of the pitch direction or the roll direction of the vehicle using the measurements of the pitch angle and the roll angle of the at rest vehicle and the

calibration data of pitch and roll angle measurements to obtain a level position of the vehicle. This calculation can be performed by the one or more sensor devices or the smart device. In step **58**, the calculated change in at least one of the pitch direction or the roll direction of the vehicle can be displayed on the smart device.

In order to initially develop the calculation data, the method described above can also include the step of determining the initial level position for a vehicle to determine any inconsistencies inherent in the leveling system. Depending on the embodiment of the method, this determination step can be performed on the one or more sensor devices or the smart device. In some embodiments, the step of determining an initial level position can comprise receiving measurements of a length and a width of the vehicle. In some embodiments of the method, the step of determining an initial level position can comprise using at least one of an accelerometer, gyroscope, or global positioning system sensor on the smart device to achieve the initial level position. In some embodiments, the step of determining an initial level position can comprise using at least one of a digital level or spirit level can also be used to achieve the initial level position. In some embodiments of the method, the step of determining an initial level position can be performed by during manufacture of the vehicle and the calibration data stored on the sensor device installed during manufacture. In some embodiments, when installing the sensor device or after installation, whether on the front, the rear, sides or at a central location of the vehicle, an axis can of a plurality of axes of the accelerometer on the sensor device can be assigned to measure the pitch of the vehicle and another axis of the plurality axes of the accelerometer on the sensor device can be assigned to measure the roll of the vehicle. For instance, in some such embodiments,

the orientation of the sensor device relative to the front, the rear, the passenger side or the drive side of the vehicle can be noted using the software application on either the sensor device or the smart device so that an appropriate axis can be assigned to determine the pitch angle measurement of the vehicle and an appropriate axis can be assigned to determine the roll angle measurement of the vehicle. The mobile smart device software application may have a screen designed to define the installed orientation of the sensor device so that data from the appropriate axes can be used for pitch and roll calculations. The pitch and roll angle measurements from the sensor device taken at the initial level position can then be captured, i.e., identified and stored or saved, to provide the calibration data of the pitch and roll angle measurements to permit consideration of any inconsistencies determined when taking measurement readings at a future time. For example, the calibration can be calculated and then saved on a sensor processor on the one or more sensor devices or saved on the smart device that is in communication with the one or more sensor devices. In some embodiments of the method, the step of capturing the pitch and roll angle measurements from the sensor device can comprise communicating calibration data from the sensor device of the pitch and roll angle measurements measured by the sensor device when the vehicle is at the initial level position to the smart device and saving the calibration data on the smart device. In some embodiments of the method, the step of capturing the pitch and roll angle measurements from the sensor device can comprise saving the calibration data of the pitch and roll angle measurements measured by the sensor device when the vehicle is at the initial level position on the sensor device. In some such embodiments where the calibration data is saved on the

sensor device, the step of saving the calibration data of the pitch and roll angle measurements on the sensor device can comprise transmitting instructions from the smart device to the sensor device to save and store the calibration data of the pitch and roll angle measurements on the sensor device. In some such embodiments, the method can include recalling the calibration data of the pitch and roll angle measurements from the sensor device to the smart device.

In some embodiments of the method, the step **58** of displaying the calculated change in at least one of the pitch direction or the roll direction of the vehicle can comprise displaying the calculated change in the pitch direction and the roll direction of the vehicle in measurements of distance. In some embodiments of the method, the step **58** of displaying the calculated change in at least one of the pitch direction or the roll direction of the vehicle can comprise displaying the calculated change in the pitch direction and the roll direction of the vehicle as angles.

In some embodiments, the method can additionally comprise providing a conversion function to permit the changing of the system used for measurements c between U.S. Customary System and the Metric System. In some embodiments, the method can additionally comprise saving a given pitch angle measurement on at least one of the smart device or the sensor device to permit later recall for the purpose of returning the vehicle to the given pitch angle position at a later time. In some embodiments, the method can further comprise collecting and storing positional movement information of the vehicle using a global positioning system sensor on the sensor device.

In some embodiments, the method can additionally comprise receiving data at the smart device from one or more vehicle control panels. In some such embodiments, the received data from one or more vehicle control panels can comprise at least one of data regarding holding tank levels or data regarding battery power levels. In some of these embodiments of the method, the smart device can display the data that is generated and displayed on the one or more vehicle control panels.

In some embodiments, the method can additionally comprise activating one or more systems on the vehicle via the software application of the smart device. As described above, the communication between the smart device and the vehicle can be accomplished using a wireless communication system or protocol, such as Bluetooth or WiFi. For example, the one or more systems activated with the smart device can comprise at least one of a lighting system, an entertainment system, a power slideouts system or a generator system.

As stated above, a software application in the form of a non-transitory computer readable medium can be provided that comprises computer executable instructions embodied in a computer readable medium that when executed by a processor of a computer control the computer to perform the steps similar to the method, generally designated **60**, described above. For the example, as shown in Figure 10, the non-transitory computer readable medium can perform a step **62** of receiving on a smart device a pitch angle measurement and a roll angle measurement of a vehicle when the vehicle is at rest from a sensor device. Additionally, the non-transitory computer readable medium can perform a step **64** of retrieving calibration data of pitch angle and roll angle measurements taken by a sensor device when the vehicle was at an initial

level position. The sensor device can comprise a vehicle leveling device or an RV leveling device. The non-transitory computer readable medium can also perform a step **66** of calculating any needed change in at least one of a pitch direction or a roll direction of the vehicle using the calibration data of the pitch and roll angle measurements to obtain a level position of the vehicle. The non-transitory computer readable medium can further perform a step **68** of displaying on the smart device the calculated change in at least one of the pitch direction or the roll direction of the vehicle needed to obtain the level position of the vehicle.

In order to initially develop the calculation data, the method performed by the software application described above can also include the step of determining the initial level position for a vehicle to determine any inconsistencies inherent in the leveling system. In some embodiments, the step of determining an initial level position can comprise receiving measurements of a length and a width of the vehicle. In some embodiments of the software application, the step of determining an initial level position can comprise using at least one of an accelerometer, gyroscope, or global positioning system sensor on the smart device to achieve the initial level position. In some embodiments of the method, the step of determining an initial level position can be performed by during manufacture of the vehicle and the calibration data stored on the sensor device installed during manufacture.

The software application can then be used to capture, i.e., identified and stored or saved, the pitch and roll angle measurements from the sensor device taken at the initial level position to provide the calibration data of the pitch and roll angle measurements to permit consideration of any inconsistencies determined when taking

measurement readings at a future time. For example, the calibration can be calculated and then saved on a sensor processor on the one or more sensor devices or saved on the smart device that is in communication with the one or more sensor devices. In some embodiments of the software application, the step of capturing the pitch and roll angle measurements from the sensor device can comprise communicating calibration data from the sensor device of the pitch and roll angle measurements measured by the sensor device when the vehicle is at the initial level position to the smart device and saving the calibration data on the smart device. In some embodiments of the software application, the step of capturing the pitch and roll angle measurements from the sensor device can comprise saving the calibration data of the pitch and roll angle measurements measured by the sensor device when the vehicle is at the initial level position on the sensor device. In some such embodiments where the calibration data is saved on the sensor device, the step of saving the calibration data of the pitch and roll angle measurements on the sensor device can comprise transmitting instructions from the smart device to the sensor device to save and store the calibration data of the pitch and roll angle measurements on the sensor device. In some such embodiments, the steps performed by the software application can include recalling the calibration data of the pitch and roll angle measurements from the sensor device to the smart device.

In some embodiments of the software application, the step **68** of displaying the calculated change in at least one of the pitch direction or the roll direction of the vehicle can comprise displaying the calculated change in the pitch direction and the roll direction of the vehicle in measurements of distance. In some embodiments of the software application, the step **68** of displaying the calculated change in at least one of

the pitch direction or the roll direction of the vehicle can comprise displaying the calculated change in the pitch direction and the roll direction of the vehicle as angles.

In some embodiments, the steps of the software application can additionally comprise providing a conversion function to permit the changing of the system used for measurements c between U.S. Customary System and the Metric System. In some embodiments, the steps of the software application can additionally comprise saving a given pitch angle measurement on at least one of the smart device or the sensor device to permit later recall for the purpose of returning the vehicle to the given pitch angle position at a later time. In some embodiments, the steps of the software application can further comprise collecting and storing positional movement information of the vehicle using a global positioning system sensor on the sensor device.

In some embodiments, the steps of the software application can additionally comprise receiving data at the smart device from one or more vehicle control panels. In some such embodiments, the received data from one or more vehicle control panels can comprise at least one of data regarding holding tank levels or data regarding battery power levels. In some of these embodiments of the software application, the smart device can display the data that is generated and displayed on the one or more vehicle control panels.

In some embodiments, the steps of the software application can additionally comprise activating one or more systems on the vehicle with the smart device. As described above, the communication between the smart device and the vehicle can be accomplished using a wireless communication system or protocol, such as Bluetooth or WiFi. For example, the one or more systems activated with the smart device can

comprise at least one of a lighting system, an entertainment system, a power slideouts system or a generator system.

In some embodiments, the software application can also comprise a method to give the leveling system user control over the battery life of the sensor battery to allow the user to extend the life of the battery in use. For example, in some embodiments, the sensor device, i.e., the vehicle leveling device, can be configured to switch between a "sleep mode," where the sensor device is using a minimal amount of power and an "awake mode," where the sensor device is prepared to perform its variety of actions and can connect with the smart device. Thus, the steps of the software application can additionally comprise steps that activate the battery for use through the detection of motion of the vehicle, such as an RV through communication with the sensor device. The sensor device, i.e., the vehicle leveling device, of the leveling system can use motion detected by the accelerometers to change the state of the sensor device between the sleep mode and the awake mode based on certain conditions and user configuration settings. So, in such embodiments, when the sensor device detects motion, the sensor device can transition from the sleep mode to the awake mode and can be connected to the smart device for communication with the leveling system software application. For example, in some embodiments, when in the awake mode the Bluetooth signal is being broadcast which uses more battery power than the sleep mode where the Bluetooth signal is not being broadcast. When the sensor device detects no motion based on a user defined period of time, the sensor goes into the sleep mode to conserve the battery. Thus, in some embodiments, the software application permits the user to define the amount of time, for example, in minutes and/or hours, after no motion

is detected that the sensor device will stay in the awake mode before going to the sleep mode. In this manner, the leveling system user can be allowed to configure the leveling system to best suit the user's specific use habits. For example, the software application can provide one or more screen displays that can allow the use to select a motion detection option to transition the sensor device between an awake mode and a sleep mode and can further provide a method of conserving battery life of the sensor device.

An additional aspect that can be employed in some embodiments of the sensor device of the leveling system to conserve battery life is an On/Off switch that is a complete battery disconnect from a circuitry perspective within the sensor device. This battery disconnect can allow the user to turn off the system entirely (to increase battery life) when the sensor is in a setting where motion is constantly being observed, such as when driving or towing the RV for many hours during travel. It can also be used to completely disconnect the battery during RV storage periods. Thus, the sensor device can comprise an On/Off switch that permits the disconnection of the battery from the circuitry, for example, from a PCB of the sensor device as described above, of the sensor device to conserve battery life. The sensor can also comprise a sounder device that can be mounted on a PCB of the sensor device that chirps an audible sound when the On/Off switch is moved into the On position. This audible sound can be used to indicate that the currently installed battery is still good. In some embodiments, this audible sound can be used to indicate that the sensor is now in a Bluetooth pairing mode. Pairing mode can be used to associate the original or additional smart device with a given sensor device of the leveling system.

The leveling system and software application can provide a custom pairing mode to associate the sensor device of a given leveling system with a specific smart device. For example, the sensor device of a leveling system can be assigned a serial number. During use, for example, during configuration of the software application and/or installation of the sensor device, the serial number from the sensor can be recorded on the smart device. Once a smartphone or tablet has been associated with a particular sensor, then it will only communicate with that sensor, for example, until it is changed by the user. In this manner, the sensor device of a leveling system on an RV can be assured to connect to the RV user's smart device and not to other possible sensors within a given camping area. For example, in some embodiments, the software application can provide a screen display that will allow the user to enter the serial number for the sensor device of the leveling system installed on the RV into the smart device. Once the serial number for that sensor device has been entered, the smart device of the user when using the software application will communicate with the sensor device of the leveling system installed on the RV of the user and not some other sensor device within the area where the RV is being set up for use.

Another aspect of the leveling system and the software application for the leveling system that some embodiment may have is the ability of the use to define the driver's side of the vehicle. By being able to define which side of the RV is the driver's side, especially for motorized RV's, the leveling system can be used in a variety of countries regardless of the types of cars used within a particular country and the country's laws regarding which side of road a vehicle is drive on. For example, by allowing the leveling system user to select the driver's side of the his or her RV, the

same leveling system and leveling system software application can be in countries that require vehicles to be driven on the right side of the road or in countries that require vehicles to be driven on the left side of the road. For example, in some embodiments, the software application can include a default setting, for example, that the driver's side of the RV is on left side of the vehicle and the passenger's side is on the right of the vehicle. In some embodiments, the software application can include a screen display that will allow the user to change the default setting of the driver's side or allow the user to select which side is the driver's side and/or passenger side of the RV. Once the driver's side is changed or selected, the references for the driver's side and the passenger's side of the RV are set for use with the particular RV so that software application reads properly for that user. The references can also change for the installation orientation selections to match the currently selected driver's side of the vehicle.

As described above, the vehicle leveling devices and leveling systems can be used on either towable recreational vehicles and motorized recreational vehicles. Another specific embodiment of a leveling system and software application is described with reference to Figures 11 and 12. As another example shown in Figure 11, an embodiment of a motorized RV **70** having a front **71**, a rear **73**, a driver side (first section) **75**, and a passenger side (second section) **77** can be provided that can be adjusted in pitch rotational directions depend on the inclination of the RV **70** from front-to-back and roll rotational directions depending on the inclination of the RV **70** from side-to-side using leveling systems and devices in a similar manner as described above. The RV **70** can comprise a front driver side wheel **72**, a front passenger side

wheel **74**, a rear driver side wheel **76**, and a rear passenger side wheel **78**. To accomplish the adjustments so that, upon parking the RV **70**, the RV **70** will be leveled in both the pitch and roll directions, a leveling system **80** can be provided that provides measurements to determine the amount of adjustment needed in both the pitch and roll directions. For example, the leveling system **80** can comprise one or more sensor devices **82** (shown schematically in dotted lines as a box within the RV **70**) that can be secured to the RV **70** to sense the inclination and/or orientation of the RV **70** in both the pitch and roll directions. The sensor device **82** can comprise a vehicle leveling device.

Additionally, the leveling system **80** can also comprise a smart device **84** that can be in communication with the sensor device **82**. For example, the smart device **84** can have a specific software application thereon that include one or more aspect of the software application described above that allows information received from the sensor device **82** about the inclination and/or orientation of the RV **70** to be processed to provide measurements to a user and to determine the amount of adjustments needed to the RV **70**. The smart device **84** and the sensor device can communicate with each other in a variety of ways. For example, in some embodiments, the sensor device **82** and smart device **84** can communicate through a wired connection. In some embodiments, as shown in Figure 11, the sensor device **82** and smart device **84** can communicate through wireless communications, such as Bluetooth.

Once the leveling system **80** has calculated the change of elevation height needed in the roll direction and the pitch direction, the smart device can determine how much each tire needs to be raised to level the RV **70**. In particular, the software application can display on the smart device the height required to reach a level position

for each wheel **72**, **74**, **76**, **78** as shown in Figure 12 at **92**, **94**, **96**, and **98** respectively. These heights are calculated in a similar manner to the calculated roll and pitch elevation heights as described in the embodiments above. Figure 12 is a screen shot of a display that shows a schematic representation of the motorized RV **70** from above and can be used to display the amount of adjustment in height of each wheel **72**, **74**, **76**, **78** of the motorized RV **70** based on the measurements taken by the vehicle leveling device **84** and the calculations of the changes in height needed in the roll direction and the pitch direction.

For example, referring to Figure 12, if the calculated roll height required is an upward elevation on the passenger side of two and a quarter (2.25) inches and the calculated pitch height required is an upward elevation in the rear of one and a half (1.5) inches, then either the smart device **84** or the vehicle leveling device **82** can calculate the movement needed for each wheel of the RV **70** using this information. Based on these adjustment calculations for the change in the height needed in the roll direction and the pitch direction, the adjustment in height of each wheel **72**, **74**, **76**, **78** can be calculated by either the smart device **84** or the vehicle leveling device **82**. The smart device **84** or the vehicle leveling device **82** can determine which wheel would be considered the pivot point, i.e., the wheel that needs no adjustment for the RV **70** to reach a level position. In some embodiments, the smart device **84** can do these calculations. In some embodiments, the vehicle leveling device, or sensor device, **82** can do these calculations.

In the example above as shown in Figure 12, the driver side front wheel would be the pivot point and the display from the software application on screen of the smart

device would show a zero (0) inch height adjustment of the frame of the motorized RV **70** required at or near the driver front wheel **72** (see Figure 11) as shown at **92** in Figure 12, since the motorized RV **70** needs an adjustment of height (two and a quarter (2.25) inches as explained above) on the passenger side **77** and an adjustment of height (one and a half (1.5) inches as explained above) in the rear **73** of the RV **70**. Based on the measurements made by the vehicle leveling device **82**, the smart device **84** or the vehicle leveling device **82** can also determine the change in elevation of height of the frame of the motorized RV **70** required at or near the other three wheels **74**, **76**, **78**. In this example, the frame of the motorized RV **70** at or near the passenger front wheel **74** would need a two and a quarter (2.25) inches adjustment in height as show at **94** in the display in Figure 12 and the frame of the motorized RV **70** at or near the passenger side rear wheel **78** would need a three and a three quarter (3.75) inches adjustment in height as show at **96** in the display in Figure 12, while the frame of the motorized RV **70** at or near the driver side rear wheel **76** would need a one and a half (1.5) inches adjustment in height as show at **98** in the display in Figure 12.

The adjustment of height to the frame of the motorized RV **70** proximate to each wheel **72**, **74**, **76**, **78** of the RV **70** can be accomplished in different manners. For example, in some embodiments, the wheels **72**, **74**, **76**, **78** of the RV **70** can be placed or driven onto blocks or stacks of blocks. In some embodiments, the RV **70** can have one more jacks that can extend downward from the frame proximate to the wheels **72**, **74**, **76**, **78** of the RV **70** that can be used to adjust the height of the frame of the RV **70**. In some embodiments, one or more jacks can be placed proximate to the wheels **72**, **74**, **76**, **78** of the RV **70** to adjust the height of the frame of the RV **70**.

Thus, the calculated adjustment proximate to each wheel is the sum of the calculated change in the height in the roll direction and the pitch direction for the given position of the respective wheel. Thus, the calculated change in height of the frame of the motorized RV **70** proximate to the front driver side wheel **72** is the sum of any calculated adjustment in height at the front **71** of the RV **70** and on the driver side **75** of the RV **70**. Additionally, the calculated change in height of the frame of the motorized RV **70** proximate to the front passenger side wheel **74** is the sum of any calculated adjustment in height at the front **71** of the RV **70** and on the passenger side **77** of the RV **70**. Similarly, the calculated change in height of the frame of the motorized RV **70** proximate to the rear driver side wheel **76** is the sum of any calculated adjustment in height at the rear **73** of the RV **70** and on the driver side **75** of the RV **70**, while the calculated change in height of the frame of the motorized RV **70** proximate to the rear passenger side wheel **78** is the sum of any calculated adjustment in height at the rear **73** of the RV **70** and on the passenger side **77** of the RV **70**.

These and other modifications and variations to the present subject matter may be practiced by those of ordinary skill in the art, without departing from the spirit and scope of the present subject matter, which is more particularly set forth herein above. In addition, it should be understood the aspects of the various embodiments may be interchanged both in whole and in part. Furthermore, those of ordinary skill in the art will appreciate that the foregoing description is by way of example only, and is not intended to limit the present subject matter.

PTO/AIA/22 (03-13)
Approved for use through 03/31/2013. 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 displays a valid OMB control number.

PETITION FOR EXTENSION OF TIME UNDER 37 CFR 1.136(a)

Docket Number (Optional): LEO-2-CIP

Application Number 15/619,281 | Filed 06/09/2017

For VEHICLE LEVELING SYSTEMS, DEVICES AND METHODS AND COMPUTER PROGRAM PRODUCTS FOR LEVELING VEHICLES USING SMART DEVICES

Art Unit: Not Yet Assigned | Examiner: Not Yet Assigned

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	
[X] One month (37 CFR 1.17(a)(1))	$ 200	$ 100	$ 50	$ 100.00
[ ] Two months (37 CFR 1.17(a)(2))	$ 600	$ 300	$ 150	$
[ ] Three months (37 CFR 1.17(a)(3))	$ 1400	$ 700	$ 350	$
[ ] Four months (37 CFR 1.17(a)(4))	$ 2200	$ 1100	$ 550	$
[ ] Five months (37 CFR 1.17(a)(5))	$ 3000	$ 1500	$ 750	$

[X] 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.

[X] The Director is hereby authorized to charge any fees which may be required, or credit any overpayment, to Deposit Account Number 60-3172.

[ ] Payment made via EFS-Web.

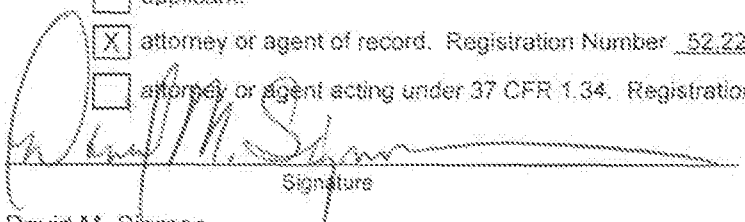
WARNING: Information on this form may become public. Credit card information should not be included on this form. Provide credit card information and authorization on PTO-2038.

I am the

[ ] applicant.

[X] attorney or agent of record. Registration Number 52,224.

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



Signature — September 22, 2017 — Date

David M. Simon — Typed or printed name

864-987-9696 — 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 _____ 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: 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.

Electronic Patent Application Fee Transmittal

Application Number:	15619261
Filing Date:	09-Jun-2017
Title of Invention:	VEHICLE LEVELING SYSTEMS, DEVICES AND METHODS AND COMPUTER PROGRAM PRODUCTS FOR LEVELING VEHICLES USING SMART DEVICES
First Named Inventor/Applicant Name:	Charles A. Leonard
Filer:	John Bennett Mullinax/David Sigmon
Attorney Docket Number:	LEO-2-CIP

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:				
LATE FILING FEE FOR OATH OR DECLARATION	2051	1	70	70
Petition:				

Description	Fee Code	Quantity	Amount	Sub-Total in USD($)
Patent-Appeals-and-Interference:				
Post-Allowance-and-Post-Issuance:				
Extension-of-Time:				
Extension - 1 month with $0 paid	2251	1	100	100
Miscellaneous:				
		Total in USD ($)		**900**

Electronic Acknowledgement Receipt

EFS ID:	30444473
Application Number:	15619261
International Application Number:	
Confirmation Number:	2353
Title of Invention:	VEHICLE LEVELING SYSTEMS, DEVICES AND METHODS AND COMPUTER PROGRAM PRODUCTS FOR LEVELING VEHICLES USING SMART DEVICES
First Named Inventor/Applicant Name:	Charles A. Leonard
Customer Number:	44728
Filer:	John Bennett Mullinax/David Sigmon
Filer Authorized By:	John Bennett Mullinax
Attorney Docket Number:	LEO-2-CIP
Receipt Date:	22-SEP-2017
Filing Date:	09-JUN-2017
Time Stamp:	11:39:48
Application Type:	Utility under 35 USC 111(a)

Payment information:

Submitted with Payment	yes
Payment Type	EFT
Payment was successfully received in RAM	$900
RAM confirmation Number	092217INTEFSW11410400
Deposit Account	
Authorized User	

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

File Listing:

Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
1		LEO2CIPRNTFMP.pdf	1354475 cf01c997fe0fefbdd05c9af31683141a7106715b	yes	10
	Multipart Description/PDF files in .zip description				
	Document Description		**Start**	**End**	
	Applicant Response to Pre-Exam Formalities Notice		1	1	
	Preliminary Amendment		2	10	
Warnings:					
Information:					
2	Specification	LEO2CIPMarkedUpSubSpec.pdf	9431904 4d661fa93ee3b8897f93a725416caf95dc17b45f	no	46
Warnings:					
Information:					
3	Specification	LEO2CIPCleanSubSpec.pdf	9337041 a2a584f499f9504b76ce14c90d0c4d7052e59bd9	no	46
Warnings:					
Information:					
4	Extension of Time	LEO2CIPExtension.pdf	258881 38a150249a0056daf55cd04fcede8c175b389e26	no	1
Warnings:					
Information:					
5	Fee Worksheet (SB06)	fee-info.pdf	39175 3391e106c140f827859bb37c561614a5d2d0a6c1	no	2
Warnings:					
Information:					

Total Files Size (in bytes):	20421476

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

Applicant(s): Leonard	
Application No.: 15/619,261	
Filed: June 9, 2017	Art Unit: Not Yet Assigned
Title: VEHICLE LEVELING SYSTEMS, DEVICES AND METHODS AND COMPUTER PROGRAM PRODUCTS FOR LEVELING VEHICLES USING SMART DEVICES	Confirmation No.: 2353
Attorney Docket No.: LEO-2-CIP	

RESPONSE TO NOTICE TO FILE MISSING PARTS OF NONPROVISIONAL APPLICATION

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

Sir:

This is in response to a Notice to File Missing Parts of a Nonprovisional Application dated June 22, 2017. Enclosed is a copy of said Notice and the following documents and fees to complete the filing requirements of the above-identified application.

(X) A Preliminary Amendment with a marked-up substitute specification and a clean version of the substitute specification; and

(X) One-month Extension of Time.

A fee of $800, which includes the filing, search, and examination fees as well as an extra claim fee, surcharge and extension fee, is also submitted herewith via EFT.

Respectfully submitted,

By _____
David M. Sigmon,
Attorney Reg. No. 52,224
Date: September 22, 2017
Telephone No. 864-987-9696

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 15/619,261	Filing Date 06/09/2017	☐ 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 $ =	
INDEPENDENT CLAIMS (37 CFR 1.16(h))	minus 3 =	*	X $ =	
☐ APPLICATION SIZE FEE (37 CFR 1.16(s))	If the specification and drawings exceed 100 sheets of paper, the application size fee due is $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)		
	09/22/2017	CLAIMS REMAINING AFTER AMENDMENT		HIGHEST NUMBER PREVIOUSLY PAID FOR	PRESENT EXTRA	RATE ($)	ADDITIONAL FEE ($)
AMENDMENT	Total (37 CFR 1.16(i))	* 18	Minus	** 20	= 0	X $40 =	0
	Independent (37 CFR 1.16(h))	* 3	Minus	***3	= 0	X $210 =	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)		
		CLAIMS REMAINING AFTER AMENDMENT		HIGHEST NUMBER PREVIOUSLY PAID FOR	PRESENT EXTRA	RATE ($)	ADDITIONAL FEE ($)
AMENDMENT	Total (37 CFR 1.16(i))	*	Minus	**	=	X $ =	
	Independent (37 CFR 1.16(h))	*	Minus	***	=	X $ =	
	☐ 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.

** If the "Highest Number Previously Paid For" IN THIS SPACE is less than 20, enter "20".

*** If the "Highest Number Previously Paid For" IN THIS SPACE is less than 3, enter "3".

The "Highest Number Previously Paid For" (Total or Independent) is the highest number found in the appropriate box in column 1.

LDRC
/EVA GILLIS/

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.

ETN1003
194/306

UNITED STATES PATENT AND TRADEMARK OFFICE

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

APPLICATION NUMBER	FILING or 371(c) DATE	GRP ART UNIT	FIL FEE REC'D	ATTY.DOCKET.NO	TOT CLAIMS	IND CLAIMS
15/619,261	06/09/2017	3766	800	LEO-2-CIP	18	3

CONFIRMATION NO. 2353

UPDATED FILING RECEIPT

44728
J. BENNETT MULLINAX, LLC
P. O. BOX 26029
GREENVILLE, SC 29616-1029

OC000000094321446

Date Mailed: 09/25/2017

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)

Charles A. Leonard, Hickory, NC;

Applicant(s)

Charles A. Leonard, Hickory, NC;

Power of Attorney: None

Domestic Priority data as claimed by applicant

This application is a CIP of 14/961,787 12/07/2015
which claims benefit of 62/088,115 12/05/2014
and claims benefit of 62/101,109 01/08/2015

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.

Permission to Access Application via Priority Document Exchange: No

Permission to Access Search Results: No

Applicant may provide or rescind an authorization for access using Form PTO/SB/39 or Form PTO/SB/69 as appropriate.

If Required, Foreign Filing License Granted: 06/22/2017

The country code and number of your priority application, to be used for filing abroad under the Paris Convention, is **US 15/619,261**

Projected Publication Date: 01/04/2018

Non-Publication Request: No

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

VEHICLE LEVELING SYSTEMS, DEVICES AND METHODS AND COMPUTER PROGRAM PRODUCTS FOR LEVELING VEHICLES USING SMART DEVICES

Preliminary Class

607

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

PROTECTING YOUR INVENTION OUTSIDE THE UNITED STATES

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

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

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

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

For information on preventing theft of your intellectual property (patents, trademarks and copyrights), you may wish to consult the U.S. Government website, http://www.stopfakes.gov. Part of a Department of Commerce initiative, this website includes self-help "toolkits" giving innovators guidance on how to protect intellectual property in specific countries such as China, Korea and Mexico. For questions regarding patent enforcement issues, applicants may call the U.S. Government hotline at 1-866-999-HALT (1-866-999-4258).

LICENSE FOR FOREIGN FILING UNDER

Title 35, United States Code, Section 184

Title 37, Code of Federal Regulations, 5.11 & 5.15

GRANTED

The applicant has been granted a license under 35 U.S.C. 184, if the phrase "IF REQUIRED, FOREIGN FILING LICENSE GRANTED" followed by a date appears on this form. Such licenses are issued in all applications where the conditions for issuance of a license have been met, regardless of whether or not a license may be required as set forth in 37 CFR 5.15. The scope and limitations of this license are set forth in 37 CFR 5.15(a) unless an earlier license has been issued under 37 CFR 5.15(b). The license is subject to revocation upon written notification. The date indicated is the effective date of the license, unless an earlier license of similar scope has been granted under 37 CFR 5.13 or 5.14.

This license is to be retained by the licensee and may be used at any time on or after the effective date thereof unless it is revoked. This license is automatically transferred to any related applications(s) filed under 37 CFR 1.53(d). This license is not retroactive.

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

NOT GRANTED

No license under 35 U.S.C. 184 has been granted at this time, if the phrase "IF REQUIRED, FOREIGN FILING LICENSE GRANTED" DOES NOT appear on this form. Applicant may still petition for a license under 37 CFR 5.12, if a license is desired before the expiration of 6 months from the filing date of the application. If 6 months has lapsed from the filing date of this application and the licensee has not received any indication of a secrecy order under 35 U.S.C. 181, the licensee may foreign file the application pursuant to 37 CFR 5.15(b).

SelectUSA

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 U.S. offers tremendous resources and advantages for those who invest and manufacture goods here. Through SelectUSA, our nation works to promote and facilitate business investment. SelectUSA provides information assistance to the international investor community; serves as an ombudsman for existing and potential investors; advocates on behalf of U.S. cities, states, and regions competing for global investment; and counsels U.S. economic development organizations on investment attraction best practices. To learn more about why the United States is the best country in the world to develop technology, manufacture products, deliver services, and grow your business, visit http://www.SelectUSA.gov or call +1-202-482-6800.

UNITED STATES PATENT AND TRADEMARK OFFICE

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

APPLICATION NUMBER	FILING OR 371(C) DATE	FIRST NAMED APPLICANT	ATTY. DOCKET NO./TITLE
15/619,261	06/09/2017	Charles A. Leonard	LEO-2-CIP

CONFIRMATION NO. 2353

44728
J. BENNETT MULLINAX, LLC
P. O. BOX 26029
GREENVILLE, SC 29616-1029

INFORMAL NOTICE

OC000000094321447

Date Mailed: 09/25/2017

INFORMATIONAL NOTICE TO APPLICANT

Applicant is notified that the above-identified application contains the deficiencies noted below. No period for reply is set forth in this notice for correction of these deficiencies. However, if a deficiency relates to the inventor's oath or declaration, the applicant must file an oath or declaration in compliance with 37 CFR 1.63, or a substitute statement in compliance with 37 CFR 1.64, executed by or with respect to each actual inventor no later than the expiration of the time period set in the "Notice of Allowability" to avoid abandonment. See 37 CFR 1.53(f).

The item(s) indicated below are also required and should be submitted with any reply to this notice to avoid further processing delays.

- A properly executed inventor's oath or declaration has not been received for the following inventor(s):
  Charles A. Leonard

Questions about the contents of this notice and the requirements it sets forth should be directed to the Office of Data Management, Application Assistance Unit, at **(571) 272-4000** or **(571) 272-4200** or **1-888-786-0101**.

/dnguyen/

PATENT APPLICATION FEE DETERMINATION RECORD

Substitute for Form PTO-875

Application or Docket Number: 15/619,261

APPLICATION AS FILED - PART I

FOR	(Column 1) NUMBER FILED	(Column 2) NUMBER EXTRA	SMALL ENTITY RATE($)	SMALL ENTITY FEE($)	OR	OTHER THAN SMALL ENTITY RATE($)	OTHER THAN SMALL ENTITY FEE($)
BASIC FEE (37 CFR 1.16(a), (b), or (c))	N/A	N/A	N/A	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))	18 minus 20 =	*	x 40 =	0.00	OR		
INDEPENDENT CLAIMS (37 CFR 1.16(h))	3 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	SMALL ENTITY RATE($)	SMALL ENTITY ADDITIONAL FEE($)	OR	OTHER THAN SMALL ENTITY RATE($)	OTHER THAN SMALL ENTITY ADDITIONAL FEE($)
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.

UNITED STATES PATENT AND TRADEMARK OFFICE

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

APPLICATION NUMBER	FILING OR 371(C) DATE	FIRST NAMED APPLICANT	ATTY. DOCKET NO./TITLE
15/619,261	06/09/2017	Charles A. Leonard	LEO-2-CIP

CONFIRMATION NO. 2353

44728
J. BENNETT MULLINAX, LLC
P. O. BOX 26029
GREENVILLE, SC 29616-1029

PUBLICATION NOTICE



Title:VEHICLE LEVELING SYSTEMS, DEVICES AND METHODS AND COMPUTER PROGRAM PRODUCTS FOR LEVELING VEHICLES USING SMART DEVICES

Publication No.US-2018-0004230-A1
Publication Date:01/04/2018

NOTICE OF PUBLICATION OF APPLICATION

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

The publication may be accessed through the USPTO's publically available Searchable Databases via the Internet at www.uspto.gov. The direct link to access the publication is currently http://www.uspto.gov/patft/.

The publication process established by the Office does not provide for mailing a copy of the publication to applicant. A copy of the publication may be obtained from the Office upon payment of the appropriate fee set forth in 37 CFR 1.19(a)(1). Orders for copies of patent application publications are handled by the USPTO's 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.

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

POWER OF ATTORNEY FOR PATENT APPLICATION

As a below named inventor, related to the invention entitled:

VEHICLE LEVELING SYSTEMS, DEVICES AND METHODS AND COMPUTER PROGRAM PRODUCTS FOR LEVELING VEHICLES USING SMART DEVICES

the specification of which is submitted to the U. S. Patent and Trademark Office on June 9, 2017, and assigned U.S. Patent Application No. 15/619,261, I hereby revoke all previous powers of attorney given in the above-identified application, if applicable. I hereby appoint Practitioner(s) associated with the following Customer Number as my/our attorney(s) or agent(s) with respect to the application identified above, and to transact all business in the United States Patent and Trademark Office connected therewith:

Customer Number: 22474

FIRM NAME: **Clements Bernard Walker PLLC**
4500 Cameron Valley Parkway, Suite 350
Charlotte, North Carolina 28211 USA

Attorney/Agent	Registration No.
Gregory N. Clements	30,713
Christopher L. Bernard	48,234
Richard A. Walker	27,415
Lawrence A. Baratta, Jr.	59,553

Attorney/Agent	Registration No.
Seth L. Hudson	48,281
Carlos M. Herrera	44,762
Jeffrey S. Bernard	50,020
Elizabeth R. Kendall	74,280

I hereby acknowledge that the above listed attorneys/agents and their firm, Clements Bernard Walker PLLC, represent my employer (if I am an employee and this application has been or will be assigned to my employer) or the entity with which I have contracted (if I am an independent contractor and this application has been or will be assigned to such entity) and, in such cases, do not represent me individually.

Please Send Correspondence to: **Customer Number: 22474**
Clements Bernard Walker PLLC
4500 Cameron Valley Parkway, Suite 350
Charlotte, North Carolina 28211 USA
patlaw@worldpatents.com

Please Direct Telephone Calls to: Seth L. Hudson
(704) 790-3600

Sole/First Inventor: Charles A. Leonard Date: 11/15/2018

Electronic Acknowledgement Receipt

EFS ID:	34360565
Application Number:	15619261
International Application Number:	
Confirmation Number:	2353
Title of Invention:	VEHICLE LEVELING SYSTEMS, DEVICES AND METHODS AND COMPUTER PROGRAM PRODUCTS FOR LEVELING VEHICLES USING SMART DEVICES
First Named Inventor/Applicant Name:	Charles A. Leonard
Customer Number:	44728
Filer:	Seth Lee Hudson/Teresa Bush-Dugar
Filer Authorized By:	Seth Lee Hudson
Attorney Docket Number:	LEO-2-CIP
Receipt Date:	20-NOV-2018
Filing Date:	09-JUN-2017
Time Stamp:	13:29:41
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	Power of Attorney	7137CIP_POA.pdf	224025 45f74d41fee3fb7c5a48878d5f4bda0c18952893	no	1

Warnings:

ETN1003

202/306

Information:	
Total Files Size (in bytes):	224025

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

New Applications Under 35 U.S.C. 111

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

National Stage of an International Application under 35 U.S.C. 371

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

New International Application Filed with the USPTO as a Receiving Office

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

UNITED STATES PATENT AND TRADEMARK OFFICE

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

APPLICATION NUMBER	FILING OR 371(C) DATE	FIRST NAMED APPLICANT	ATTY. DOCKET NO./TITLE
15/619,261	06/09/2017	Charles A. Leonard	7137CIP

CONFIRMATION NO. 2353

POA ACCEPTANCE LETTER

22474
Clements Bernard Walker PLLC
4500 Cameron Valley Parkway
Suite 350
Charlotte, NC 28211

OC000000104029955

Date Mailed: 11/27/2018

NOTICE OF ACCEPTANCE OF POWER OF ATTORNEY

This is in response to the Power of Attorney filed 11/20/2018.

The Power of Attorney in this application is accepted. Correspondence in this application will be mailed to the above address as provided by 37 CFR 1.33.

Questions about the contents of this notice and the requirements it sets forth should be directed to the Office of Data Management, Application Assistance Unit, at **(571) 272-4000** or **(571) 272-4200** or **1-888-786-0101**.

/cnguyen/

ETN1003
204/306

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.
15/619,261	06/09/2017	Charles A. Leonard	7137CIP	2353

22474 7590 12/28/2018

Clements Bernard Walker PLLC
4500 Cameron Valley Parkway
Suite 350
Charlotte, NC 28211

EXAMINER
MARTINEZ BORRERO, LUIS A

ART UNIT	PAPER NUMBER
3668	

NOTIFICATION DATE	DELIVERY MODE
12/28/2018	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):

patlaw@worldpatents.com

Office Action Summary	Application No. 15/619,261	Applicant(s) Leonard, Charles A.	
	Examiner LUIS A MARTINEZ BORRERO	Art Unit 3668	AIA Status Yes

-- 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 06/09/2017.

☐ 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) 1-18 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) 1-18 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 06/09/2017 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: _____.

DETAIL ACTION

Notice of Pre-AIA or AIA Status

The present application, filed on or after March 16, 2013, is being examined under the first inventor to file provisions of the AIA.

Notice on Prior Art Rejections

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.

Status of Claims

This Office Action is in response to the Applicant's application filed June 9, 2017. Claims **1-18** are presently pending and are presented for examination.

Nonstatutory Double Patenting

1. The nonstatutory double patenting rejection is based on a judicially created doctrine grounded in public policy (a policy reflected in the statute) so as to prevent the unjustified or improper timewise extension of the "right to exclude" granted by a patent and to prevent possible harassment by multiple assignees. A nonstatutory double patenting rejection is appropriate where the claims at issue are not identical, but at least one examined application claim is not patentably distinct from the reference claim(s) because the examined application claim is either anticipated by, or would have been obvious over, the reference claim(s). See, e.g., In re Berg,

140 F.3d 1428, 46 USPQ2d 1226 (Fed. Cir. 1998); In re Goodman, 11 F.3d 1046, 29 USPQ2d 2010 (Fed. Cir. 1993); In re Longi, 759 F.2d 887, 225 USPQ 645 (Fed. Cir. 1985); In re Van Ornum, 686 F.2d 937, 214 USPQ 761 (CCPA 1982); In re Vogel, 422 F.2d 438, 164 USPQ 619 (CCPA 1970); and In re Thorington, 418 F.2d 528, 163 USPQ 644 (CCPA 1969).

A timely filed terminal disclaimer in compliance with 37 CFR 1.321(c) or 1.321(d) may be used to overcome an actual or provisional rejection based on a nonstatutory double patenting ground provided the reference application or patent either is shown to be commonly owned with this application, or claims an invention made as a result of activities undertaken within the scope of a joint research agreement.

A terminal disclaimer must be signed in compliance with 37 CFR 1.321(b).

The USPTO internet Web site contains terminal disclaimer forms which may be used. Please visit http://www.uspto.gov/forms/. The filing date of the application will determine what form should be used. A web-based eTerminal Disclaimer may be filled out completely online using web-screens. An eTerminal Disclaimer that meets all requirements is auto-processed and approved immediately upon submission. For more information about eTerminal Disclaimers, refer to http://www.uspto.gov/patents/process/file/efs/guidance/eTD-info-I.jsp.

Claim(s) **1-18** is/are provisionally rejected on the ground of nonstatutory double patenting as being unpatentable over claim(s) **1-5, 7, 10, 12, 14-16, 18, 20, 22-29, 38, and 43-44** of copending App# 14/961,787. Although the claims at issue are not identical, they are not patentably distinct from each other because the claimed invention is the same.

This is a provisional nonstatutory double patenting rejection because the patentably indistinct claims have not in fact been patented.

CLAIM INTERPRETATION

2. The following is a quotation of 35 U.S.C. 112(f):

> (f) Element in Claim for a Combination. – An element in a claim for a combination may be expressed as a means or step for performing a specified function without the recital of structure, material, or acts in support thereof, and such claim shall be construed to cover the corresponding structure, material, or acts described in the specification and equivalents thereof.

The following is a quotation of pre-AIA 35 U.S.C. 112, sixth paragraph:

> An element in a claim for a combination may be expressed as a means or step for performing a specified function without the recital of structure, material, or acts in support thereof, and such claim shall be construed to cover the corresponding structure, material, or acts described in the specification and equivalents thereof.

The claims in this application are given their broadest reasonable interpretation using the plain meaning of the claim language in light of the specification as it would be understood by one of ordinary skill in the art. The broadest reasonable interpretation of a claim element (also commonly referred to as a claim limitation) is limited by the description in the specification when 35 U.S.C. 112(f) or pre-AIA 35 U.S.C. 112, sixth paragraph, is invoked.

As explained in MPEP § 2181, subsection I, claim limitations that meet the following three-prong test will be interpreted under 35 U.S.C. 112(f) or pre-AIA 35 U.S.C. 112, sixth paragraph:

(A) the claim limitation uses the term "means" or "step" or a term used as a substitute for "means" that is a generic placeholder (also called a nonce term or a non-structural term having no specific structural meaning) for performing the claimed function;

(B) the term "means" or "step" or the generic placeholder is modified by functional language, typically, but not always linked by the transition word "for" (e.g., "means for") or another linking word or phrase, such as "configured to" or "so that"; and

(C) the term "means" or "step" or the generic placeholder is not modified by sufficient structure, material, or acts for performing the claimed function.

Use of the word "means" (or "step") in a claim with functional language creates a rebuttable presumption that the claim limitation is to be treated in accordance with 35 U.S.C. 112(f) or pre-AIA 35 U.S.C. 112, sixth paragraph. The presumption that the claim limitation is interpreted under 35 U.S.C. 112(f) or pre-AIA 35 U.S.C. 112, sixth paragraph, is rebutted when the claim limitation recites sufficient structure, material, or acts to entirely perform the recited function.

Absence of the word "means" (or "step") in a claim creates a rebuttable presumption that the claim limitation is not to be treated in accordance with 35 U.S.C. 112(f) or pre-AIA 35 U.S.C. 112, sixth paragraph. The presumption that the claim limitation is not interpreted under 35 U.S.C. 112(f) or pre-AIA 35 U.S.C. 112, sixth paragraph, is rebutted when the claim limitation recites function without reciting sufficient structure, material or acts to entirely perform the recited function.

Claim limitations in this application that use the word "means" (or "step") are being interpreted under 35 U.S.C. 112(f) or pre-AIA 35 U.S.C. 112, sixth paragraph, except as otherwise indicated in an Office action. Conversely, claim limitations in this application that do not use the word "means" (or "step") are not being interpreted under 35 U.S.C. 112(f) or pre-AIA 35 U.S.C. 112, sixth paragraph, except as otherwise indicated in an Office action.

This application includes one or more claim limitations that do not use the word "means," but are nonetheless being interpreted under 35 U.S.C. 112(f) or pre-AIA 35 U.S.C. 112, sixth paragraph, because the claim limitation(s) uses a generic placeholder that is coupled with functional language without reciting sufficient structure to perform the recited function and the

generic placeholder is not preceded by a structural modifier. Such claim limitation(s) is/are: "a sensor device" and "smart device", in claims **1-18**.

Because this/these claim limitation(s) is/are being interpreted under 35 U.S.C. 112(f) or pre-AIA 35 U.S.C. 112, sixth paragraph, it/they is/are being interpreted to cover the corresponding structure described in the specification as performing the claimed function, and equivalents thereof.

If applicant does not intend to have this/these limitation(s) interpreted under 35 U.S.C. 112(f) or pre-AIA 35 U.S.C. 112, sixth paragraph, applicant may: (1) amend the claim limitation(s) to avoid it/them being interpreted under 35 U.S.C. 112(f) or pre-AIA 35 U.S.C. 112, sixth paragraph (e.g., by reciting sufficient structure to perform the claimed function); or (2) present a sufficient showing that the claim limitation(s) recite(s) sufficient structure to perform the claimed function so as to avoid it/them being interpreted under 35 U.S.C. 112(f) or pre-AIA 35 U.S.C. 112, sixth paragraph.

Claim Rejections - 35 USC § 112

3. The following is a quotation of 35 U.S.C. 112(b):

> (B) CONCLUSION.—The specification shall conclude with one or more claims particularly pointing out and distinctly claiming the subject matter which the inventor or a joint inventor regards as the invention.

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.

4. Claims **1, 2 and 9** are rejected under 35 U.S.C. 112(b) or 35 U.S.C. 112 (pre-AIA), second paragraph, as reciting or depending upon a claim that recites limitations for which there are no antecedent basis. In particular:

Claims 1 and 2 recite "the amount of adjustments in height needed". There is insufficient antecedent basis for this limitation in the claims.

Claim 9 recites "the pitch angle and the roll angle of the vehicle". There is insufficient antecedent basis for this limitation in the claim.

Claim Rejections - 35 USC § 102

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

A person shall be entitled to a patent unless –

> (a)(2) the claimed invention was described in a patent issued under section 151, or in an application for patent published or deemed published under section 122(b), in which the patent or application, as the case may be, names another inventor and was effectively filed before the effective filing date of the claimed invention.

6. Claims **1, and 3-18** are rejected under 35 U.S.C. 102(a) (2) as being anticipated by Thorpe et al, US 2008/0142768, hereinafter referred to as Thorpe.

In regards of claim 1, Thorpe discloses a leveling system for leveling a vehicle that is at rest, the leveling system comprising: a sensor device secured to a vehicle to sense at least one of an inclination or an orientation of the vehicle in both a pitch direction and a roll direction ***(See at least ¶ 12, via The level sensing means is configured to determine the pitch and the roll of the recreational vehicle so the user can operate the leveling mechanism to place the recreational vehicle in its level condition… the level sensing means is a dual-axis accelerometer that is configured to determine the tilt of the recreational vehicle in both the front-to-back and side-to-side directions), (¶ 0038, via Level sensing means 38 comprises one or more tilt sensors that***

are configured to detect the amount of pitch and roll of recreational vehicle), (¶ 0038, via In one configuration, level sensing means 38 comprises two separate tilt sensors, one positioned in the front/back direction for determining the pitch and one positioned in the left/right direction for determining the roll); and a smart device in communication with the sensor device to allow information received from the sensor device about at least one of the inclination or the orientation of the vehicle in both the pitch direction and the roll direction to be processed to provide measurements to a user and to determine the amount of adjustments in height needed to at least one of the pitch direction or the roll direction to level the vehicle ***(See at least ¶ 8, via The foregoing patents are representative of leveling systems that require manual, independent determination of the amount of height adjustment needed to place the vehicle in the level condition), (¶ 0038, via the output from level sensing means 38 goes to one or more analog conversion devices, such as the operation amplifiers 48a, 48b, 48c and 48d, that convert the analog signal to a linear value that is used by controller 36 to determine the pitch and roll level position relative to the common reference 50. This data is then wirelessly transmitted to control unit 14 for processing into operator- useable information. Alternatively, controller 36 or level unit 12 can process the data and transmit the final tilt adjustment data to control unit 14 for display to the operator)***.

In regards of claim 3, Thorpe discloses the system according to claim 1, wherein at least one of the sensor device or the smart device is configured to calculate the change of height of a frame of a motorized recreational vehicle proximate to each wheel of the motorized recreational vehicle when the sensor device is installed on the motorized recreational vehicle ***(¶ 8, via The foregoing patents are representative of leveling systems that require manual, independent determination***

of the amount of height adjustment needed to place the vehicle in the level condition), (¶ 0038, via the output from level sensing means 38 goes to one or more analog conversion devices, such as the operation amplifiers 48a, 48b, 48c and 48d, that convert the analog signal to a linear value that is used by controller 36 to determine the pitch and roll level position relative to the common reference 50. This data is then wirelessly transmitted to control unit 14 for processing into operator- useable information. Alternatively, controller 36 or level unit 12 can process the data and transmit the final tilt adjustment data to control unit 14 for display to the operator)

In regards of claim 4, Thorpe discloses the system according to claim 1, wherein the smart device is configured to allow an input of which side of a vehicle to which the sensor device is installed is to be a driver's side of the vehicle ***(¶ 36, via level unit 12 is placed on a flat surface inside recreational vehicle 16, such as on a cabinet shelf or on top of a counter or the like, to allow the components disposed in interior chamber 28 of level unit 12 to measure the pitch and roll tilt), (the examiner interprets a driver's side of the vehicle as an example of any flat surface in the driver's side of the vehicle).***

In regards of claim 5, Thorpe discloses the system according to claim 1, wherein sensor device comprises an On/Off switch that permits a battery of the sensor device to be disconnected from circuitry of the sensor device ***(See at least ¶ 40, via Power button 78, which connects to circuit board 34 at on/off switch 82 on FIG. 10, is used to turn on or off control unit 14).***

In regards of claim 6, Thorpe discloses the system according to claim 1, wherein the sensor

device is configured to switch between a sleep mode and an awake mode based on the sensor device detecting motion by a vehicle to which the sensor device is installed ***(See at least ¶ 40, via Mode button 80, which connects to circuit board 34 at mode switch 84 on FIG. 9, is used to switch control unit 14 between its various display and function modes), (See at least ¶ 44, via In the preferred embodiment, it is not necessary to manually activate level unit 12, as it is configured to continuously cycle on and check for a signal from control unit 14), (the examiner interprets a sleep mode and an awake mode as expressed by the specification to be where the sensor device is using a minimal amount of power and where the sensor device is prepared to perform its variety of actions).***

In regards of claim 7, Thorpe discloses the system according to claim 1, wherein the smart device and the sensor device communicate with each ether through a wireless connection and the smart device is configured to receive a serial number of the sensor device so that the smart device communicates with the particular sensor device ***(See at least ¶ 0011, via the leveling system has a level unit which determines how level the vehicle is and wirelessly transmits that information to a control unit which visually indicates to the operator the amount the recreational vehicle is out of level in degrees and the amount needed to raise a side or end of the vehicle in order to level the vehicle), (the examiner notes that pairing between devices is a known feature in the art and it would be obvious to implement this feature for communication between devices).***

In regards of claim 8, Thorpe discloses the system according to claim 1, wherein the smart device is configured to permit an input of a display resolution by a user such that the display

resolution changes in increments input by the user ***(¶ 0040, via on FIG. 9, is used to switch control unit 14 between its various display and function modes, such as showing the pitch or roll adjustments needed to obtain level condition), (¶ 0038, via controller 36 or level unit 12 can process the data and transmit the final tilt adjustment data to control unit 14 for display to the operator), (the examiner notes that resolution alteration or modification is a known feature in the art and it would be obvious to implement this feature for a display device).***

In regards of claim 9, Thorpe discloses a method for leveling a recreational vehicle, the method comprising: providing a leveling system comprising a sensor device secured to a vehicle to sense at least one of an inclination or an orientation of the vehicle in both a pitch direction and a roll direction ***(See at least ¶ 12, via The level sensing means is configured to determine the pitch and the roll of the recreational vehicle so the user can operate the leveling mechanism to place the recreational vehicle in its level condition… the level sensing means is a dual-axis accelerometer that is configured to determine the tilt of the recreational vehicle in both the front-to-back and side-to-side directions), (¶ 0038, via Level sensing means 38 comprises one or more tilt sensors that are configured to detect the amount of pitch and roll of recreational vehicle), (¶ 0038, via In one configuration, level sensing means 38 comprises two separate tilt sensors, one positioned in the front/back direction for determining the pitch and one positioned in the left/right direction for determining the roll)*** and a smart device in communication with the sensor device ***(¶ 0038, via the output from level sensing means 38 goes to one or more analog conversion devices, such as the operation amplifiers 48a, 48b, 48c and 48d, that convert the analog signal to a linear value that is used by controller 36 to determine the pitch and roll level position relative to the common reference 50. This data is then***

wirelessly transmitted to control unit 14 for processing into operator- useable information. Alternatively, controller 36 or level unit 12 can process the data and transmit the final tilt adjustment data to control unit 14 for display to the operator); measuring the pitch angle and the roll angle of the vehicle when the vehicle is at rest using the sensor device ***(¶ 0040, via, control unit 14 between its various display and function modes, such as showing the pitch or roll adjustments needed to obtain level condition)***; retrieving calibration data of pitch angle and roll angle measurements taken by the sensor device when the vehicle was at an initial level position ***(See at least ¶ 43, via To set leveling system 10 for future use, it is preferred to place the recreational vehicle 16 in its level condition 20 based on the operator's preference…This activity will set the reference position, from which the amount of out-of-level will be determined, to zero. This calibration step should be done even if the initial placement of level unit 12 indicates recreational vehicle 16 is level to ensure the surface on which level unit 12 is placed is not compensating for an incorrect level of recreational vehicle)***; calculating any needed change in height to at least one of a rear or front section or first or second side sections of the vehicle to obtain a level position of the vehicle in at least one of the pitch direction or the roll direction of the vehicle using the calibration data of pitch and roll angle measurements ***(¶ 12, via The level sensing means is configured to determine the pitch and the roll of the recreational vehicle so the user can operate the leveling mechanism to place the recreational vehicle in its level condition)***; displaying the calculated changes in height on the smart device ***(¶ 0038, via the output from level sensing means 38 goes to one or more analog conversion devices, such as the operation amplifiers 48a, 48b, 48c and 48d, that convert the analog signal to a linear value that is used by controller 36 to determine the pitch and roll level position relative to the common reference 50. This data is then wirelessly transmitted to control unit 14 for processing***

into operator- useable information. Alternatively, controller 36 or level unit 12 can process the data and transmit the final tilt adjustment data to control unit 14 for display to the operator); and adjusting the height to the at least one of the rear or front section or the first or second side sections of the vehicle to obtain the level position of the vehicle based on the calculated changes In height ***(¶ 12, via The level sensing means is configured to determine the pitch and the roll of the recreational vehicle so the user can operate the leveling mechanism to place the recreational vehicle in its level condition)***.

In regards of claim 10, Thorpe discloses the method according to claim 9, further comprising: determining the initial level position for a vehicle to determine any inconsistencies inherent in the leveling system ***(See at least ¶ 11, via The leveling system of the present invention includes a calibration procedure to allow the operator to selectively calibrate the zero or level condition), (the examiner interprets inconsistencies as an example of misreadings or miscalculations during calibration)***; and capturing pitch and roll angle measurements from the sensor device taken at the initial level position to provide the calibration data of the pitch and roll angle measurements ***(¶ 12, via The level sensing means is configured to determine the pitch and the roll of the recreational vehicle so the user can operate the leveling mechanism to place the recreational vehicle in its level condition)*** to permit consideration of any inconsistencies determined when taking measurement readings at a future time ***(¶ 19, via provides the operator with the ability to set the calibration for a zero or level condition from which future measurements will be taken to determine the amount a side and/or an end of the vehicle must be raised to place it in the preset level condition).***

In regards of claim 11, Thorpe discloses the method according to claim 9, wherein the step of calculating any needed change further comprises calculating the change of height of each wheel position of a motorized recreational vehicle when the sensor device is installed on the motorized recreational vehicle ***(¶ 8, via The foregoing patents are representative of leveling systems that require manual, independent determination of the amount of height adjustment needed to place the vehicle in the level condition), (¶ 0011, via the leveling system has a level unit which determines how level the vehicle is and wirelessly transmits that information to a control unit which visually indicates to the operator the amount the recreational vehicle is out of level in degrees and the amount needed to raise a side or end of the vehicle in order to level the vehicle), (See at least ¶ 5, via that are configured to allow the user to drive the vehicle's wheel(s) up on one or more blocks).***

In regards of claim 12, Thorpe discloses the method according to claim 9, further comprising selecting which side of a vehicle to which the sensor device is installed is to be a driver's side of the vehicle ***(¶ 36, via level unit 12 is placed on a flat surface inside recreational vehicle 16, such as on a cabinet shelf or on top of a counter or the like, to allow the components disposed in interior chamber 28 of level unit 12 to measure the pitch and roll tilt), (the examiner interprets a driver's side of the vehicle as an example of any flat surface in the driver's side of the vehicle).***

In regards of claim 13, Thorpe discloses the method according to claim 9, further comprising switching the sensor device between a sleep made and an awake mode based on the sensor

device detecting motion by a vehicle to which the sensor device is installed ***(See at least ¶ 40, via Mode button 80, which connects to circuit board 34 at mode switch 84 on FIG. 9, is used to switch control unit 14 between its various display and function modes), (See at least ¶ 44, via In the preferred embodiment, it is not necessary to manually activate level unit 12, as it is configured to continuously cycle on and check for a signal from control unit 14), (the examiner interprets a sleep mode and an awake mode as expressed by the specification to be where the sensor device is using a minimal amount of power and where the sensor device is prepared to perform its variety of actions).***

In regards of claim 14, Thorpe discloses the method according to claim 9, wherein the smart device and the sensor device communicate with each other through a wireless connect on and further comprising entering a serial number of the sensor device into the smart device so that the smart device communicates with the particular sensor device ***(See at least ¶ 0011, via the leveling system has a level unit which determines how level the vehicle is and wirelessly transmits that information to a control unit which visually indicates to the operator the amount the recreational vehicle is out of level in degrees and the amount needed to raise a side or end of the vehicle in order to level the vehicle), (the examiner notes that pairing between devices is a known feature in the art and it would be obvious to implement this feature for communication between devices).***

In regards of claim 15, Thorpe discloses the method according to claim 9, further comprising inputting a display resolution such that the display resolution changes in specified increments ***(¶ 0040, via on FIG. 9, is used to switch control unit 14 between its various display and function***

modes, such as showing the pitch or roll adjustments needed to obtain level condition), (¶ 0038, via controller 36 or level unit 12 can process the data and transmit the final tilt adjustment data to control unit 14 for display to the operator), (the examiner notes that resolution alteration or modification is a known feature in the art and it would be obvious to implement this feature for a display device).

In regards of claim 16, Thorpe discloses a non-transitory computer readable medium comprising computer executable instructions embodied in a computer readable medium that when executed by a processor of a computer control the computer to perform steps comprising: receiving on a smart device a pitch angle measurement and a roll angle measurement of a vehicle when the vehicle is at rest from a sensor device ***(See at least ¶ 12, via The level sensing means is configured to determine the pitch and the roll of the recreational vehicle so the user can operate the leveling mechanism to place the recreational vehicle in its level condition… the level sensing means is a dual-axis accelerometer that is configured to determine the tilt of the recreational vehicle in both the front-to-back and side-to-side directions), (¶ 0038, via Level sensing means 38 comprises one or more tilt sensors that are configured to detect the amount of pitch and roll of recreational vehicle), (¶ 0038, via In one configuration, level sensing means 38 comprises two separate tilt sensors, one positioned in the front/back direction for determining the pitch and one positioned in the left/right direction for determining the roll)***; retrieving calibration data of pitch angle and roll angle measurements taken by the sensor device when the vehicle was at an initial level position ***(See at least ¶ 43, via To set leveling system 10 for future use, it is preferred to place the recreational vehicle 16 in its level condition 20 based on the operator's preference…This activity will set the reference position, from which the***

amount of out-of-level will be determined, to zero. This calibration step should be done even if the initial placement of level unit 12 indicates recreational vehicle 16 is level to ensure the surface on which level unit 12 is placed is not compensating for an incorrect level of recreational vehicle); calculating any needed change in height to at least one of a rear or front section or first or second side sections of the vehicle to obtain a level position of the vehicle in at least one of a pitch direction or a roll direction of the vehicle using the calibration data of the pitch and roll angle measurements to obtain a level position of the vehicle ***(¶ 12, via The level sensing means is configured to determine the pitch and the roll of the recreational vehicle so the user can operate the leveling mechanism to place the recreational vehicle in its level condition)***; and displaying the calculated changes in height needed to obtain the level position of the vehicle on the smart device ***(¶ 0038, via the output from level sensing means 38 goes to one or more analog conversion devices, such as the operation amplifiers 48a, 48b, 48c and 48d, that convert the analog signal to a linear value that is used by controller 36 to determine the pitch and roll level position relative to the common reference 50. This data is then wirelessly transmitted to control unit 14 for processing into operator- useable information. Alternatively, controller 36 or level unit 12 can process the data and transmit the final tilt adjustment data to control unit 14 for display to the operator)***.

In regards of claim 17, Thorpe discloses the non-transitory computer readable medium according to claim 16, further comprising calculating a change of height of each wheel position of a motorized recreational vehicle when the sensor device is installed on the motorized recreational vehicle ***(¶ 8, via The foregoing patents are representative of leveling systems that require manual, independent determination of the amount of height adjustment needed to***

place the vehicle in the level condition), (¶ 0011, via the leveling system has a level unit which determines how level the vehicle is and wirelessly transmits that information to a control unit which visually indicates to the operator the amount the recreational vehicle is out of level in degrees and the amount needed to raise a side or end of the vehicle in order to level the vehicle), (See at least ¶ 5, via that are configured to allow the user to drive the vehicle's wheel(s) up on one or more blocks).

In regards of claim 18, Thorpe discloses the non-transitory computer readable medium according to claim 17, wherein the step of displaying the calculated changes in height comprises displaying the change of height of each wheel position of the motorized recreational vehicle on the smart device ***(¶ 0012, via The control unit also has a display panel for displaying the pitch and roll information received from the level unit and one or more operator accessible control buttons for activating and operating the leveling system.), (See at least ¶ 5, via that are configured to allow the user to drive the vehicle's wheel(s) up on one or more blocks).***

Claim Rejections - 35 USC § 103

7. 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.

8. Claim **2 is** rejected under 35 U.S.C 103 as being unpatentable over Thorpe et al, as presented in independent claim 1 above, in view of Hulsing et al. US 4,935,883, hereinafter referred to as Hulsing, respectively.

In regards of claim 2, Thorpe discloses the system according to claim 1, wherein the sensor device comprises a printed circuit board that comprises at least one of a digital accelerometer or a digital gyroscope ***(¶ 38, via level sensing means 38 is a dual-axis accelerometer, such as the model number LIS2L02AS4 low-power two-axis linear accelerometer available from ST Microelectronics, that is configured to detect tilting in both the front/back and left/right directions so as to determine the attitude of recreational vehicle 16 relative to a calibrated reference position (i.e., the level condition 20). The level sensing means 38 includes an integrated circuit interface that takes the information from the sensing element of sensing means 28 to deliver an analog signal for conversion and then use by control unit 14)***, and the printed circuit board comprises a processor to process data collected by the sensor device and to perform calculations related to the determination of the amount of adjustments in height needed to at least one of the pitch direction or the roll direction to level the vehicle ***(¶ 0038, via Level sensing means 38 comprises one or more tilt sensors that are configured to detect the amount of pitch and roll of recreational vehicle), (¶ 0038, via In one configuration, level sensing means 38 comprises two separate tilt sensors, one positioned in the front/back direction for determining the pitch and one positioned in the left/right direction for determining the roll).*** Thorpe fails to explicitly disclose of a digital accelerometer or a digital gyroscope that have been temperature calibrated.

However, Hulsing teaches a digital accelerometer or a digital gyroscope that have been temperature calibrated ***(See at least Column 9, lines 35-45, via The output from temperature sensors 174 is converted from an analog signal to a digital signal by an A to D converter (not separately shown), and transmitted to CPU 142 over leads 175. The temperature within the enclosure is controlled by temperature control 176 in response to the signals produced by temperature sensors 174 and transmitted over leads 173. CPU 142 applies appropriate temperature correction factors in modeling the acceleration data derived from accelerometer 68, correcting for errors in the control of temperature by temperature control 176), (Column 9, lines 49-51, via In addition, a more critical temperature control is provided for accelerometer 68, which is preferably maintained at 100° ±0. l C).***

Therefore, it would have been obvious to one of ordinary skill in the art before the effective filing date of the claimed invention to modify a printed circuit board that comprises at least one of a digital accelerometer or a digital gyroscope of Thorpe and include a digital accelerometer or a digital gyroscope that have been temperature calibrated as taught by Hulsing because it would allow the method to provide temperature control for the accelerometer to ensure correction of errors from due to temperature changes.

Conclusion

Any inquiry concerning this communication or earlier communications from the examiner should be directed to LUIS A MARTINEZ BORRERO whose email is luis.martinezborrero@uspto.gov and telephone number is (571)272-4577. The examiner can normally be reached on M-F 8:00-5:00. If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, FADEY JABR can be reached on 5712721516. 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.

/L.A.M/

Examiner, Art Unit 3668

/COURTNEY D HEINLE/
Primary Examiner, Art Unit 3668

Notice of References Cited	Application/Control No. 15/619,261	Applicant(s)/Patent Under Reexamination Leonard, Charles A.	
	Examiner LUIS A MARTINEZ BORRERO	Art Unit 3668	Page 1 of 2

U.S. PATENT DOCUMENTS

*		Document Number Country Code-Number-Kind Code	Date MM-YYYY	Name	CPC Classification	US Classification
*	A	US-9421907-B2	08-2016	Carpani; Anthony	G01C9/00	1/1
*	B	US-20080142768-A1	06-2008	Thorpe; Jim	B60S9/12	254/423
*	C	US-20070180719-A1	08-2007	Donnelly; Edward J.	B60S9/02	33/366.11
*	D	US-7786883-B1	08-2010	Davison, III; George M.	B60P3/36	33/366.11
*	E	US-7743520-B1	06-2010	Jiorle; Michael A.	G01C9/28	33/366.11
*	F	US-7025361-B1	04-2006	Erickson; John Scott	B60S9/02	280/6.153
*	G	US-6037874-A	03-2000	Heironimus; Gregory	G01C9/06	33/366.16
*	H	US-4760649-A	08-1988	Preston; Corlis E.	B60R16/0233	33/333
*	I	US-3657695-A	04-1972	Birmingham; Robert C.	B60D1/36	280/400
*	J	US-4547972-A	10-1985	Heidel; Jeffrey C.	G01C9/06	33/299
*	K	US-20160161944-A1	06-2016	Leonard; Charles A.	G05D1/0016	701/2
*	L	US-4935883-A	06-1990	Hulsing II; Rand H.	G01V7/00	175/45
*	M	US-20120197587-A1	08-2012	Luk; Yiu Wah	B60W40/09	702/141

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.

Notice of References Cited	Application/Control No. 15/619,261	Applicant(s)/Patent Under Reexamination Leonard, Charles A.	
	Examiner LUIS A MARTINEZ BORRERO	Art Unit 3668	Page 2 of 2

U.S. PATENT DOCUMENTS

*		Document Number Country Code-Number-Kind Code	Date MM-YYYY	Name	CPC Classification	US Classification
*	A	US-20120208520-A1	08-2012	Howarter; Jamie C.	B60R25/2009	455/420
	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.

Index of Claims	Application/Control No.	Applicant(s)/Patent Under Reexamination
	15/619,261	Leonard, Charles A.
	Examiner	**Art Unit**
	LUIS A MARTINEZ BORRERO	3668

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

CLAIMS

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

CLAIM		DATE								
Final	Original	12/07/2018								
	1	✓								
	2	✓								
	3	✓								
	4	✓								
	5	✓								
	6	✓								
	7	✓								
	8	✓								
	9	✓								
	10	✓								
	11	✓								
	12	✓								
	13	✓								
	14	✓								
	15	✓								
	16	✓								
	17	✓								
	18	✓								

Search Notes	Application/Control No.	Applicant(s)/Patent Under Reexamination
	15/619,261	Leonard, Charles A.
	Examiner	Art Unit
	LUIS A MARTINEZ BORRERO	3668

CPC - Searched*		
Symbol	Date	Examiner
G05D1/08, 1/0891, 1/0221, 1/0088, 1/0016,	12/07/2018	LAM
B60T17/22, 8/171, 2201/04, 7/22, 8/32,	12/07/2018	LAM

CPC Combination Sets - Searched*		
Symbol	Date	Examiner

US Classification - Searched*			
Class	Subclass	Date	Examiner

* 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
East Search	12/07/2018	LAM
Google Patent Search	12/07/2018	LAM

Interference Search			
US Class/CPC Symbol	US Subclass/CPC Group	Date	Examiner

	/L.A.M/ Examiner, Art Unit 3668

ETN1003
230/306

UNITED STATES PATENT AND TRADEMARK OFFICE

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

BIB DATA SHEET

CONFIRMATION NO. 2353

SERIAL NUMBER	FILING or 371(c) DATE	CLASS	GROUP ART UNIT	ATTORNEY DOCKET NO.
15/619,261	06/09/2017 RULE	701	3668	7137CIP

APPLICANTS

INVENTORS

Charles A. Leonard, Hickory, NC;

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

This application is a CIP of 14/961,787 12/07/2015
which claims benefit of 62/088,115 12/05/2014
and claims benefit of 62/101,109 01/08/2015

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

**** IF REQUIRED, FOREIGN FILING LICENSE GRANTED **** ** SMALL ENTITY **
06/22/2017

			STATE OR COUNTRY	SHEETS DRAWINGS	TOTAL CLAIMS	INDEPENDENT CLAIMS
Foreign Priority claimed ❑ Yes ☑ No 35 USC 119(a-d) conditions met ❑ Yes ☑ No Verified and Acknowledged /LUIS A MARTINEZ BORRERO/ Examiner's Signature		❑ Met after Allowance Initials	NC	15	18	3

ADDRESS

Clements Bernard Walker PLLC
4500 Cameron Valley Parkway
Suite 350
Charlotte, NC 28211
UNITED STATES

TITLE

VEHICLE LEVELING SYSTEMS, DEVICES AND METHODS AND COMPUTER PROGRAM PRODUCTS FOR LEVELING VEHICLES USING SMART DEVICES

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

EAST Search History

EAST Search History (Prior Art)

Ref #	Hits	Search Query	DBs	Default Operator	Plurals	Time Stamp
L1	1584	((vehicle or car or automobile) near4(level$4)) and ((sens$4 or detect$3)near5 (inclinat$4))	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2018/12/06 22:52
L2	486	1 AND ((G05D1/0088 OR G05D2201/0213 OR G05D1/0061 OR G05D1/0223 OR G05D1/0257 OR G05D1/0016 OR G05D1/0891 OR G05D1/0011 OR G05D1/0055 OR G05D1/0094 OR G05D1/02 OR G05D1/0214 OR G05D1/0221 OR G05D1/0274 OR G05D1/0278 OR G05D1/12 OR G05D2201/0201 OR G05D2201/0208 OR G05D2201/0215 OR B60T2201/04 OR B60T7/12 OR B60T8/171 OR B60T13/662 OR B60T17/22 OR B60T2201/022 OR B60T2201/06 OR B60T2260/06 OR B60T7/122 OR B60T7/22 OR B60T8/245 OR B60T1/062 OR B60T2210/36 OR B60T2220/04 OR B60T7/042 OR B60T8/32 OR B60T8/3205 OR B60T13/74 OR B60T13/741 OR B60T1/005 OR B60T2201/09 OR B60T2201/10 OR B60T2210/14 OR B60T2210/16 OR B60T2230/03 OR B60T2230/04 OR B60T2270/89 OR B60T7/085 OR B60T7/20 OR B60T8/17 OR B60T8/1706 OR B60T8/172 OR B60T8/175 OR B60T8/17552 OR B60T8/17616 OR B60T8/3215 OR B60T8/4827 OR B60T8/52).CPC. OR (1/1 OR 348/148 OR 600/479 OR 701/41).CCLS. OR (G05D1/00 OR G05D1/02 OR G05D1/08 OR G05D1/12 OR B60T8/32 OR B60T7/12 OR B60T8/24 OR B60T13/66 OR B60T8/171 OR B60T13/74 OR B60T17/22 OR B60T1/00 OR B60T7/20 OR B60T8/172 OR B60T8/175 OR B60T8/1755 OR B60T8/1761 OR B60T8/48).IPCR.)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2018/12/06 22:53
L3	94	2 and inclinat$3 and sensor and pitch and roll	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2018/12/06 22:54
L4	4	((vehicle or car or automobile) near4(level$4)) with ((sens$4 or detect$3)near5 (inclinat$4)) with	US-PGPUB; USPAT; USOCR;	OR	OFF	2018/12/06 22:55

		(accelerometer or gyroscope)	FPRS; EPO; JPO; DERWENT; IBM_TDB			
L5	11	("20070180719" | "20080142768" | "3657695" | "4547972" | "4760649" | "6037874" | "6397133" | "7025361" | "7743520" | "7786883" | "8083015").PN. OR ("9421907").URPN.	US-PGPUB; USPAT; USOCR	OR	OFF	2018/12/06 22:56
L6	22	("3739364" | "4085375").PN. OR ("4547972").URPN.	US-PGPUB; USPAT; USOCR	OR	OFF	2018/12/06 22:59
L7	17	("3861052" | "3916531" | "4182046" | "4492029" | "4584778" | "4658508").PN. OR ("4760649").URPN.	US-PGPUB; USPAT; USOCR	OR	OFF	2018/12/06 22:59
L8	43	("4912662" | "5083383" | "5168632" | "5259118" | "5313713" | "5410532" | "5479715" | "5488779" | "5680208" | "5689330").PN. OR ("6037874").URPN.	US-PGPUB; USPAT; USOCR	OR	OFF	2018/12/06 22:59
L9	14	("5176391" | "5890721" | "5915700" | "6176495" | "6351696" | "6584385").PN. OR ("7025361").URPN.	US-PGPUB; USPAT; USOCR	OR	OFF	2018/12/06 22:59
L10	25	("20060064888" | "3233235" | "3324564" | "3657551" | "4154000" | "4467527" | "4625423" | "4658508" | "5136784" | "5784794" | "6526668" | "6836972" | "6981333").PN. OR ("7743520").URPN.	US-PGPUB; USPAT; USOCR	OR	OFF	2018/12/06 23:00
L11	33	("20060100979" | "20070180719" | "20070245579" | "20080142768" | "2155876" | "3181203" | "3258884" | "3260564" | "3417518" | "3866365" | "4232488" | "4568096" | "4572527" | "4743037" | "4746133" | "4784400" | "5078442" | "5136784" | "5159989" | "5176391" | "5188379" | "5676385" | "5806196" | "6176495" | "6526668" | "7025361").PN. OR ("7786883").URPN.	US-PGPUB; USPAT; USOCR	OR	OFF	2018/12/06 23:00
L12	0	((vehicle or car or automobile) near4(level$4)) with ((sens$4 or detect$3)near5 (inclinat$4)) with (accelerometer or gyroscope) with ((smart adj device) or d evice or phone or cell or cellphone)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2018/12/06 23:02
L13	33690	((vehicle or car or automobile) near4 (level$4)) and ((smart adj device) or phone or cell or cellphone or mobile)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2018/12/06 23:05
L14	10900	13 AND ((G05D1/0088 OR G05D1/0891).CPC. OR (1/1).CCLS. OR (G05D1/02 OR G05D1/00 OR G05D1/08).IPCR.)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2018/12/06 23:06
L15	799	14 and sensor and pitch and roll	US-PGPUB; USPAT;	OR	OFF	2018/12/06 23:07

			USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB			
L16	457	15 and ((sens$3 or determin$3 or detect$3) near5 (inclination or orientation))	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2018/12/06 23:08
L17	149	16 and accelerometer and gyroscope	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2018/12/06 23:09
L18	47	17 and ((adjust$3) near5 (level$3 or inclination or tilt))	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2018/12/06 23:10
L19	2615	(pitch near3 roll) with level$3	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2018/12/06 23:12
L20	349	19 and (axis near3 accelerometer)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2018/12/06 23:12
L21	204	20 and ((adjust$3 or alter$3 or chang$3 or modif$4) near3 (level$3 or orientation or inclination))	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2018/12/06 23:13
L22	18	((pitch near3 roll) near6 (axis near3 accelerometer)) with (vehicle car or automobile)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2018/12/06 23:14
L23	0	(tri-axial) with accelerometer with 1evel$3	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2018/12/06 23:16

L24	52	(tri-axial) with accelerometer with level$3	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2018/12/06 23:17
L25	124	(tri-axial) with accelerometer with (temperature adj sensor)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2018/12/06 23:18
L26	57	((tri-axial) near3 accelerometer) near6(temperature adj sensor)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2018/12/06 23:18
L27	14	"4935883"	USPAT	OR	OFF	2018/12/06 23:21
L28	1	"20120197587"	US-PGPUB	OR	OFF	2018/12/06 23:22
L29	1	"20120208520"	US-PGPUB	OR	OFF	2018/12/06 23:23
L30	410	((("LEONARD") near3 ("Charles"))).INV.	US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT	OR	OFF	2018/12/06 23:26

EAST Search History (Interference)

< This search history is empty>

12/6/2018 11:26:44 PM
C:\Users\lmartinezborrero\Documents\EAST\Workspaces\15619261.wsp

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 15/619,261	Filing Date 06/09/2017	☐ 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)		(Column 2)	(Column 3)			
AMENDMENT	03/19/2019	CLAIMS REMAINING AFTER AMENDMENT		HIGHEST NUMBER PREVIOUSLY PAID FOR	PRESENT EXTRA		RATE ($)	ADDITIONAL FEE ($)
	Total (37 CFR 1.16(i))	* 14	Minus	** 20	= 0		x $50 =	0
	Independent (37 CFR 1.16(h))	* 3	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".	/SHARAIN E MORELAND/
*** 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.

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Inventor(s)	Charles A. Leonard
Application No.	15/619,261
Filing Date	June 9, 2017
Title	VEHICLE LEVELING SYSTEMS, DEVICES AND METHODS AND COMPUTER PROGRAM PRODUCTS FOR LEVELING VEHICLES USING SMART DEVICES
Examiner	MARTINEZ BORRERO, LUIS A
Art Unit	3668
Confirmation No.	2353

Commissioner for Patents
Via EFS-Web

AMENDMENT AND RESPONSE TO NON-FINAL OFFICE ACTION

In response to the Non-Office Action dated December 28, 2018, rejecting claims 1-18 of the above-referenced Application, in which claims 1-18 are pending, Applicant respectfully requests that the following amendments be entered and remarks be considered, without prejudice or disclaimer to continued examination on the merits. In view of these amendments and remarks, Applicant submits that the Application is now in condition for allowance and respectfully requests such action.

AMENDMENTS TO THE CLAIMS begin on page 2; and

APPLICANT ARGUMENTS/REMARKS MADE begin on page 8.

ETN1003
237/306

Electronic Acknowledgement Receipt

EFS ID:	35469326
Application Number:	15619261
International Application Number:	
Confirmation Number:	2353
Title of Invention:	VEHICLE LEVELING SYSTEMS, DEVICES AND METHODS AND COMPUTER PROGRAM PRODUCTS FOR LEVELING VEHICLES USING SMART DEVICES
First Named Inventor/Applicant Name:	Charles A. Leonard
Customer Number:	22474
Filer:	Seth Lee Hudson/Teresa Bush-Dugar
Filer Authorized By:	Seth Lee Hudson
Attorney Docket Number:	7137CIP
Receipt Date:	19-MAR-2019
Filing Date:	09-JUN-2017
Time Stamp:	16:28:51
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		7137CIP_NonFinal_OA_Response.pdf	1216012 c0b64a9dfec997409fe3e72447fd76e8b7dc107c	yes	14

	Multipart Description/PDF files in .zip description		
	Document Description	**Start**	**End**
	Applicant Arguments/Remarks Made in an Amendment	8	14
	Claims	2	7
	Amendment/Req. Reconsideration-After Non-Final Reject	1	1
Warnings:			
Information:			
	Total Files Size (in bytes):	1216012	

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.

REMARKS

This Amendment and Response is being submitted in response to the Non-Final Office Action dated December 28, 2018. It is respectfully submitted that the cited references, either singularly or in combination, fail to anticipate or render obvious the claimed invention.

In response, Claims 1, 9, and 16 are amended to further clarify the subject matter which Applicant regards as the present invention, without prejudice or disclaimer to continue examination on the merits. These amendments are fully supported in the Specification, Drawings, and Claims of the Application and no new matter has been added. Based upon the amendments and the remarks presented herein, reconsideration of the Application is respectfully requested.

Claims 1, 2, and 9 are rejected under 35 U.S.C. 112(b), second paragraph. In response, Applicant has amended claims 1 and 9 to overcome the rejection. Claim 2 has been cancelled. Claims 1 and 3-18 are rejected under 35 U.S.C. 102(a)(2) as being anticipated by Thorpe et al. (U.S. Patent Publication No. 2008/0142768). Claim 2 is rejected under 35 U.S.C. 103 as being unpatentable over Thorpe et al. (U.S. Patent Publication No. 2008/0142768) in view of Hulsing (U.S. Patent No. 4,935,883).

Thorpe et al. discloses a leveling system for use with recreational vehicles having one or more leveling mechanisms to level the vehicle in the side-to-side and front-to-back directions. The invention comprises a level unit that is placed on a generally horizontal surface inside the vehicle and a control unit which is in a spaced apart relation to the level unit. Both units have a controller and transceiver for wireless communication with the other unit and one or more batteries as the power supply. The level unit has one or more level sensing mechanisms to determine the pitch and roll of the vehicle. Preferably, a single dual-axis tilt measuring mechanism is utilized. The control unit has one or more control buttons to allow the operator to activate and operate the system and a display panel that displays the amount of pitch and roll correction necessary to place the recreational vehicle in its level condition.

Hulsing discloses an apparatus and method for establishing a level plane and with respect to the level plane, vertically aligning an acceleration sensitive axis of a gravity measurement

device. The gravity measurement device includes an accelerometer, which is rotatably mounted on a gimbal shaft within a gimbal frame. The gimbal frame is also rotatable about a longitudinal axis that is preferably oriented at a right angle to the longitudinal axis of the gimbal shaft. A stepping motor is connected through an antibacklash gear, an idler gear and an antibacklash gear to a drive shaft. Rotation of this drive shaft causes the accelerometer to rotate about the gimbal shaft. In a similar fashion, a stepping motor is drivingly connected to a drive shaft, used to rotate the gimbal frame. A control selectively energizes the stepping motors, so that the acceleration sensitive axis of the accelerometer is rotated until an output signal from the accelerometer indicates that the acceleration of gravity is zero and thus that the sensitive axis is level at two cross axis positions, thereby determining a level reference plane. The control then causes the accelerometer to be rotated 90° relative to the reference plane, so that the acceleration sensitive axis is vertically aligned, thereby enabling the accelerometer to measure the local acceleration of gravity with minimal error due to vertical alignment.

Independent claim 1, as amended, recites (with emphasis added):

1. A leveling system for leveling a vehicle that is at rest, the leveling system comprising:

a sensor device secured to a vehicle to sense at least one of an inclination or an orientation of the vehicle in both a pitch direction and a roll direction, each of the one or more sensor devices comprising a printed circuit board that comprises

a digital accelerometer that uses an X-axis, Y-axis, and a Z-axis that permits calculation in both the pitch or roll direction regardless of positioning of the respective one or more sensor devices relative to the vehicle to which the one or more sensor devices are secured,

a processor to process data collected by the respective sensor device, and

a digital temperature sensor that collects and transmits temperature data of the ambient air where the vehicle is at rest to the processor, wherein the processor compares the transmitted temperature data with data stored in a temperature correction table having temperature correction data for environmental air temperatures ranging from about −60 °C to about 90 °C to determine how to correct deviations within the collected data; and

a smart device in communication with the sensor device to allow information received from the sensor device about at least one of the inclination or the orientation of the vehicle in both the pitch direction and the roll direction to be processed to provide measurements to a user and to determine an amount of adjustments in height needed to adjust wheels of the vehicle, **when the vehicle has two or more wheels, the smart device configured to determine an initial level position based upon the position of a single wheel of the vehicle to provide a calibration data of the pitch and roll angle measurements for determining the amount the remaining wheels of the vehicle need to be raised or lowered to reach a level position.**

Independent claims 9 and 14 have similarly been amended to include a digital temperature sensor and a smart device configured to determine the initial level position based upon a single wheel and providing calibration data and adjusting the height of the remaining wheels. The cited references do not teach or suggest, either alone or in combination, a digital temperature sensor that collects and transmits temperature data to a processor, wherein the processor compares the transmitted temperature data with data stored in a temperature correction table to determine how to correct deviations within data collected from a digital accelerometer. Further, the cited

references fail to teach the smart device configured to determine an initial level position based upon the position of a single wheel of the vehicle to provide a calibration data of the pitch and roll angle measurements for determining the amount the remaining wheels of the vehicle need to be raised or lowered to reach a level position.

First, the rejections should be withdrawn because Thorpe and Hulsing fail to disclose or suggest at least "a digital temperature sensor that collects and transmits temperature data to the processor, wherein the processor compares the transmitted temperature data with data stored in a temperature correction table to determine how to correct deviations within the collected data", as recited in independent claims, as amended.

The Office Action points to Hulsing to cure the deficiencies of Thorpe. However, Hulsing teaches leveling a precision gravity measurement device for use in boreholes when surveying oil or gas wells.[1] Specifically, Hulsing teaches using stepper motors in a two-gimbal system to rotate

---

[1] *See Hulsing*, Background ("The earth's gravitational field varies, depending upon the position at which it is measured, the density of adjacent mass, the altitude or depth of the measurement and the proximity of natural topographical features and man-made artifacts of substantial mass, such as mountains and large buildings. Variations in gravitational field have been measured with precision over a substantial portion of the earth's surface, and maps have been prepared relating gravitational field intensity to position. While these maps are of scientific interest, they also have military applications. Using these maps, for example, a submerged submarine can navigate while on covert missions by monitoring gravity profiles along the ocean floor.

Accurate gravity measurement is also important to the petroleum industry. Precision gravity surveys of depleted oil or gas wells are sometimes made, in which variations in local gravity are monitored in the microgal or nano-g range, to develop data profiling variations in the density of the strata surrounding the well or borehole that may provide an indication of untapped pockets of gas or oil. Gravity measurements at this level of resolution require use of a very high precision gravity sensor, and great care must be taken during the measurements to achieve usable results. For example, the gravity sensor must be oriented so that its sensitive axis is vertically aligned. Deviation from vertical alignment by an angle θ produces an error equal to the value of the gravitational acceleration, g, multiplied by cos θ. Thus, a deviation from vertical, by an angle θ equal to 50 microradians contributes one nano-g (or about one microgal) error.

A conventional gravity measurement device of the type used in gravimetric logging of boreholes, typically includes a sensor fixed to a frame, that is mounted in a two-axis gimbal, so that a reference plane in the frame may be precisely leveled. The sensor is fixed at a precise angle of 90° relative to the reference plane, enabling its sensitive axis to be vertically aligned by leveling the reference plane. Clearly, the angular relationship between the reference plane and the sensitive axis must be correct to avoid alignment errors. Both the lack of precision in properly leveling the reference plane and the difficulty in maintaining the precise 90° angle between the sensitive axis of the gravity measurement device and the reference plane have significantly hindered the speed, resolution, and accuracy of prior art gravity measurement devices. In addition, the two-axis gimbal of such prior art devices has been limited to rotation about each axis through an angle of only about ±12°. The limited angle of gimbal travel has made gravity measurement impossible for use in surveying boreholes having an inclination angle in excess of 12°.

Another approach for determining vertical alignment for gravity measurement uses a wheel rotating about a level axis. A plurality of accelerometers are mounted around the periphery of the wheel and are operative to produce an output signal that periodically cycles through a +1 g, 0 g, -1 g, and 0 g indication as the wheel rotates. The advantage of this approach over the two-axis gimbal device is that data produced by the rotating accelerometers may be processed

an accelerometer a predetermined amount of steps that equal 90° from an initial minimum or maximum measurement of the acceleration of gravity. The gravimetric survey equipment of Hulsing requires that heaters within the two-gimbal system to keep the system at a predetermined temperature, 98°±2°C, or even 100°±0.1°C for more accurate accelerometers.[2] The system of Hulsing uses temperature sensors to control the operation of the heaters, and the data based on the signal from the accelerometer is then corrected for the predetermined temperature at which the system is kept. The system in Hulsing is unlike the claimed system in that the claimed system does not use a temperature feedback loop to control the temperature surrounding the accelerometer. Rather, the claimed system simply uses the measured temperature to cross reference a table lookup for dynamically applying a correction factor to adjust the data collected from the digital

---

to determine and cancel bias errors in the output signal. However, it is still necessary to level the axis of rotation of the wheel, so that the plane of the wheel is vertical. Furthermore, the signals output by the accelerometers must be transmitted to a processor through slip rings or other moving electrical connections, likely to introduce noise. Processing the signal output from a rotating accelerometer is also more difficult and potentially a source of error; the result is in part dependent on accurately timing the rotation of the wheel.

The limitations and problems associated with prior art gravity measurement devices described above, particularly with respect to accurately leveling the devices so that the sensitive axis of the gravity sensor is vertically aligned, have greatly inhibited widespread use of precision gravity surveys, particularly with respect to gravimetric borehole logging surveys. The present invention provides a simple, very accurate solution to this problem, which promises to greatly improve the accuracy and speed with which such measurements may be made. These and other advantages of the present invention will be apparent from the attached drawings and the Description of the Preferred Embodiment that follows.").

[2] *See Hulsing*, col. 9, ll. 6–51 ("The signal indicative of acceleration, which is output from accelerometer 68, is conveyed via leads 170 to a digital counter 168. A 400 Hz timer 164 generates a read interrupt signal for the digital counter which is input thereto over leads 166. Digital counter 168 determines the frequency of the output signal, including fractional cycles of the signal (by comparison to the number of cycles of an internal high frequency clock). Data representing the frequency of the signal output from accelerometer 68 and thus the acceleration it is measuring are provided CPU 142 over data lines 150.

Stepping motors 20 and 22 are controlled by CPU 142 in accordance with digital data input to stepping motor drivers 172 over data lines 150. The sequential steps described above for determining level and for aligning the acceleration sensitive axis of accelerometer 68 vertically to measure the acceleration of gravity are carried out by CPU 142, as provided in a software digital program stored within ROM 144. Stepping motor drivers 172 take their commands from the CPU and drive stepping motors 20 and 22 through the required number of steps determined by the CPU, accordingly. CPU 142 ensures that stepping motors 20 and 22 are energized as required.

To achieve maximum precision in measurement of the acceleration of gravity, gravity measurement device 10 includes an internal temperature control circuit, including a plurality of temperature sensors 174, which are disposed at spaced apart positions within tubular enclosure 12. The output from temperature sensors 174 is converted from an analog signal to a digital signal by an A to D converter (not separately shown), and transmitted to CPU 142 over leads 175. The temperature within the enclosure is controlled by temperature control 176 in response to the signals produced by temperature sensors 174 and transmitted over leads 173. CPU 142 applies appropriate temperature correction factors in modeling the acceleration data derived from accelerometer 68, correcting for errors in the control of temperature by temperature control 176.

In the preferred embodiment, temperature control 176 attempts to maintain the temperature within tubular enclosure 12 at approximately 98° ±2° C. by energizing heaters 180 as required. In addition, a more critical temperature control is provided for accelerometer 68, which is preferably maintained at 100° ±0.1° C.").

accelerometer, no matter what the temperature of the ambient air happens to be in the environment in which the vehicle is at rest. Therefore, it would not be obvious to adapt the statically attached two-axis leveling system of Thorpe et al. with the freely rotating accelerometer gravity measurement device of Hulsing.

Second, neither Thorpe nor Hulsing teach a smart device configured to determine an initial level position based upon the position of a single wheel of the vehicle to provide a calibration data of the pitch and roll angle measurements for determining the amount the remaining wheels of the vehicle need to be raised or lowered to reach a level position.

Accordingly, Thorpe et al. and Hulsing do not teach or suggest, either alone or in combination, the subject matter recited in the independent claims. The dependent claims are allowable based on their direct or indirect dependency from an allowable independent claim.[3]

Therefore, because the teachings of Hulsing do not cure the deficiencies of Thorpe et al. Applicant's claims are patentable over the teachings of Thorpe et al. and Hulsing, alone or in combination. For at least these reasons, Applicant respectfully requests reconsideration of the present Application in light of the foregoing amendments and following remarks.

Applicant will submit a terminal disclaimer once an indication the claims have been allowed.

AUTHORIZATION FOR E-MAIL COMMUNICATION - MPEP § 502.03

Recognizing that Internet communications are not secure, we hereby authorize the USPTO to communicate with any authorized representative concerning any subject matter of this Application by electronic mail. We understand that a copy of these communications will be made of record in the Application file.

[3] MPEP § 2143.03.

CONCLUSION

Applicant would like to thank the Examiner for the attention and consideration accorded the present Application. It is submitted that the Application is in good and proper form for allowance. A favorable action on the part of the Examiner is respectfully solicited. The Examiner is encouraged to call the undersigned at (704) 790-3600 for any questions or if it appears that an interview would be helpful in advancing the case. Should the Examiner determine that any further action is necessary to place the Application in condition for allowance, the Examiner is encouraged to contact the undersigned at the telephone number, facsimile number, address, or email address provided below. It is not believed that any fees for additional claims, extensions of time, or the like are required beyond those that may otherwise be indicated in the documents accompanying this paper. However, if such additional fees are required, the Examiner is encouraged to notify the undersigned at the Examiner's earliest convenience.

Respectfully submitted,

Date: March 19, 2019

/Seth L. Hudson/
Seth L. Hudson
Registration No.: 48,281

Attorney for Applicant

CLEMENTS BERNARD WALKER
4500 Cameron Valley Parkway, Suite 350
Charlotte, North Carolina 28211 USA
Telephone: 704.366.6642
Facsimile: 704.366.9744
shudson@worldpatents.com

CLAIMS

Please amend the claims as follows, without prejudice or disclaimer to continued examination on the merits:

1. (Currently Amended) A leveling system for leveling a vehicle that is at rest, the leveling system comprising:

a sensor device secured to a vehicle to sense at least one of an inclination or an orientation of the vehicle in both a pitch direction and a roll direction, each of the one or more sensor devices comprising a printed circuit board that comprises

a digital accelerometer that uses an X-axis, Y-axis, and a Z-axis that permits calculation in both the pitch or roll direction regardless of positioning of the respective one or more sensor devices relative to the vehicle to which the one or more sensor devices are secured,

a processor to process data collected by the respective sensor device, and

a digital temperature sensor that collects and transmits temperature data of the ambient air where the vehicle is at rest to the processor, wherein the processor compares the transmitted temperature data with data stored in a temperature correction table having temperature correction data for environmental air temperatures ranging from about −60 °C to about 90 °C to determine how to correct deviations within the collected data; and

a smart device in communication with the sensor device to allow information received from the sensor device about at least one of the inclination or the orientation of the vehicle in both the pitch direction and the roll direction to be processed to provide measurements to a user and to determine ~~the~~ an amount of adjustments in height needed to adjust wheels of the vehicle, when the vehicle has four wheels, ~~at least one of the pitch direction or the roll direction to level the vehicle~~, the smart device configured to determine an initial level position based upon the position of a highest wheel of the vehicle to provide a calibration data of the pitch and roll angle measurements for determining the amount the remaining wheels of the vehicle need to be raised to reach a level position.

2. (Cancelled)

3. (Cancelled)

4. (Original) The system according to claim 1, wherein the smart device is configured to allow an input of which side of a vehicle to which the sensor device is installed is to be a driver's side of the vehicle.

5. (Original) The system according to claim 1, wherein sensor device comprises an On/Off switch that permits a battery of the sensor device to be disconnected from circuitry of the sensor device.

6. (Original) The system according to claim 1, wherein the sensor device is configured to switch between a sleep mode and an awake mode based on the sensor device detecting motion by a vehicle to which the sensor device is installed.

7. (Original) The system according to claim 1, wherein the smart device and the sensor device communicate with each [e]other through a wireless connection and the smart device is configured to receive a serial number of the sensor device so that the smart device communicates with the particular sensor device.

8. (Original) The system according to claim 1, wherein the smart device is configured to permit an input of a display resolution by a user such that the display resolution changes in increments input by the user.

9. (Currently Amended) A method for leveling a recreational vehicle, the method comprising~~: providing a leveling system comprising a sensor device secured to a vehicle to sense at least one of an inclination or an orientation of the vehicle in both a pitch direction and a roll direction and a smart device in communication with the sensor device; measuring the pitch angle and the roll angle of the vehicle when the vehicle is at rest using the sensor~~

~~device; retrieving calibration data of pitch angle and roll angle measurements taken by the sensor device when the vehicle was at an initial level position; calculating any needed change in height to at least one of a rear or front section or first or second side sections of the vehicle to obtain a level position of the vehicle in at least one of the pitch direction or the roll direction of the vehicle using the calibration data of pitch and roll angle measurements; displaying the calculated changes in height on the smart device; and adjusting the height to the at least one of the rear or front section or the first or second side sections of the vehicle to obtain the level position of the vehicle based on the calculated changes In height~~

providing a leveling system comprising

one or more sensor devices secured to a vehicle to sense at least one of an inclination or an orientation of the vehicle in both a pitch direction and a roll direction and a smart device in communication with the one or more sensor devices, each of the one or more sensor devices comprising a printed circuit board that comprises a digital accelerometer that uses an X-axis, Y-axis, and a Z-axis that permits calculation in both the pitch or roll direction regardless of positioning of the respective one or more sensor devices relative to the vehicle to which the one or more sensor devices are secured for determining the height needed to adjust wheels of the vehicle, when the vehicle has two or more wheels, and

a digital temperature sensor that collects and transmits temperature data of the ambient air where the vehicle is at rest to a processor, wherein the processor compares the transmitted temperature data with data stored in a temperature correction table having temperature correction data for environmental air temperatures ranging from about −60 °C to about 90 °C to determine how to correct deviations within data collected from the one or more sensor devices;

determining an initial level position for the vehicle using the smart device to determine any inconsistencies inherent in the leveling system; ~~and~~

capturing pitch and roll angle measurements from the sensor device taken at the initial level position of a single wheel of the vehicle to provide a calibration data of the pitch and

roll angle measurements to permit consideration of any inconsistencies determined when taking measurement readings at a future time;

measuring the pitch angle and the roll angle of the vehicle when the vehicle is at rest using the sensor device;

retrieving calibration data of pitch angle and roll angle measurements taken by the sensor device when the vehicle was at an initial level position;

calculating any needed change in height to the remaining wheels of the vehicle to obtain a level position of the vehicle in at least one of the pitch directions or the roll direction of the vehicle using the calibration data of pitch and roll angle measurements;

displaying the calculated change in the height to the remaining wheels of the vehicle in at least one of the pitch directions or the roll direction of the vehicle on the smart device; and

adjusting the height to the wheels of the vehicle to obtain the level position of the vehicle based on the calculated change.

10. (Cancelled)

11. (Cancelled)

12. (Original) The method according to claim 9, further comprising selecting which side of a vehicle to which the sensor device is installed is to be a driver's side of the vehicle.

13. (Original) The method according to claim 9, further comprising switching the sensor device between a sleep made and an awake mode based on the sensor device detecting motion by a vehicle to which the sensor device is installed.

14. (Original) The method according to claim 9, wherein the smart device and the sensor device communicate with each other through a wireless connect on and further comprising entering a serial number of the sensor device into the smart device so that the smart device communicates with the particular sensor device.

15. (Original) The method according to claim 9, further comprising inputting a display

resolution such that the display resolution changes in specified increments.

16. (Currently Amended) A non-transitory computer readable medium comprising ~~computer executable instructions embodied in a computer readable medium that when executed by a processor of a computer control the computer to perform steps comprising: receiving on a smart device a pitch angle measurement and a roll angle measurement of a vehicle when the vehicle is at rest from a sensor device; retrieving calibration data of pitch angle and roll angle measurements taken by the sensor device when the vehicle was at an initial level position; calculating any needed change in height to at least one of a rear or front section or first or second side sections of the vehicle to obtain a level position of the vehicle in at least one of a pitch direction or a roll direction of the vehicle using the calibration data of the pitch and roll angle measurements to obtain a level position of the vehicle; and displaying the calculated changes in height needed to obtain the level position of the vehicle on the smart device~~ computer executable instructions embodied in a computer readable medium that when executed by a processor of a computer control the computer to perform steps comprising: receiving on a smart device a pitch angle measurement and a roll angle measurement of a vehicle when the vehicle is at rest from a sensor device secured to the vehicle, the sensor device comprising a printed circuit board that comprises a digital accelerometer that uses an X-axis, Y-axis, and a Z-axis that permits calculation in both the pitch or roll direction regardless of positioning of the respective device relative to the vehicle to which the one or more sensor devices are secured for determining the height needed to adjust wheels of the vehicle, when the vehicle has two or more wheels, and

capturing pitch and roll angle measurements from the sensor device taken at the initial level position based upon the position of a single wheel of the vehicle, the smart device after determining an initial level position for the vehicle using the smart device to provide a calibration data of the pitch and roll angle measurements to permit consideration of any inconsistencies determined when taking measurement readings at a future time;

retrieving calibration data of pitch angle and roll angle measurements taken by the sensor device when the vehicle was at the initial level position;

comparing temperature data transmitted from a digital temperature sensor with data stored in a temperature correction table having temperature correction data for environmental air temperatures ranging from about −60 °C to about 90 °C to determine how to correct deviations within the captured measurement data;

calculating any needed change in height the remaining wheels of the vehicle to obtain a level position of the vehicle in at least one of a pitch directions or a roll direction of the vehicle using the calibration data of the pitch and roll angle measurements; and

displaying the calculated change in height to the remaining wheels of the vehicle to obtain a level position of the vehicle in at least one of the pitch direction or the roll direction of the vehicle needed to obtain the level position of the vehicle on the smart device so that the height to at least one of the rear or front section or the first or second side sections of the vehicle is adjusted to obtain the level position of the vehicle based on the calculated change.

17. (Original) The non-transitory computer readable medium according to claim 16, further comprising calculating a change of height of each wheel position of a motorized recreational vehicle when the sensor device is installed on the motorized recreational vehicle.

18. (Original) The non-transitory computer readable medium according to claim 17, wherein the step of displaying the calculated changes in height comprises displaying the change of height of each wheel position of the motorized recreational vehicle on the smart device.

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.
15/619,261	06/09/2017	Charles A. Leonard	7137CIP	2353

22474 7590 06/21/2019

Clements Bernard Walker PLLC
4500 Cameron Valley Parkway
Suite 350
Charlotte, NC 28211

EXAMINER
MARTINEZ BORRERO, LUIS A

ART UNIT	PAPER NUMBER
3668	

NOTIFICATION DATE	DELIVERY MODE
06/21/2019	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):

patlaw@worldpatents.com

Office Action Summary	Application No. 15/619,261	Applicant(s) Leonard, Charles A.	
	Examiner LUIS A MARTINEZ BORRERO	Art Unit 3668	AIA (FITF) Status Yes

-- 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 03/19/2019.

☐ 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) 1,4-9 and 12-18 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) 1,4-9 and 12-18 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 06/09/2017 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: _____.

DETAIL ACTION

Notice of Pre-AIA or AIA Status

The present application, filed on or after March 16, 2013, is being examined under the first inventor to file provisions of the AIA.

Notice on Prior Art Rejections

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.

Status of Claims

This Office Action is in response to the Applicant's amendments/remarks filed March 19, 2019. Claim 2, 3, 10, and 11 have been canceled. Claims **1, 9, and 16** are amended. Claims **1, 4-9, and 12-18** are presently pending and are presented for examination.

Response to Arguments/Remarks

1. **Nonstatutory Double Patenting.** Applicant's arguments filed on February 19, 2019 with regard to the previous Non-Final Office action have been fully considered. The applicant did not address this rejection in his arguments. Therefore, the previous Nonstatutory Double Patenting rejection is maintained.

2. **35 U.S.C. 112(b) Rejection.** Applicant's amendments/remarks filed on February 19, 2019 with regard to the previous 35 U.S.C. 112(b) rejection have been fully considered. Applicant's amendments/remarks are persuasive. Accordingly, 35 U.S.C. 112(b) rejection is withdrawn.

3. **35 USC § 102 Rejection**. Applicant's arguments filed on February 19, 2019 with regard to the previous 35 USC § 102 rejection have been fully considered. Applicant's arguments, with respect to the previous 35 USC § 102 rejection are moot. Therefore, the rejection has been withdrawn. However, upon further consideration, a new ground(s) of rejection are presented in this Final Office Action.

Nonstatutory Double Patenting

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

Ornum, 686 F.2d 937, 214 USPQ 761 (CCPA 1982); In re Vogel, 422 F.2d 438, 164 USPQ 619 (CCPA 1970); and In re Thorington, 418 F.2d 528, 163 USPQ 644 (CCPA 1969).

A timely filed terminal disclaimer in compliance with 37 CFR 1.321(c) or 1.321(d) may be used to overcome an actual or provisional rejection based on a nonstatutory double patenting ground provided the reference application or patent either is shown to be commonly owned with this application, or claims an invention made as a result of activities undertaken within the scope of a joint research agreement.

A terminal disclaimer must be signed in compliance with 37 CFR 1.321(b).

The USPTO internet Web site contains terminal disclaimer forms which may be used. Please visit http://www.uspto.gov/forms/. The filing date of the application will determine what form should be used. A web-based eTerminal Disclaimer may be filled out completely online using web-screens. An eTerminal Disclaimer that meets all requirements is auto-processed and approved immediately upon submission. For more information about eTerminal Disclaimers, refer to http://www.uspto.gov/patents/process/file/efs/guidance/eTD-info-I.jsp.

Claim(s) **1, 4-9, and 12-18** is/are provisionally rejected on the ground of nonstatutory double patenting as being unpatentable over claim(s) **1-5, 7, 10, 12, 14-16, 18, 20, 22-29, 38, and 43-44** of copending App# 14/961,787. Although the claims at issue are not identical, they are not patentably distinct from each other because the claimed invention is the same.

This is a provisional nonstatutory double patenting rejection because the patentably indistinct claims have not in fact been patented.

CLAIM INTERPRETATION

5. The following is a quotation of 35 U.S.C. 112(f):

> (f) Element in Claim for a Combination. – An element in a claim for a combination may be expressed as a means or step for performing a specified function without the recital of structure, material, or acts in support thereof, and such claim shall be construed to cover the corresponding structure, material, or acts described in the specification and equivalents thereof.

The following is a quotation of pre-AIA 35 U.S.C. 112, sixth paragraph:

> An element in a claim for a combination may be expressed as a means or step for performing a specified function without the recital of structure, material, or acts in support thereof, and such claim shall be construed to cover the corresponding structure, material, or acts described in the specification and equivalents thereof.

The claims in this application are given their broadest reasonable interpretation using the plain meaning of the claim language in light of the specification as it would be understood by one of ordinary skill in the art. The broadest reasonable interpretation of a claim element (also commonly referred to as a claim limitation) is limited by the description in the specification when 35 U.S.C. 112(f) or pre-AIA 35 U.S.C. 112, sixth paragraph, is invoked.

As explained in MPEP § 2181, subsection I, claim limitations that meet the following three-prong test will be interpreted under 35 U.S.C. 112(f) or pre-AIA 35 U.S.C. 112, sixth paragraph:

(A) the claim limitation uses the term "means" or "step" or a term used as a substitute for "means" that is a generic placeholder (also called a nonce term or a non-structural term having no specific structural meaning) for performing the claimed function;

(B) the term "means" or "step" or the generic placeholder is modified by functional language, typically, but not always linked by the transition word "for" (e.g., "means for") or another linking word or phrase, such as "configured to" or "so that"; and

(C) the term "means" or "step" or the generic placeholder is not modified by sufficient structure, material, or acts for performing the claimed function.

Use of the word "means" (or "step") in a claim with functional language creates a rebuttable presumption that the claim limitation is to be treated in accordance with 35 U.S.C. 112(f) or pre-AIA 35 U.S.C. 112, sixth paragraph. The presumption that the claim limitation is interpreted under 35 U.S.C. 112(f) or pre-AIA 35 U.S.C. 112, sixth paragraph, is rebutted when the claim limitation recites sufficient structure, material, or acts to entirely perform the recited function.

Absence of the word "means" (or "step") in a claim creates a rebuttable presumption that the claim limitation is not to be treated in accordance with 35 U.S.C. 112(f) or pre-AIA 35 U.S.C. 112, sixth paragraph. The presumption that the claim limitation is not interpreted under 35 U.S.C. 112(f) or pre-AIA 35 U.S.C. 112, sixth paragraph, is rebutted when the claim limitation recites function without reciting sufficient structure, material or acts to entirely perform the recited function.

Claim limitations in this application that use the word "means" (or "step") are being interpreted under 35 U.S.C. 112(f) or pre-AIA 35 U.S.C. 112, sixth paragraph, except as otherwise indicated in an Office action. Conversely, claim limitations in this application that do not use the word "means" (or "step") are not being interpreted under 35 U.S.C. 112(f) or pre-AIA 35 U.S.C. 112, sixth paragraph, except as otherwise indicated in an Office action.

This application includes one or more claim limitations that do not use the word "means," but are nonetheless being interpreted under 35 U.S.C. 112(f) or pre-AIA 35 U.S.C. 112, sixth paragraph, because the claim limitation(s) uses a generic placeholder that is coupled with functional language without reciting sufficient structure to perform the recited function and the generic placeholder is not preceded by a structural modifier. Such claim limitation(s) is/are: "a smart device", in claims **1, 4, 7-9, 14, 16, and 18**.

Because this/these claim limitation(s) is/are being interpreted under 35 U.S.C. 112(f) or pre-AIA 35 U.S.C. 112, sixth paragraph, it/they is/are being interpreted to cover the corresponding structure described in the specification as performing the claimed function, and equivalents thereof.

If applicant does not intend to have this/these limitation(s) interpreted under 35 U.S.C. 112(f) or pre-AIA 35 U.S.C. 112, sixth paragraph, applicant may: (1) amend the claim limitation(s) to avoid it/them being interpreted under 35 U.S.C. 112(f) or pre-AIA 35 U.S.C. 112, sixth paragraph (e.g., by reciting sufficient structure to perform the claimed function); or (2) present a sufficient showing that the claim limitation(s) recite(s) sufficient structure to perform the claimed function so as to avoid it/them being interpreted under 35 U.S.C. 112(f) or pre-AIA 35 U.S.C. 112, sixth paragraph.

Claim Rejections - 35 USC § 112

6. The following is a quotation of the first paragraph of 35 U.S.C. 112(a):

> (a) IN GENERAL.—The specification shall contain a written description of the invention, and of the manner and process of making and using it, in such full, clear, concise, and exact terms as to enable any person skilled in the art to which it pertains, or with which it is most nearly connected, to make and use the same, and shall set forth the best mode contemplated by the inventor or joint inventor of carrying out the invention.

The following is a quotation of the first paragraph of pre-AIA 35 U.S.C. 112:

> The specification shall contain a written description of the invention, and of the manner and process of making and using it, in such full, clear, concise, and exact terms as to enable any person skilled in the art to which it pertains, or with which it is most nearly connected, to make and use the same, and shall set forth the best mode contemplated by the inventor of carrying out his invention.

7. Claims **1, 4-9, and 12-18** rejected under 35 U.S.C. 112(a) or 35 U.S.C. 112 (pre-AIA), first paragraph, as failing to comply with the written description requirement. The claim(s) contains subject matter which was not described in the specification in such a way as to

reasonably convey to one skilled in the relevant art that the inventor or a joint inventor, or for pre-AIA the inventor(s), at the time the application was filed, had possession of the claimed invention.

8. Claim 1 recites "a digital temperature sensor that collects and transmits temperature data of the ambient air where the vehicle is at rest", "having temperature correction data for environmental air temperatures ranging from about -60 °C to about 90 °C to determine how to correct deviations within the collected data", "the smart device configured to determine an initial level position based upon the position of a highest wheel of the vehicle", and "capturing pitch and roll angle measurements from the sensor device taken at the initial level position of a single wheel of the vehicle". There is no description in the original specification of the above features. There is some description of "any angle deviation at that temperature in the temperature calibration lookup table is read and used to correct the current accelerometer angle data", however, the specification does not specifically refers to the features describe above. Therefore, the claim is rejected under 35 U.S.C. 112(a) for failing to comply with the written description requirement. Independent claims present or are part of the features described above thus they are rejected for the same reasons. Similar features of claim 1 are presented in independent claims **9 and 16** thus this claims are also rejected under 35 U.S.C. 112(a). Therefore, claims **1, 4-9, and 12-18** are all rejected under 35 U.S.C. 112(a).

Claim Rejections - 35 USC § 112

9. The following is a quotation of 35 U.S.C. 112(b):

> (B) CONCLUSION.—The specification shall conclude with one or more claims particularly pointing out and distinctly claiming the subject matter which the inventor or a joint inventor regards as the invention.

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.

10. Claims 1, 4-9, and 12-18 are rejected under 35 U.S.C. 112(b) or 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.

11. Claim 1 recites "the smart device configured to determine an initial level position based upon the position of a highest wheel of the vehicle". It is unclear how an initial level position based upon the position of a highest wheel of the vehicle is determined. The specification states that "by placing the smart device 24 on the floor or some other horizontal surface of the RV", however the limitation of the claim requires knowing the position of the highest wheel. Further, the specification is silent with respect of the position of a highest wheel of the vehicle. As a result of this ambiguity, the precise boundary of the claim cannot be determined. Therefore, the claim is rejected as indefinite under 35 U.S.C. 112(b).

12. Claims 9 and 16 recite "capturing pitch and roll angle measurements from the sensor device taken at the initial level position based upon the position of a single wheel of the vehicle". It is unclear how an initial level position based upon the position of a single wheel of the vehicle is determined. The specification states that "by placing the smart device 24 on the floor or some other horizontal surface of the RV", however the limitation of the claim requires knowing the position of a single wheel of the vehicle. Further, the specification is silent with respect of the position of a single wheel of the vehicle. As a result of this ambiguity, the precise boundary of

the claim cannot be determined. Therefore, the claim is rejected as indefinite under 35 U.S.C. 112(b).

Claim Rejections - 35 USC § 103

13. 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.

14. Claims **1, 4-9, and 12-18** are rejected under 35 U.S.C 103 as being unpatentable over Thorpe et al, US 2008/0142768, in view of Luk et al, US 2012/0197587, further in view of Tanenhaus et al, US 8,239,162, hereinafter referred to as Thorpe, Luk, and Tanenhaus respectively.

In regards of claim 1, Thorpe discloses a leveling system for leveling a vehicle that is at rest, the leveling system comprising: a sensor device secured to a vehicle to sense at least one of an inclination or an orientation of the vehicle in both a pitch direction and a roll direction ***(See at least ¶ 12, via The level sensing means is configured to determine the pitch and the roll of the recreational vehicle so the user can operate the leveling mechanism to place the recreational vehicle in its level condition… the level sensing means is a dual-axis accelerometer that is configured to determine the tilt of the recreational vehicle in both the front-to-back and side-to-side directions), (¶ 0038, via Level sensing means 38 comprises one or more tilt sensors that are configured to detect the amount of pitch and roll of recreational vehicle), (¶ 0038, via In***

one configuration, level sensing means 38 comprises two separate tilt sensors, one positioned in the front/back direction for determining the pitch and one positioned in the left/right direction for determining the roll); each of the one or more sensor devices comprising a printed circuit board that comprises a digital accelerometer that permits calculation in both the pitch or roll direction regardless of positioning of the respective one or more sensor devices relative to the vehicle to which the one or more sensor devices are secured, a processor to process data collected by the respective sensor device ***(See at least ¶ 34, via In other embodiments, the vehicle sensors 206, 208 may comprise one or more of an accelerometer, a gyroscope, a liquid capacitive device, an electrolytic level device, a gas bubble in liquid device, a pendulum device, and the like), (¶ 29, via a vehicle 104 may be leveled by a leveling system 102 based on a first signal 202 representing a lateral force (i.e., tilt, roll) acting on the vehicle 104 and a second signal 204 representing a longitudinal force (i.e., pitch) acting on the vehicle 104. The first 202 and second 204 signals may be sent by one or more vehicle sensors (206, 208) associated with the vehicle 104, and received by a processing or control portion 210 of the leveling system), (¶ 36, via level unit 12 is placed on a flat surface inside recreational vehicle 16), (¶ 38, via level sensing means 38 is a dual-axis accelerometer, such as the model number LIS2L02AS4 low-power two-axis linear accelerometer available from ST Microelectronics, that is configured to detect tilting in both the front/back and left/right directions so as to determine the attitude of recreational vehicle 16 relative to a calibrated reference position (i.e., the level condition 20). The level sensing means 38 includes an integrated circuit interface that takes the information from the sensing element of sensing means 28 to deliver an analog signal for conversion and then use by control unit 14)***; and a smart device in communication with the sensor device to allow information received from the sensor device about at least one of

the inclination or the orientation of the vehicle in both the pitch direction and the roll direction to be processed to provide measurements to a user and to determine the amount of adjustments in height needed to at least one of the pitch direction or the roll direction to level the vehicle ***(See at least ¶ 8, via The foregoing patents are representative of leveling systems that require manual, independent determination of the amount of height adjustment needed to place the vehicle in the level condition), (¶ 0038, via the output from level sensing means 38 goes to one or more analog conversion devices, such as the operation amplifiers 48a, 48b, 48c and 48d, that convert the analog signal to a linear value that is used by controller 36 to determine the pitch and roll level position relative to the common reference 50. This data is then wirelessly transmitted to control unit 14 for processing into operator- useable information. Alternatively, controller 36 or level unit 12 can process the data and transmit the final tilt adjustment data to control unit 14 for display to the operator)***, the smart device configured to determine an initial level position based upon the position of a highest wheel of the vehicle ***(See at least ¶ 43, via To set leveling system 10 for future use, it is preferred to place the recreational vehicle 16 in its level condition 20 based on the operator's preference…This activity will set the reference position, from which the amount of out-of-level will be determined, to zero. This calibration step should be done even if the initial placement of level unit 12 indicates recreational vehicle 16 is level to ensure the surface on which level unit 12 is placed is not compensating for an incorrect level of recreational vehicle)*** to provide a calibration data of the pitch and roll angle measurements for determining the amount the remaining wheels of the vehicle need to be raised to reach a level position ***(¶ 12, via The level sensing means is configured to determine the pitch and the roll of the recreational vehicle so the user can operate the leveling mechanism to place the recreational vehicle in its level condition)***.

Thorpe fails to explicitly disclose a digital accelerometer that uses an X-axis, Y-axis, and a Z-axis.

However, Luk teaches a digital accelerometer that uses an X-axis, Y-axis, and Z-axis ***(See at least ¶ 11, via wherein said device is securely attached to said wheeled vehicle in a manner that sensed tri-axial directional accelerations by said device are tri-axial directional accelerations of the moving vehicle), (See at least ¶ 13, via sense (e.g. by the built-in accelerometer) and measure the moving wheeled vehicle's individual accelerations in each of said tri-axial fore-aft, lateral and vertical directions).***

Therefore, it would have been obvious to one of ordinary skill in the art before the effective filing date of the claimed invention to modify each of the one or more sensor devices comprising a printed circuit board that comprises a digital accelerometer that permits calculation in both the pitch or roll direction regardless of positioning of the respective one or more sensor devices relative to the vehicle to which the one or more sensor devices are secured, a processor to process data collected by the respective sensor device of Thorpe and include a digital accelerometer that uses an X-axis, Y-axis, and Z-axis as taught by Luk because it would allow the system to measure the pitch and roll tilt in multiple axis so that leveling system can determine the adjustment necessary to neutralize that tilting.

Thorpe fails to explicitly disclose a digital temperature sensor that collects and transmits temperature data of the ambient air where the vehicle is at rest to the processor, wherein the processor compares the transmitted temperature data with data stored in a temperature correction table having temperature correction data for environmental air temperatures ranging from about -60 °C to about 90 °C to determine how to correct deviations within the collected data.

However, Tanenhaus teaches a digital temperature sensor that collects and transmits temperature data of the ambient air where the vehicle is at rest to the processor ***(See at least Column 11, lines 4-8, "Temperature sensors 121 in a particular embodiment are part of each of the gyros 104 and accelerometer 107. The temperature sensors 121 sense temperature and compensate for changes outside the normal gyro and accelerometer ranges")***, wherein the processor compares the transmitted temperature data with data stored in a temperature correction table ***(See at least Column 15, lines 36-39, "the measurement system to provide a correction signal for correction of gyro bias errors, the accelerometer errors, and the temperature derived from an internal temperature sensor to measure and correct for temperature extremes")*** having temperature correction data for environmental air temperatures ranging from about -60 °C to about 90 °C to determine how to correct deviations within the collected data ***(See at least Column 22, lines 19-28, "Accuracy is improved by using DC offset removal at two temperature points, recalibrating the gyros to reduce drift. These equations can be extended to both -60° C. and + 105° C., if needed…"The IMU measures each gyro temperature sensor continuously and corrects each device once per second to achieve maximum overall accuracy).***

Therefore, it would have been obvious to one of ordinary skill in the art before the effective filing date of the claimed invention to modify each of the one or more sensor devices comprising a printed circuit board that comprises a digital accelerometer that permits calculation in both the pitch or roll direction regardless of positioning of the respective one or more sensor devices relative to the vehicle to which the one or more sensor devices are secured, a processor to process data collected by the respective sensor device of Thorpe and include a digital temperature sensor that collects and transmits temperature data of the ambient air where the vehicle is at rest to the processor, wherein the processor compares the transmitted temperature

data with data stored in a temperature correction table having temperature correction data for environmental air temperatures ranging from about -60 °C to about 90 °C to determine how to correct deviations within the collected data as taught by Tanenhaus because it would allow the temperature sensors sense temperature and compensate for changes outside the normal gyro and accelerometer ranges ***(See Tanenhaus at least Column 11, lines 6-8).***

In regards of claim 4, Thorpe discloses the system according to claim 1, wherein the smart device is configured to allow an input of which side of a vehicle to which the sensor device is installed is to be a driver's side of the vehicle ***(¶ 36, via level unit 12 is placed on a flat surface inside recreational vehicle 16, such as on a cabinet shelf or on top of a counter or the like, to allow the components disposed in interior chamber 28 of level unit 12 to measure the pitch and roll tilt), (the examiner interprets a driver's side of the vehicle as an example of any flat surface in the driver's side of the vehicle).***

In regards of claim 5, Thorpe discloses the system according to claim 1, wherein sensor device comprises an On/Off switch that permits a battery of the sensor device to be disconnected from circuitry of the sensor device ***(See at least ¶ 40, via Power button 78, which connects to circuit board 34 at on/off switch 82 on FIG. 10, is used to turn on or off control unit 14).***

In regards of claim 6, Thorpe discloses the system according to claim 1, wherein the sensor device is configured to switch between a sleep mode and an awake mode based on the sensor device detecting motion by a vehicle to which the sensor device is installed ***(See at least ¶ 40, via Mode button 80, which connects to circuit board 34 at mode switch 84 on FIG. 9, is***

used to switch control unit 14 between its various display and function modes), (See at least ¶ 44, via In the preferred embodiment, it is not necessary to manually activate level unit 12, as it is configured to continuously cycle on and check for a signal from control unit 14), (the examiner interprets a sleep mode and an awake mode as expressed by the specification to be where the sensor device is using a minimal amount of power and where the sensor device is prepared to perform its variety of actions).

In regards of claim 7, Thorpe discloses the system according to claim 1, wherein the smart device and the sensor device communicate with each ether through a wireless connection and the smart device is configured to receive a serial number of the sensor device so that the smart device communicates with the particular sensor device ***(See at least ¶ 0011, via the leveling system has a level unit which determines how level the vehicle is and wirelessly transmits that information to a control unit which visually indicates to the operator the amount the recreational vehicle is out of level in degrees and the amount needed to raise a side or end of the vehicle in order to level the vehicle), (the examiner notes that pairing between devices is a known feature in the art and it would be obvious to implement this feature for communication between devices).***

In regards of claim 8, Thorpe discloses the system according to claim 1, wherein the smart device is configured to permit an input of a display resolution by a user such that the display resolution changes in increments input by the user ***(¶ 0040, via on FIG. 9, is used to switch control unit 14 between its various display and function modes, such as showing the pitch or roll adjustments needed to obtain level condition), (¶ 0038, via controller 36 or level unit 12***

can process the data and transmit the final tilt adjustment data to control unit 14 for display to the operator), (the examiner notes that resolution alteration or modification is a known feature in the art and it would be obvious to implement this feature for a display device).

In regards of claim 9, Thorpe discloses a method for leveling a recreational vehicle, the method comprising providing a leveling system comprising one or more sensor devices secured to a vehicle to sense at least one of an inclination or an orientation of the vehicle in both a pitch direction and a roll direction and a smart device in communication with the one or more sensor devices ***(See at least ¶ 12, via The level sensing means is configured to determine the pitch and the roll of the recreational vehicle so the user can operate the leveling mechanism to place the recreational vehicle in its level condition… the level sensing means is a dual-axis accelerometer that is configured to determine the tilt of the recreational vehicle in both the front-to-back and side-to-side directions), (¶ 0038, via Level sensing means 38 comprises one or more tilt sensors that are configured to detect the amount of pitch and roll of recreational vehicle), (¶ 0038, via In one configuration, level sensing means 38 comprises two separate tilt sensors, one positioned in the front/back direction for determining the pitch and one positioned in the left/right direction for determining the roll)***; each of the one or more sensor devices comprising a printed circuit board that comprises a digital accelerometer that permits calculation in both the pitch or roll direction regardless of positioning of the respective one or more sensor devices relative to the vehicle to which the one or more sensor devices are secured for determining the height needed to adjust wheels of the vehicle, when the vehicle has two or more wheels ***(See at least ¶ 34, via In other embodiments, the vehicle sensors 206, 208 may comprise one or more of an accelerometer, a gyroscope, a liquid capacitive device, an***

electrolytic level device, a gas bubble in liquid device, a pendulum device, and the like), (¶ 29, via a vehicle 104 may be leveled by a leveling system 102 based on a first signal 202 representing a lateral force (i.e., tilt, roll) acting on the vehicle 104 and a second signal 204 representing a longitudinal force (i.e., pitch) acting on the vehicle 104. The first 202 and second 204 signals may be sent by one or more vehicle sensors (206, 208) associated with the vehicle 104, and received by a processing or control portion 210 of the leveling system), (¶ 36, via level unit 12 is placed on a flat surface inside recreational vehicle 16), (¶ 38, via level sensing means 38 is a dual-axis accelerometer, such as the model number LIS2L02AS4 low-power two-axis linear accelerometer available from ST Microelectronics, that is configured to detect tilting in both the front/back and left/right directions so as to determine the attitude of recreational vehicle 16 relative to a calibrated reference position (i.e., the level condition 20). The level sensing means 38 includes an integrated circuit interface that takes the information from the sensing element of sensing means 28 to deliver an analog signal for conversion and then use by control unit 14); determining an initial level position for the vehicle using the smart device to determine any inconsistencies inherent in the leveling system ***(See at least ¶ 11, via The leveling system of the present invention includes a calibration procedure to allow the operator to selectively calibrate the zero or level condition), (the examiner interprets inconsistencies as an example of misreadings or miscalculations during calibration)***; and capturing pitch and roll angle measurements from the sensor device taken at the initial level position of a single wheel of the vehicle to provide a calibration data of the pitch and roll angle measurements to permit consideration of any inconsistencies determined when taking measurement readings at a future time ***(¶ 12, via The level sensing means is configured to determine the pitch and the roll of the recreational vehicle so the user can operate the leveling***

mechanism to place the recreational vehicle in its level condition); measuring the pitch angle and the roll angle of the vehicle when the vehicle is at rest using the sensor device ***(See at least ¶ 8, via The foregoing patents are representative of leveling systems that require manual, independent determination of the amount of height adjustment needed to place the vehicle in the level condition), (¶ 0038, via the output from level sensing means 38 goes to one or more analog conversion devices, such as the operation amplifiers 48a, 48b, 48c and 48d, that convert the analog signal to a linear value that is used by controller 36 to determine the pitch and roll level position relative to the common reference 50. This data is then wirelessly transmitted to control unit 14 for processing into operator- useable information. Alternatively, controller 36 or level unit 12 can process the data and transmit the final tilt adjustment data to control unit 14 for display to the operator)***, retrieving calibration data of pitch angle and roll angle measurements taken by the sensor device when the vehicle was at an initial level position ***(See at least ¶ 43, via To set leveling system 10 for future use, it is preferred to place the recreational vehicle 16 in its level condition 20 based on the operator's preference…This activity will set the reference position, from which the amount of out-of-level will be determined, to zero. This calibration step should be done even if the initial placement of level unit 12 indicates recreational vehicle 16 is level to ensure the surface on which level unit 12 is placed is not compensating for an incorrect level of recreational vehicle)*** calculating any needed change in height to the remaining wheels of the vehicle to obtain a level position of the vehicle in at least one of the pitch directions or the roll direction of the vehicle using the calibration data of pitch and roll angle measurements ***(¶ 12, via The level sensing means is configured to determine the pitch and the roll of the recreational vehicle so the user can operate the leveling mechanism to place the recreational vehicle in its level condition)***;

displaying the calculated change in the height to the remaining wheels of the vehicle in at least one of the pitch directions or the roll direction of the vehicle on the smart device ***(¶ 0040, via on FIG. 9, is used to switch control unit 14 between its various display and function modes, such as showing the pitch or roll adjustments needed to obtain level condition), (¶ 0038, via controller 36 or level unit 12 can process the data and transmit the final tilt adjustment data to control unit 14 for display to the operator)***; and adjusting the height to the wheels of the vehicle to obtain the level position of the vehicle based on the calculated change ***(¶ 8, via The foregoing patents are representative of leveling systems that require manual, independent determination of the amount of height adjustment needed to place the vehicle in the level condition), (¶ 0038, via the output from level sensing means 38 goes to one or more analog conversion devices, such as the operation amplifiers 48a, 48b, 48c and 48d, that convert the analog signal to a linear value that is used by controller 36 to determine the pitch and roll level position relative to the common reference 50. This data is then wirelessly transmitted to control unit 14 for processing into operator- useable information. Alternatively, controller 36 or level unit 12 can process the data and transmit the final tilt adjustment data to control unit 14 for display to the operator), (See at least fig 2. ¶ 0040, via control unit 14 has a front cover 68 and back cover 70 that define control housing 72 enclosing a control chamber 74 in which is disposed the components that allow the user to control leveling system 10 and communicate with the spaced apart level unit).***

Thorpe fails to explicitly disclose a digital accelerometer that uses an X-axis, Y-axis, and a Z-axis.

However, Luk teaches a digital accelerometer that uses an X-axis, Y-axis, and Z-axis ***(See at least ¶ 11, via wherein said device is securely attached to said wheeled vehicle in a***

manner that sensed tri-axial directional accelerations by said device are tri-axial directional accelerations of the moving vehicle), (See at least ¶ 13, via sense (e.g. by the built-in accelerometer) and measure the moving wheeled vehicle's individual accelerations in each of said tri-axial fore-aft, lateral and vertical directions).

Therefore, it would have been obvious to one of ordinary skill in the art before the effective filing date of the claimed invention to modify one or more sensor devices relative to the vehicle to which the one or more sensor devices are secured for determining the height needed to adjust wheels of the vehicle of Thorpe and include a digital accelerometer that uses an X-axis, Y-axis, and Z-axis as taught by Luk because it would allow the system to measure the pitch and roll tilt in multiple axis so that leveling system can determine the adjustment necessary to neutralize that tilting.

Thorpe fails to explicitly disclose a digital temperature sensor that collects and transmits temperature data of the ambient air where the vehicle is at rest to a processor, wherein the processor compares the transmitted temperature data with data stored in a temperature correction table having temperature correction data for environmental air temperatures ranging from about -60 °C to about 90 °C to determine how to correct deviations within data collected from the one or more sensor devices.

However, Tanenhaus teaches a digital temperature sensor that collects and transmits temperature data of the ambient air where the vehicle is at rest to the processor ***(See at least Column 11, lines 4-8, "Temperature sensors 121 in a particular embodiment are part of each of the gyros 104 and accelerometer 107. The temperature sensors 121 sense temperature and compensate for changes outside the normal gyro and accelerometer ranges")***, wherein the processor compares the transmitted temperature data with data stored in a temperature correction

table ***(See at least Column 15, lines 36-39, "the measurement system to provide a correction signal for correction of gyro bias errors, the accelerometer errors, and the temperature derived from an internal temperature sensor to measure and correct for temperature extremes")*** having temperature correction data for environmental air temperatures ranging from about -60 °C to about 90 °C to determine how to correct deviations within data collected from the one or more sensor devices ***(See at least Column 22, lines 19-28, "Accuracy is improved by using DC offset removal at two temperature points, recalibrating the gyros to reduce drift. These equations can be extended to both -60° C. and + 105° C., if needed…"The IMU measures each gyro temperature sensor continuously and corrects each device once per second to achieve maximum overall accuracy).***

Therefore, it would have been obvious to one of ordinary skill in the art before the effective filing date of the claimed invention to modify one or more sensor devices relative to the vehicle to which the one or more sensor devices are secured for determining the height needed to adjust wheels of the vehicle of Thorpe and include a digital temperature sensor that collects and transmits temperature data of the ambient air where the vehicle is at rest to the processor, wherein the processor compares the transmitted temperature data with data stored in a temperature correction table having temperature correction data for environmental air temperatures ranging from about -60 °C to about 90 °C to determine how to correct deviations within data collected from the one or more sensor devices as taught by Tanenhaus because it would allow the temperature sensors sense temperature and compensate for changes outside the normal gyro and accelerometer ranges ***(See Tanenhaus at least Column 11, lines 6-8).***

In regards of claim 12, Thorpe discloses the method according to claim 9, further comprising

selecting which side of a vehicle to which the sensor device is installed is to be a driver's side of the vehicle ***(¶ 36, via level unit 12 is placed on a flat surface inside recreational vehicle 16, such as on a cabinet shelf or on top of a counter or the like, to allow the components disposed in interior chamber 28 of level unit 12 to measure the pitch and roll tilt), (the examiner interprets a driver's side of the vehicle as an example of any flat surface in the driver's side of the vehicle).***

In regards of claim 13, Thorpe discloses the method according to claim 9, further comprising switching the sensor device between a sleep made and an awake mode based on the sensor device detecting motion by a vehicle to which the sensor device is installed ***(See at least ¶ 40, via Mode button 80, which connects to circuit board 34 at mode switch 84 on FIG. 9, is used to switch control unit 14 between its various display and function modes), (See at least ¶ 44, via In the preferred embodiment, it is not necessary to manually activate level unit 12, as it is configured to continuously cycle on and check for a signal from control unit 14), (the examiner interprets a sleep mode and an awake mode as expressed by the specification to be where the sensor device is using a minimal amount of power and where the sensor device is prepared to perform its variety of actions).***

In regards of claim 14, Thorpe discloses the method according to claim 9, wherein the smart device and the sensor device communicate with each other through a wireless connect on and further comprising entering a serial number of the sensor device into the smart device so that the smart device communicates with the particular sensor device ***(See at least ¶ 0011, via the leveling system has a level unit which determines how level the vehicle is and wirelessly***

transmits that information to a control unit which visually indicates to the operator the amount the recreational vehicle is out of level in degrees and the amount needed to raise a side or end of the vehicle in order to level the vehicle), (the examiner notes that pairing between devices is a known feature in the art and it would be obvious to implement this feature for communication between devices).

In regards of claim 15, Thorpe discloses the method according to claim 9, further comprising inputting a display resolution such that the display resolution changes in specified increments ***(¶ 0040, via on FIG. 9, is used to switch control unit 14 between its various display and function modes, such as showing the pitch or roll adjustments needed to obtain level condition), (¶ 0038, via controller 36 or level unit 12 can process the data and transmit the final tilt adjustment data to control unit 14 for display to the operator), (the examiner notes that resolution alteration or modification is a known feature in the art and it would be obvious to implement this feature for a display device).***

In regards of claim 16, Thorpe discloses a non-transitory computer readable medium comprising computer executable instructions embodied in a computer readable medium that when executed by a processor of a computer control the computer to perform steps comprising: receiving on a smart device a pitch angle measurement and a roll angle measurement of a vehicle when the vehicle is at rest from a sensor device secured to the vehicle ***(See at least ¶ 12, via The level sensing means is configured to determine the pitch and the roll of the recreational vehicle so the user can operate the leveling mechanism to place the recreational vehicle in its level condition… the level sensing means is a dual-axis accelerometer that is configured to***

determine the tilt of the recreational vehicle in both the front-to-back and side-to-side directions), (¶ 0038, via Level sensing means 38 comprises one or more tilt sensors that are configured to detect the amount of pitch and roll of recreational vehicle), (¶ 0038, via In one configuration, level sensing means 38 comprises two separate tilt sensors, one positioned in the front/back direction for determining the pitch and one positioned in the left/right direction for determining the roll), the sensor device comprising a printed circuit board that comprises a digital accelerometer that permits calculation in both the pitch or roll direction regardless of positioning of the respective device relative to the vehicle to which the one or more sensor devices are secured for determining the height needed to adjust wheels of the vehicle, when the vehicle has two or more wheels, ***(See at least ¶ 34, via In other embodiments, the vehicle sensors 206, 208 may comprise one or more of an accelerometer, a gyroscope, a liquid capacitive device, an electrolytic level device, a gas bubble in liquid device, a pendulum device, and the like), (¶ 29, via a vehicle 104 may be leveled by a leveling system 102 based on a first signal 202 representing a lateral force (i.e., tilt, roll) acting on the vehicle 104 and a second signal 204 representing a longitudinal force (i.e., pitch) acting on the vehicle 104. The first 202 and second 204 signals may be sent by one or more vehicle sensors (206, 208) associated with the vehicle 104, and received by a processing or control portion 210 of the leveling system), (¶ 36, via level unit 12 is placed on a flat surface inside recreational vehicle 16), (¶ 38, via level sensing means 38 is a dual-axis accelerometer, such as the model number LIS2L02AS4 low-power two-axis linear accelerometer available from ST Microelectronics, that is configured to detect tilting in both the front/back and left/right directions so as to determine the attitude of recreational vehicle 16 relative to a calibrated reference position (i.e., the level condition 20). The level sensing means 38 includes an integrated circuit interface***

that takes the information from the sensing element of sensing means 28 to deliver an analog signal for conversion and then use by control unit 14), and capturing pitch and roll angle measurements from the sensor device taken at the initial level position of a single wheel of the vehicle ***(See at least ¶ 11, via The leveling system of the present invention includes a calibration procedure to allow the operator to selectively calibrate the zero or level condition), (the examiner interprets inconsistencies as an example of misreadings or miscalculations during calibration)*** the smart device after determining an initial level position for the vehicle using the smart device to provide a calibration data of the pitch and roll angle measurements ***(¶ 12, via The level sensing means is configured to determine the pitch and the roll of the recreational vehicle so the user can operate the leveling mechanism to place the recreational vehicle in its level condition)*** to permit consideration of any inconsistencies determined when taking measurement readings at a future time ***(¶ 19, via provides the operator with the ability to set the calibration for a zero or level condition from which future measurements will be taken to determine the amount a side and/or an end of the vehicle must be raised to place it in the preset level condition)***; retrieving calibration data of pitch angle and roll angle measurements taken by the sensor device when the vehicle was at an initial level position ***(¶ 0019, via provide a leveling system for recreational vehicles that provides the operator with the ability to set the calibration for a zero or level condition from which future measurements will be taken to determine the amount a side and/or an end of the vehicle must be raised to place it in the preset level condition), (¶ 0036, via Proper placement of level unit 12 is necessary for the operation of level unit 12 to determine the amount of pitch (front/back angle) and roll (left/right) for analyzing the attitude of recreational vehicle 16 relative to a calibrated reference position or predetermined attitude at level condition), (¶ 0038, via the output from***

level sensing means 38 goes to one or more analog conversion devices, such as the operation amplifiers 48a, 48b, 48c and 48d, that convert the analog signal to a linear value that is used by controller 36 to determine the pitch and roll level position relative to the common reference 50. This data is then wirelessly transmitted to control unit 14 for processing into operator-useable information. Alternatively, controller 36 or level unit 12 can process the data and transmit the final tilt adjustment data to control unit 14 for display to the operator); calculating any needed change in height the remaining wheels of the vehicle to obtain a level position of the vehicle in at least one of a pitch directions or a roll direction of the vehicle using the calibration data of the pitch and roll angle measurements ***(¶ 8, via The foregoing patents are representative of leveling systems that require manual, independent determination of the amount of height adjustment needed to place the vehicle in the level condition), (¶ 0011, via the leveling system has a level unit which determines how level the vehicle is and wirelessly transmits that information to a control unit which visually indicates to the operator the amount the recreational vehicle is out of level in degrees and the amount needed to raise a side or end of the vehicle in order to level the vehicle), (¶ 0036, via Proper placement of level unit 12 is necessary for the operation of level unit 12 to determine the amount of pitch (front/back angle) and roll (left/right) for analyzing the attitude of recreational vehicle 16 relative to a calibrated reference position or predetermined attitude at level condition 20);*** and displaying the calculated change in height to the remaining wheels of the vehicle to obtain a level position of the vehicle in at least one of the pitch direction or the roll direction of the vehicle needed to obtain the level position of the vehicle on the smart device so that the height to at least one of the rear or front section or the first or second side sections of the vehicle is adjusted to obtain the level position of the vehicle based on the calculated change ***(¶ 0040, via on FIG. 9, is used to***

switch control unit 14 between its various display and function modes, such as showing the pitch or roll adjustments needed to obtain level condition), (¶ 0038, via controller 36 or level unit 12 can process the data and transmit the final tilt adjustment data to control unit 14 for display to the operator).

Thorpe fails to explicitly disclose a digital accelerometer that uses an X-axis, Y-axis, and a Z-axis.

However, Luk teaches a digital accelerometer that uses an X-axis, Y-axis, and Z-axis ***(See at least ¶ 11, via wherein said device is securely attached to said wheeled vehicle in a manner that sensed tri-axial directional accelerations by said device are tri-axial directional accelerations of the moving vehicle), (See at least ¶ 13, via sense (e.g. by the built-in accelerometer) and measure the moving wheeled vehicle's individual accelerations in each of said tri-axial fore-aft, lateral and vertical directions).***

Therefore, it would have been obvious to one of ordinary skill in the art before the effective filing date of the claimed invention to modify receiving on a smart device a pitch angle measurement and a roll angle measurement of a vehicle when the vehicle is at rest from a sensor device secured to the vehicle of Thorpe and include a digital accelerometer that uses an X-axis, Y-axis, and Z-axis as taught by Luk because it would allow the system to measure the pitch and roll tilt in multiple axis so that leveling system can determine the adjustment necessary to neutralize that tilting.

Thorpe fails to explicitly disclose comparing temperature data transmitted from a digital temperature sensor with data stored in a temperature correction table having temperature correction data for environmental air temperatures ranging from about -60 °C to about 90 °C to determine how to correct deviations within the capture measurement data.

However, Tanenhaus teaches comparing temperature data transmitted from a digital temperature sensor with data stored in a temperature correction table having temperature correction data for environmental air temperatures ranging from about -60 °C to about 90 °C to determine how to correct deviations within the capture measurement data ***(See at least Column 11, lines 4-8, "Temperature sensors 121 in a particular embodiment are part of each of the gyros 104 and accelerometer 107. The temperature sensors 121 sense temperature and compensate for changes outside the normal gyro and accelerometer ranges")***, ***(See at least Column 15, lines 36-39, "the measurement system to provide a correction signal for correction of gyro bias errors, the accelerometer errors, and the temperature derived from an internal temperature sensor to measure and correct for temperature extremes"), (See at least Column 22, lines 19-28, "Accuracy is improved by using DC offset removal at two temperature points, recalibrating the gyros to reduce drift. These equations can be extended to both -60° C. and + 105° C., if needed…"The IMU measures each gyro temperature sensor continuously and corrects each device once per second to achieve maximum overall accuracy).***

Therefore, it would have been obvious to one of ordinary skill in the art before the effective filing date of the claimed invention to modify the sensor device comprising a printed circuit board that comprises a digital accelerometer that permits calculation in both the pitch or roll direction regardless of positioning of the respective device relative to the vehicle to which the one or more sensor devices are secured for determining the height needed to adjust wheels of the vehicle of Thorpe and include comparing temperature data transmitted from a digital temperature sensor with data stored in a temperature correction table having temperature correction data for environmental air temperatures ranging from about -60 °C to about 90 °C to determine how to correct deviations within the capture measurement data as taught by

Tanenhaus because it would allow the temperature sensors sense temperature and compensate for changes outside the normal gyro and accelerometer ranges ***(See Tanenhaus at least Column 11, lines 6-8).***

In regards of claim 17, Thorpe discloses the non-transitory computer readable medium according to claim 16, further comprising calculating a change of height of each wheel position of a motorized recreational vehicle when the sensor device is installed on the motorized recreational vehicle ***(¶ 8, via The foregoing patents are representative of leveling systems that require manual, independent determination of the amount of height adjustment needed to place the vehicle in the level condition), (¶ 0011, via the leveling system has a level unit which determines how level the vehicle is and wirelessly transmits that information to a control unit which visually indicates to the operator the amount the recreational vehicle is out of level in degrees and the amount needed to raise a side or end of the vehicle in order to level the vehicle), (See at least ¶ 5, via that are configured to allow the user to drive the vehicle's wheel(s) up on one or more blocks).***

In regards of claim 18, Thorpe discloses the non-transitory computer readable medium according to claim 17, wherein the step of displaying the calculated changes in height comprises displaying the change of height of each wheel position of the motorized recreational vehicle on the smart device ***(¶ 0012, via The control unit also has a display panel for displaying the pitch and roll information received from the level unit and one or more operator accessible control buttons for activating and operating the leveling system.), (See at least ¶ 5, via that are configured to allow the user to drive the vehicle's wheel(s) up on one or more blocks).***

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 **LUIS MARTINEZ** whose email is luis.martinezborrero@uspto.gov and telephone number is (571)272-4577. The examiner can normally be reached on Monday-Friday 8:30AM-5:00PM EST.

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, **FADEY JABR** can be reached on (571) 272-1516. 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.

/L.A.M/
Examiner, Art Unit 3668

/COURTNEY D HEINLE/
Primary Examiner, Art Unit 3668

Notice of References Cited	Application/Control No. 15/619,261	Applicant(s)/Patent Under Reexamination Leonard, Charles A.	
	Examiner LUIS A MARTINEZ BORRERO	Art Unit 3668	Page 1 of 2

U.S. PATENT DOCUMENTS

*		Document Number Country Code-Number-Kind Code	Date MM-YYYY	Name	CPC Classification	US Classification
*	A	US-9421907-B2	08-2016	Carpani; Anthony	G01C9/00	1/1
*	B	US-20080142768-A1	06-2008	Thorpe; Jim	B60S9/12	254/423
*	C	US-20070180719-A1	08-2007	Donnelly; Edward J.	B60S9/02	33/366.11
*	D	US-7786883-B1	08-2010	Davison, III; George M.	B60P3/36	33/366.11
*	E	US-7743520-B1	06-2010	Jiorle; Michael A.	G01C9/28	33/366.11
*	F	US-7025361-B1	04-2006	Erickson; John Scott	B60S9/02	280/6.153
*	G	US-6037874-A	03-2000	Heironimus; Gregory	G01C9/06	33/366.16
*	H	US-4760649-A	08-1988	Preston; Corlis E.	B60R16/0233	33/333
*	I	US-3657695-A	04-1972	Birmingham; Robert C.	B60D1/36	280/400
*	J	US-4547972-A	10-1985	Heidel; Jeffrey C.	G01C9/06	33/299
*	K	US-20160161944-A1	06-2016	Leonard; Charles A.	G05D1/0016	701/2
*	L	US-4935883-A	06-1990	Hulsing II; Rand H.	G01V7/00	175/45
*	M	US-20120197587-A1	08-2012	Luk; Yiu Wah	B60W40/09	702/141

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.

Notice of References Cited	Application/Control No. 15/619,261	Applicant(s)/Patent Under Reexamination Leonard, Charles A.	
	Examiner LUIS A MARTINEZ BORRERO	Art Unit 3668	Page 2 of 2

U.S. PATENT DOCUMENTS

*		Document Number Country Code-Number-Kind Code	Date MM-YYYY	Name	CPC Classification	US Classification
*	A	US-20120208520-A1	08-2012	Howarter; Jamie C.	B60R25/2009	455/420
*	B	US-8239162-B2	08-2012	Tanenhaus; Martin E.	G01C21/16	702/145
	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.

Search Notes	Application/Control No.	Applicant(s)/Patent Under Reexamination
	15/619,261	Leonard, Charles A.
	Examiner	Art Unit
	LUIS A MARTINEZ BORRERO	3668

CPC - Searched*		
Symbol	Date	Examiner
G05D1/08, 1/0891, 1/0221, 1/0088, 1/0016,	12/07/2018	LAM
B60T17/22, 8/171, 2201/04, 7/22, 8/32,	12/07/2018	LAM
G05D1/0891, 1/0016,	06/11/2019	LAM
B62D1/00,	06/11/2019	LAM

CPC Combination Sets - Searched*		
Symbol	Date	Examiner

US Classification - Searched*			
Class	Subclass	Date	Examiner

* 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
East Search	12/07/2018	LAM
Google Patent Search	12/07/2018	LAM
East Search	06/11/2019	LAM

Interference Search			
US Class/CPC Symbol	US Subclass/CPC Group	Date	Examiner

	/L.A.M/ Examiner, Art Unit 3668

ETN1003
288/306

Index of Claims	Application/Control No.	Applicant(s)/Patent Under Reexamination
	15/619,261	Leonard, Charles A.
	Examiner	**Art Unit**
	LUIS A MARTINEZ BORRERO	3668

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

CLAIMS

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

CLAIM		DATE								
Final	Original	12/07/2018	06/11/2019							
	1	✓	✓							
	2	✓	-							
	3	✓	-							
	4	✓	✓							
	5	✓	✓							
	6	✓	✓							
	7	✓	✓							
	8	✓	✓							
	9	✓	✓							
	10	✓	-							
	11	✓	-							
	12	✓	✓							
	13	✓	✓							
	14	✓	✓							
	15	✓	✓							
	16	✓	✓							
	17	✓	✓							
	18	✓	✓							

EAST Search History

EAST Search History (Prior Art)

Ref #	Hits	Search Query	DBs	Default Operator	Plurals	Time Stamp
L1	1718	G05D1/0891.cpc.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2019/06/11 23:29
L2	657	B62D1/00.cpc.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2019/06/11 23:29
L3	3389	G05D1/0016.cpc.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2019/06/11 23:29
L4	11555	((temperature adj sensor) NEAR5 (GYRO OR ACCELEROMETER))	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2019/06/11 23:31
L5	1	1 and 4	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2019/06/11 23:31
L6	2	2 and 4	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2019/06/11 23:31
L7	16	3 and 4	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2019/06/11 23:31
L8	154	("20080059068" | "20090265193" |	US-PGPUB;	OR	OFF	2019/06/11

		"20100012776" | "20100215212" | "20100228418" | "20100268409" | "20100286859" | "20110270470" | "20120170797" | "20120197461" | "20120250010" | "20120271461" | "20130206915" | "20130216089" | "20130238168" | "20140061376" | "20140259549" | "20140267627" | "20140277842" | "20140316614" | "20140316616" | "20140324405" | "20140336928" | "20150325064" | "20150343644" | "20150344136" | "20150377405" | "20160004795" | "20160176542" | "4818990" | "5575438" | "7400384" | "7496226" | "7872794" | "7929125" | "8060270" | "8207484" | "8212995" | "8346578" | "8818572" | "8830485" | "8872818" | "8874283" | "8896819" | "8997362" | "9009000" | "9129355" | "9152863" | "9162753" | "9256225" | "9256994" | "9273981" | "9310221" | "9329599" | "9340283" | "9403593" | "9406237").PN. OR ("2012/0194551" | "9609288").URPN.	USPAT; USOCR			23:32
L9	1	("9008860").PN. OR ("9483050").URPN.	US-PGPUB; USPAT; USOCR	OR	OFF	2019/06/11 23:32
L10	1	("20160314621").PN. OR ("9760089").URPN.	US-PGPUB; USPAT; USOCR	OR	OFF	2019/06/11 23:32
L11	1	"20120197587"	US-PGPUB	OR	OFF	2019/06/11 23:33
L12	18	"8239162"	US-PGPUB; USPAT	OR	OFF	2019/06/11 23:34
L13	1	"20080142768"	US-PGPUB; USPAT	OR	OFF	2019/06/11 23:35
L14	412	((("LEONARD") near3 ("Charles"))).INV.	US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT	OR	OFF	2019/06/11 23:35
L15	2	14 and 1	US-PGPUB; USPAT	OR	OFF	2019/06/11 23:35
S1	1584	((vehicle or car or automobile) near4(level$4)) and ((sens$4 or detect$3)near5 (inclinat$4))	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2018/12/06 22:52
S2	486	S1 AND ((G05D1/0088 OR G05D2201/0213 OR G05D1/0061 OR G05D1/0223 OR G05D1/0257 OR G05D1/0016 OR G05D1/0891 OR G05D1/0011 OR G05D1/0055 OR G05D1/0094 OR G05D1/02 OR G05D1/0214 OR G05D1/0221 OR G05D1/0274 OR G05D1/0278 OR G05D1/12 OR G05D2201/0201 OR G05D2201/0208 OR G05D2201/0215 OR B60T2201/04 OR B60T7/12 OR	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2018/12/06 22:53

		B60T8/171 OR B60T13/662 OR B60T17/22 OR B60T2201/022 OR B60T2201/06 OR B60T2260/06 OR B60T7/122 OR B60T7/22 OR B60T8/245 OR B60T1/062 OR B60T2210/36 OR B60T2220/04 OR B60T7/042 OR B60T8/32 OR B60T8/3205 OR B60T13/74 OR B60T13/741 OR B60T1/005 OR B60T2201/09 OR B60T2201/10 OR B60T2210/14 OR B60T2210/16 OR B60T2230/03 OR B60T2230/04 OR B60T2270/89 OR B60T7/085 OR B60T7/20 OR B60T8/17 OR B60T8/1706 OR B60T8/172 OR B60T8/175 OR B60T8/17552 OR B60T8/17616 OR B60T8/3215 OR B60T8/4827 OR B60T8/52).CPC. OR (1/1 OR 348/148 OR 600/479 OR 701/41).CCLS. OR (G05D1/00 OR G05D1/02 OR G05D1/08 OR G05D1/12 OR B60T8/32 OR B60T7/12 OR B60T8/24 OR B60T13/66 OR B60T8/171 OR B60T13/74 OR B60T17/22 OR B60T1/00 OR B60T7/20 OR B60T8/172 OR B60T8/175 OR B60T8/1755 OR B60T8/1761 OR B60T8/48).IPCR.)				
S3	94	S2 and inclinat$3 and sensor and pitch and roll	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2018/12/06 22:54
S4	4	((vehicle or car or automobile) near4(level$4)) with ((sens$4 or detect$3)near5 (inclinat$4)) with (accelerometer or gyroscope)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2018/12/06 22:55
S5	11	("20070180719" | "20080142768" | "3657695" | "4547972" | "4760649" | "6037874" | "6397133" | "7025361" | "7743520" | "7786883" | "8083015").PN. OR ("9421907").URPN.	US-PGPUB; USPAT; USOCR	OR	OFF	2018/12/06 22:56
S6	22	("3739364" | "4085375").PN. OR ("4547972").URPN.	US-PGPUB; USPAT; USOCR	OR	OFF	2018/12/06 22:59
S7	17	("3861052" | "3916531" | "4182046" | "4492029" | "4584778" | "4658508").PN. OR ("4760649").URPN.	US-PGPUB; USPAT; USOCR	OR	OFF	2018/12/06 22:59
S8	43	("4912662" | "5083383" | "5168632" | "5259118" | "5313713" | "5410532" | "5479715" | "5488779" | "5680208" | "5689330").PN. OR ("6037874").URPN.	US-PGPUB; USPAT; USOCR	OR	OFF	2018/12/06 22:59
S9	14	("5176391" | "5890721" | "5915700" | "6176495" | "6351696" | "6584385").PN. OR ("7025361").URPN.	US-PGPUB; USPAT; USOCR	OR	OFF	2018/12/06 22:59
S10	25	("20060064888" | "3233235" | "3324564" | "3657551" | "4154000" | "4467527" | "4625423" | "4658508" | "5136784" | "5784794" | "6526668" | "6836972" |	US-PGPUB; USPAT; USOCR	OR	OFF	2018/12/06 23:00

		"6981333").PN. OR ("7743520").URPN.				
S11	33	("20060100979" | "20070180719" | "20070245579" | "20080142768" | "2155876" | "3181203" | "3258884" | "3260564" | "3417518" | "3866365" | "4232488" | "4568096" | "4572527" | "4743037" | "4746133" | "4784400" | "5078442" | "5136784" | "5159989" | "5176391" | "5188379" | "5676385" | "5806196" | "6176495" | "6526668" | "7025361").PN. OR ("7786883").URPN.	US-PGPUB; USPAT; USOCR	OR	OFF	2018/12/06 23:00
S12	0	((vehicle or car or automobile) near4(level$4)) with ((sens$4 or detect$3)near5 (inclinat$4)) with (accelerometer or gyroscope) with ((smart adj device) or d evice or phone or cell or cellphone)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2018/12/06 23:02
S13	33690	((vehicle or car or automobile) near4 (level$4)) and ((smart adj device) or phone or cell or cellphone or mobile)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2018/12/06 23:05
S14	10900	S13 AND ((G05D1/0088 OR G05D1/0891).CPC. OR (1/1).CCLS. OR (G05D1/02 OR G05D1/00 OR G05D1/08).IPCR.)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2018/12/06 23:06
S15	799	S14 and sensor and pitch and roll	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2018/12/06 23:07
S16	457	S15 and ((sens$3 or determin$3 or detect$3) near5 (inclination or orientation))	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2018/12/06 23:08
S17	149	S16 and accelerometer and gyroscope	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2018/12/06 23:09
S18	47	S17 and ((adjust$3) near5 (level$3 or inclination or tilt))	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2018/12/06 23:10
S19	2615	(pitch near3 roll) with level$3	US-PGPUB;	OR	OFF	2018/12/06

			USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB			23:12
S20	349	S19 and (axis near3 accelerometer)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2018/12/06 23:12
S21	204	S20 and ((adjust$3 or alter$3 or chang$3 or modif$4) near3 (level$3 or orientation or inclination))	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2018/12/06 23:13
S22	18	((pitch near3 roll) near6 (axis near3 accelerometer)) with (vehicle car or automobile)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2018/12/06 23:14
S23	0	(tri-axial) with accelerometer with 1evel$3	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2018/12/06 23:16
S24	52	(tri-axial) with accelerometer with level$3	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2018/12/06 23:17
S25	124	(tri-axial) with accelerometer with (temperature adj sensor)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2018/12/06 23:18
S26	57	((tri-axial) near3 accelerometer) near6(temperature adj sensor)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2018/12/06 23:18
S27	14	"4935883"	USPAT	OR	OFF	2018/12/06 23:21
S28	1	"20120197587"	US-PGPUB	OR	OFF	2018/12/06 23:22
S29	1	"20120208520"	US-PGPUB	OR	OFF	2018/12/06

						23:23
S30	410	((("LEONARD") near3 ("Charles"))).INV.	US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT	OR	OFF	2018/12/06 23:26

EAST Search History (Interference)

< This search history is empty>

6/ 11/ 2019 11:37:30 PM
C:\ Users\ lmartinezborrero\ Documents\ EAST\ Workspaces\ 15619261.wsp

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 15/619,261	Filing Date 06/09/2017	☐ 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)		(Column 2)	(Column 3)			
AMENDMENT	08/20/2019	CLAIMS REMAINING AFTER AMENDMENT		HIGHEST NUMBER PREVIOUSLY PAID FOR	PRESENT EXTRA		RATE ($)	ADDITIONAL FEE ($)
	Total (37 CFR 1.16(i))	* 18	Minus	** 20	= 0		x $50 =	0
	Independent (37 CFR 1.16(h))	* 3	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".	/SHARON D HARRIS/
*** 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.

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Inventor(s)	Charles A. LEONARD
Application No.	15/619,261
Filing Date	June 9, 2017
Title	VEHICLE LEVELING SYSTEMS, DEVICES AND METHODS AND COMPUTER PROGRAM PRODUCTS FOR LEVELING VEHICLES USING SMART DEVICES
Examiner	MARTINEZ BORRERO, Luis A.
Art Unit	3668
Confirmation No.	2353

Commissioner for Patents
Via EFS-Web

AMENDMENT AND RESPONSE TO FINAL OFFICE ACTION

In response to the Final Office Action dated June 21, 2019, rejecting claims 1, 4-9, and 12-18 of the above-referenced Application, in which claims 1, 7, 9, 14, 16, and 18-30 are pending, Applicant respectfully requests that the following amendments be entered and remarks be considered, without prejudice or disclaimer to continued examination on the merits. In view of these amendments and remarks, Applicant submits that the Application is now in condition for allowance and respectfully requests such action. The present response is being submitted with a Request for Continued Examination (RCE) in accordance with 37 C.F.R. § 1.114.

AMENDMENTS TO THE CLAIMS begin on page 2; and

APPLICANT ARGUMENTS/REMARKS MADE begin on page 10.

CLAIMS

Please amend the claims as follows, without prejudice or disclaimer to continued examination on the merits:

1. (Currently Amended) A ~~leveling~~ system for leveling a vehicle that is at rest, the ~~leveling~~ system comprising:

a sensor device secured to a vehicle to sense ~~at least one of~~ an inclination ~~or an orientation~~ of the vehicle in both a pitch direction and a roll direction, each of the one or more sensor devices comprising a printed circuit board that ~~comprises~~ includes:

a digital accelerometer ~~that uses an X-axis, Y-axis, and a Z-axis~~ that permits calculation in both the pitch ~~or~~ direction and roll direction ~~regardless of positioning of the respective one or more sensor devices relative to the vehicle to which the one or more sensor devices are secured~~, and

a processor to process data collected by the respective sensor device; and

~~a digital temperature sensor that collects and transmits temperature data of the ambient air where the vehicle is at rest to the processor, wherein the processor compares the transmitted temperature data with data stored in a temperature correction table having temperature correction data for environmental air temperatures ranging from about −60 °C to about 90 °C to determine how to correct deviations within the collected data; and~~

a smart device in wireless communication with the sensor device to allow information received from the sensor device about ~~at least one of~~ the inclination ~~or the orientation~~ of the vehicle in both the pitch direction and the roll direction to be processed ~~to provide measurements to a user and~~ to determine an amount of adjustments in height needed to ~~adjust wheels of~~ level the vehicle~~, when the vehicle has four wheels, the smart device configured to determine an initial level position based upon the position of a highest wheel of the vehicle to provide a calibration data of the pitch and roll angle measurements for determining the amount the remaining wheels of the vehicle need to be raised to reach a level position~~ in both the pitch direction and the roll direction;

wherein the vehicle includes four wheels, and wherein at least one of the sensor device and smart device is configured to determine, based on the height needed to level the vehicle in both

the pitch direction and the roll direction, adjustments in height to four parts of a frame of the vehicle, the four parts of the frame located at or near the four wheels of the vehicle.

2-6. (Cancelled)

7. (Original) The system according to claim 1, wherein the smart device and the sensor device communicate with each other through a wireless connection and the smart device is configured to receive a serial number of the sensor device so that the smart device communicates with the particular sensor device.

8. (Cancelled)

9. (Currently Amended) A method for leveling a recreational vehicle having at least a front driver-side wheel, a back driver-side wheel, a front passenger-side wheel, and a back passenger-side wheel, the method comprising:

~~providing a leveling system comprising~~

~~one or more sensor devices secured to a vehicle to sense at least one of~~ sensing an inclination ~~or an orientation~~ of the recreational vehicle in both a pitch direction and a roll direction;

~~and a smart device in communication with the one or more sensor devices, each of the one or more sensor devices comprising a printed circuit board that comprises a digital accelerometer that uses an X-axis, Y-axis, and a Z-axis that permits calculation in both the pitch or roll direction regardless of positioning of the respective one or more sensor devices relative to the vehicle to which the one or more sensor devices are secured for~~ determining ~~the~~ an amount of adjustments in height needed to ~~adjust wheels of~~ level the recreational vehicle~~, when the vehicle has two or more wheels~~ in both the pitch direction and roll direction, and

~~a digital temperature sensor that collects and transmits temperature data of the ambient air where the vehicle is at rest to a processor, wherein the processor compares the transmitted temperature data with data stored in a temperature correction table having temperature correction data for environmental air temperatures ranging from about −60 °C to about 90 °C to determine how to correct deviations within data collected from the one or more sensor devices;~~

~~determining an initial level position for the vehicle using the smart device to determine any inconsistencies inherent in the leveling system;~~

~~capturing pitch and roll angle measurements from the sensor device taken at the initial level position of a single wheel of the vehicle to provide a calibration data of the pitch and roll angle measurements to permit consideration of any inconsistencies determined when taking measurement readings at a future time;~~

~~measuring the pitch angle and the roll angle of the vehicle when the vehicle is at rest using the sensor device;~~

~~retrieving calibration data of pitch angle and roll angle measurements taken by the sensor device when the vehicle was at an initial level position;~~

~~calculating any needed change in height to the remaining wheels of the vehicle to obtain a level position of the vehicle in at least one of the pitch directions or the roll direction of the vehicle using the calibration data of pitch and roll angle measurements;~~

calculating an adjustment in height to four portions of a frame of the recreational vehicle based on the amount of adjustments in height needed to level the vehicle in both the pitch direction and the roll direction, the four portions of the frame located at or near the front driver-side wheel, the back driver-side wheel, the front passenger-side wheel, and the back passenger-side wheel; and

displaying the calculated ~~change~~ adjustment in the height to the ~~remaining wheels~~ four portions of the frame of the recreational vehicle ~~in at least one of the pitch directions or the roll direction of the vehicle~~ on the smart device~~; and~~

~~adjusting the height to the wheels of the vehicle to obtain the level position of the vehicle based on the calculated change~~.

10-13. (Cancelled)

14. (Currently Amended) The method according to claim 9, wherein the smart device and the sensor device communicate with each other through a wireless ~~connect on~~ connection and further comprising entering a serial number of the sensor device into the smart device so that the smart device communicates with the particular sensor device.

15. (Cancelled)

16. (Currently Amended) A non-transitory computer readable medium comprising computer executable instructions ~~embodied in a computer readable medium~~ that when executed by a processor of a computer control the computer to perform steps comprising:

receiving on a smart device a pitch angle measurement and a roll angle measurement of a vehicle when the vehicle is at rest from a sensor device secured to the vehicle~~, the sensor device comprising a printed circuit board that comprises a digital accelerometer that uses an X-axis, Y-axis, and a Z-axis that permits calculation~~ ;

calculating in both the pitch ~~or~~ direction and the roll direction ~~regardless of positioning of the respective device relative to the vehicle to which the one or more sensor devices are secured~~ for determining the height needed to adjust a frame of the vehicle at four locations at or near four wheels of the vehicle~~, when the vehicle has two or more wheels~~ to level the vehicle~~, and an inclination or an orientation of the vehicle~~ in both [[a]] the pitch direction and [[a]] the roll direction; and

~~capturing pitch and roll angle measurements from the sensor device taken at the initial level position based upon the position of a single wheel of the vehicle, the smart device after determining an initial level position for the vehicle using the smart device to provide a calibration data of the pitch and roll angle measurements to permit consideration of any inconsistencies determined when taking measurement readings at a future time;~~

~~retrieving calibration data of pitch angle and roll angle measurements taken by the sensor device when the vehicle was at the initial level position;~~

~~comparing temperature data transmitted from a digital temperature sensor with data stored in a temperature correction table having temperature correction data for environmental air temperatures ranging from about −60 °C to about 90 °C to determine how to correct deviations within the captured measurement data;~~

~~calculating any needed change in height the remaining wheels of the vehicle to obtain a level position of the vehicle in at least one of a pitch directions or a roll direction of the vehicle using the calibration data of the pitch and roll angle measurements; and~~

displaying, on the smart device, the ~~calculated change~~ adjustment in height to the ~~remaining wheels~~ frame of the vehicle to obtain a level position of the vehicle in ~~at least one of~~ the pitch direction ~~or~~ and the roll direction ~~of the vehicle needed to obtain the level position of the vehicle on the smart device so that the height to at least one of the rear or front section or the first or second~~

~~side sections of the vehicle is adjusted to obtain the level position of the vehicle based on the calculated change~~.

17. (Cancelled)

18. (Currently Amended) The non-transitory computer readable medium according to ~~claim 17~~ claim 16, wherein the step of displaying the ~~calculated changes~~ adjustment in height comprises the step of displaying the change of height of the frame at or near each wheel position of the ~~motorized recreational~~ vehicle on the smart device.

19. (New) The system according to claim 1, wherein the smart device is configured to display an image representing the vehicle on a display screen of the smart device, and wherein the smart device is further configured to display the adjustments in height to the four parts of the frame located at or near the four wheels of the vehicle.

20. (New) The system according to claim 1, wherein the smart device is further configured to display on the display screen near-real-time height adjustments remaining that are needed to level the vehicle when the vehicle is in the process of being leveled.

21. (New) The system according to claim 1, wherein the smart device is configured to calculate a first adjustment in height to level the vehicle in the pitch direction and a second adjustment in height to level the vehicle in the roll direction, and wherein the smart device is further configured to calculate the adjustments in height to each of the four parts of the frame of the vehicle by adding the first adjustment with the second adjustment.

22. (New) The system according to claim 21, wherein:

the four parts of the frame include a first part located at or near a front driver-side wheel, a second part located at or near a back driver-side wheel, a third part located at or near a front passenger-side wheel, and a fourth part located at or near a back passenger-side wheel;

an adjustment in height to the first part includes adding a rearward pitch adjustment of the first adjustment with a right roll adjustment of the second adjustment;

an adjustment in height to the second part includes adding a forward pitch adjustment of the first adjustment with the right roll adjustment of the second adjustment;

an adjustment in height to the third part includes adding the rearward pitch adjustment of the first adjustment with a left roll adjustment of the second adjustment; and

an adjustment in height to the fourth part includes adding the forward pitch adjustment of the first adjustment with the left roll adjustment of the second adjustment.

23. (New) The system according to claim 1, further comprising a temperature calibration lookup table, wherein the smart device is configured to correct the adjustments in height based on current temperature readings and information from the temperature calibration lookup table.

24. (New) The method according to claim 9, further comprising:

calculating a first adjustment in height to level the vehicle in the pitch direction;

calculating a second adjustment in height to level the vehicle in the roll direction;

the four parts of the frame include a first part located at or near a front driver-side wheel, a second part located at or near a back driver-side wheel, a third part located at or near a front passenger-side wheel, and a fourth part located at or near a back passenger-side wheel;

calculating an adjustment in height to a first part of the frame located at or near a front driver-side wheel by adding a rearward pitch adjustment of the first adjustment and a right roll adjustment of the second adjustment;

calculating an adjustment in height to a second part of the frame located at or near a rear driver-side wheel by adding a forward pitch adjustment of the first adjustment and the right roll adjustment of the second adjustment;

calculating an adjustment in height to a third part of the frame located at or near a front passenger-side wheel by adding the rearward pitch adjustment of the first adjustment and a left roll adjustment of the second adjustment; and

calculating an adjustment in height to a fourth part of the frame located at or near a rear passenger-side wheel by adding the forward pitch adjustment of the first adjustment and the left roll adjustment of the second adjustment.

25. (New) The method according to claim 9, further comprising the step of displaying on the display screen near-real-time height adjustments remaining that are needed to level the vehicle when the vehicle is in the process of being leveled.

26. (New) The method according to claim 9, further comprising the step of correcting the adjustments in height based on current temperature readings and information from a temperature calibration lookup table.

27. (New) The non-transitory computer readable medium according to claim 16, wherein the computer executable instructions, when executed, further control the computer to:

calculate a first adjustment in height to level the vehicle in the pitch direction and a second adjustment in height to level the vehicle in the roll direction; and

calculate the adjustments in height to each of the four parts of the frame of the vehicle by adding the first adjustment with the second adjustment.

28. (New) The non-transitory computer readable medium according to claim 27, wherein the four parts of the frame include a first part located at or near a front driver-side wheel, a second part located at or near a back driver-side wheel, a third part located at or near a front passenger-side wheel, and a fourth part located at or near a back passenger-side wheel, and wherein the computer executable instructions, when executed, further control the computer to:

calculate an adjustment in height to the first part by adding a rearward pitch adjustment of the first adjustment with a right roll adjustment of the second adjustment;

calculate an adjustment in height to the second part by adding a forward pitch adjustment of the first adjustment with the right roll adjustment of the second adjustment;

calculate an adjustment in height to the third part by adding the rearward pitch adjustment of the first adjustment with a left roll adjustment of the second adjustment; and

calculate an adjustment in height to the fourth part by adding the forward pitch adjustment of the first adjustment with the left roll adjustment of the second adjustment.

29. (New) The non-transitory computer readable medium according to claim 16, wherein the computer executable instructions, when executed, further control the computer to

display, in near real time, height adjustments that are remaining for leveling the vehicle during a vehicle leveling process.

30. (New) The non-transitory computer readable medium according to claim 16, wherein the computer executable instructions, when executed, further control the computer to correct the adjustments in height based on current temperature readings and information from a temperature calibration lookup table.

REMARKS

This Amendment and Response is being submitted in response to the Final Office Action dated June 21, 2019. In the present amendment, claims 1, 9, 14, 16, and 18 have been amended and claims 4-6, 8, 12, 13, 15, and 17 have been cancelled to further clarify the subject matter which Applicant regards as the present invention, without prejudice or disclaimer to continue examination on the merits. Also, new claims 19-30 are added in the present application. These amendments are fully supported in the Specification, Drawings, and Claims of the Application and no new matter has been added. Based upon the amendments and the remarks presented herein, reconsideration of the Application is respectfully requested.

I. Response to Double Patenting Rejection

Claims 1, 4-9, and 12-18 stand rejected as being provisionally rejected on the ground of non-statutory double patenting as being unpatentable over claims 1-5, 7, 10, 12, 14-16, 18, 20, 22-29, 38, 43, and 44 of co-pending App. No. 14/961,787. Applicant respectfully traverses the Double Patenting rejection for at least the reason that the claims in the present application and the claims in App. No. 14/961,787 have been extensively amended. Applicant believes that the claims in the two applications are directed to patentably distinct inventions and therefore respectfully requests that the Examiner kindly withdraw the Double Patenting rejection.

II. Response to 35 U.S.C. § 112(f) Claim Interpretation

The Office Action interprets the term "smart device," which appears in several of the pending claims, as invoking an interpretation of "means plus function." Applicant respectfully disagrees and contends that the claimed smart device includes specific structure that allows "wireless communication with the sensor device" and includes other structural elements. Therefore, Applicant respectfully requests that the Examiner kindly interpret the term "smart device" according to its common ordinary definition without invoking an interpretation under 35 U.S.C. § 112(f).

III. Response to 35 U.S.C. § 112 Rejections

Claims 1, 4-9, and 12-18 stand rejected under 35 U.S.C. § 112(a) as allegedly failing to comply with the written description requirement. To advance prosecution of the present