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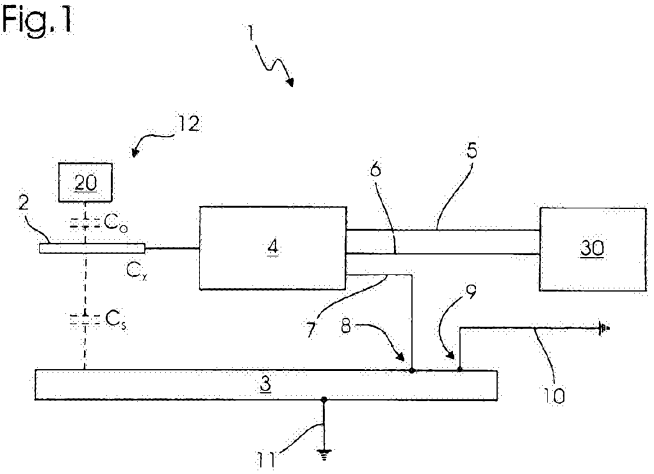
(54) **Capacitive Sensor Arrangement.**

(57) The invention relates to a capacitive sensor arrangement (1), comprising a sensing electrode (2) having a capacitance (Cx) which depends on the presence of the object (20) in a detection space (12); - a measurement device (4) connected to the sensing electrode (2) and configured to detect the capacitance (Cx) of the sensing electrode (2); a conducting structure (3), wherein the capacitance (Cx) of the sensing electrode (2) depends on a grounded condition of the structure (3). In order to provide means for a reliable capacitive measurement, the invention provides that the measurement device (4) is connected to a power supply line (5) for connection to a power source (30) and to a first ground line (7); operability of the measurement device (4) depends on the first ground line (7) being at least indirectly connected to ground; and the first ground line (7) is connected to the structure (3).

Fig.1



Capacitive Sensor Arrangement

Technical field

[0001] The present invention generally relates to a capacitive sensor arrangement.

Background of the Invention

[0002] Capacitive sensors today are used for a vast variety of applications, like input devices (e.g. touchpads, capacitive sliders, touch wheels, etc.), proximity sensors or occupant detection systems.

[0003] There are many different types of capacitive sensors known in the art, but most of them rely on the following principle. A sensing electrode is disposed so that an approaching object (person, hand, finger or the like) changes the capacitance of the electrode with respect to ground. This changing capacitance is measured by a measurement circuit or measurement device. For instance, the sensing electrode may be connected to an alternating voltage, e.g. a square-wave voltage, and the current through the sensing electrode, which depends on its capacitance, can be converted by the measurement circuit into a voltage. This voltage is indicative of the capacitance and thus may be used to determine whether an object is near the electrode.

[0004] However, in many cases, the total capacitance of the sensing electrode to ground is also influenced by conducting objects or structures permanently in the vicinity of the electrode. E.g. in the case of an occupancy sensor, metal components of the respective vehicle seat (a seat frame or the like) influence the capacity of the sensing electrode. In other applications, the sensor arrangement may be used for hands-off detection, i.e. to detect whether at least one of the driver's hands is in contact with the steering wheel or not. In that case, the conducting object or structure is part of the vehicle steering wheel, e.g. the steering wheel frame or steering wheel core. The electric field between the electrode and the respective object differs considerably depending on whether the object is connected to ground (thus having a defined potential) or not (thus having an undefined or "floating" potential). If the connection to ground is maintained, the respective object accounts for an offset in the capacitive measurements. However,

in some applications, it is difficult to guarantee a connection to ground for the service lifetime of the sensor. Thus, especially for safety-relevant systems, it is necessary to monitor the grounded condition of the respective structure.

[0005] Presently, there are two concepts of performing such monitoring. According to a first concept, the structure is connected by two separate wires to the measurement device. One wire provides the ground potential and the second wire is used for monitoring the connection between the measurement device and the structure. According to a second concept, the structure is connected to the measurement device with one wire which provides the ground potential during the capacitive measurements. In a diagnostics mode, the wire is used to apply an AC current to the structure, which current is measured. If the AC current is above a threshold, it can be concluded that the structure is still connected to the connection wire and to ground. This approach, which is described in WO 2014/122197 A1, although reliable, is rather complicated, since it requires or dedicated circuitry for the diagnostics mode.

Object of the invention

[0006] It is therefore desirable to provide means for a reliable capacitive measurement.

[0007] This problem is solved by a capacitive sensor arrangement according to claim 1.

General Description of the Invention

[0008] The invention provides a capacitive sensor arrangement for detecting an object. The application of the inventive sensor arrangement is not limited in any way, but it may be in particular be used in automotive systems, e.g. as an occupancy sensor for a vehicle seat or a sensor for a smart trunk opener or a capacitive sensor for hands-off detection in a steering wheel.

[0009] The sensor comprises a sensing electrode having a capacitance which depends on the presence of the object in a detection space. In other words, the capacitance of the sensing electrode depends on whether the object is in the detection space or not. In this context, "detection space" refers to a space where the presence of the object (significantly) influences the capacitance. It is

understood that such a detection space is at least partially in the proximity of the sensing electrode, and may in particular be adjacent to the sensing electrode. Of course, the sensor arrangement may comprise a plurality of sensing electrodes.

[0010] A measurement device is connected to the sensing electrode and is configured to detect the capacitance of the sensing electrode. Here and in the following, unless otherwise specified, "connected" is to be understood as "electrically connected". Detecting the capacitance means that the measurement device measures at least one quantity from which the capacitance can be derived. Normally, the measurement device is configured to apply an alternating voltage to the sensing electrode. It is preferred that the alternating voltage is periodic and thus can be characterised by a (base) frequency. The measurement device may be connected directly to the sensing electrode, but there may also be other elements in between. In order to detect the capacitance, the measurement device may apply a voltage having known characteristics and detect the resulting current flowing into the sensing electrode.

[0011] Furthermore, the sensor arrangement comprises a conducting structure, wherein the capacitance of the sensing electrode depends on a grounded condition of the structure. An example of such a conducting structure is a metal structure permanently in the vicinity of the sensing electrode, which may be necessary e.g. for mechanical reasons. For example, the conducting structure may be a support for other elements (or even the sensing electrode itself). Normally, the conducting structure has no direct electrical connection to the sensing electrode. As a voltage is applied to the sensing electrode, an electric field is generated, which also influences charge carriers within the conducting structure. If the structure is connected to ground, therefore having a defined electrical potential, part of the current flowing into the sensing electrode flows via the grounded structure to ground and thus influences the capacitive sensing in a well-defined manner. However, if the conducting structure is not connected to ground, thereby having an undefined or floating potential, there will be no significant current flowing through the conducting structure towards ground and consequently the sensing current flowing into the sensing electrode is reduced. Whether or not the structure is connected to ground is referred to as a "grounded condition". This condition influences the electric field and thus the capacitance of the sensing

electrode. In other words, if the grounded condition changes during the service time of the sensor arrangement, this could falsify the capacitance-based detection of the object.

[0012] The measurement device is connected to a power supply line for connection to a power source and to a first ground line. Operability of the measurement device depends on the first ground line being at least indirectly connected to ground. The power source may be a voltage source or a current source. The power supply line and the first ground line can be any kind of wire or cable adapted to conduct electrical current. It may also be a bundle of wires. In order to operate the measurement device, the power supply line needs to be connected to a power source. The first ground line is configured for at least indirectly connecting the measurement device to ground so that the measurement device is connected in series between the power supply line and the first ground line.

[0013] In order to operate the measurement device, an electrical current flows through the power supply line, the measurement device and the first ground line. In other words, operability of the measurement device depends on the first ground line being (directly or indirectly) connected to ground. The power supply line, the measurement device and the first ground line are parts of one electrical circuit, which is only closed if the first ground line has a connection to ground. The measurement device is only fully operable if the first ground line is at least indirectly connected to ground. In some embodiments, the measurement device may retain a reduced operability even when the first ground line is not grounded. The structure may e.g. still be connected the battery ground potential via e.g. the vehicle chassis so that the capacitive measurements may still be valid.

[0014] In the inventive sensor arrangement, the first ground line is connected to the structure. Therefore, if the structure is connected to ground and the first ground line is intact, the measurement device is (fully) operable. If the measurement device is not (fully) operable, the structure is either not connected to ground or the first ground line has been disconnected. In the first case, the structure no longer has a defined potential, wherefore any measurements of the capacitance would be falsified. In the second case, it would be impossible to monitor the grounded condition of the structure, which would also make the

measurements unreliable. In both cases, where any measurements would be unreliable, the measurement device becomes (at least partially) inoperable so that normally no more measurements are conducted. In other words, any loss or uncertainty of the grounded condition of the structure becomes evident by the interoperability of the measurement device. Therefore, the inventive sensor arrangement does not need any diagnostic mode or complicated additional circuitry in order to verify the grounded condition of the structure.

[0015] The structure may be directly connected to ground, e.g. the structure may be connected mechanically to a component that has ground potential. However, in many cases, such connections are not reliable. According to a preferred embodiment, the structure is connected to ground by a second ground line. The second ground line may be designed similar to the first ground line. In this context, it is conceivable that the second ground line is directly connected to the first ground line. However, this bears the risk that the first ground line could become disconnected from the structure while the measurement device is still connected to ground via the first and second ground line.

[0016] Therefore, it is preferred that at least a portion of the structure is connected in series between the first and second ground line. In other words, the first and second ground lines are only connected indirectly via the structure. Thus, it can be assured that the measurement device becomes inoperable if the structure is not grounded.

[0017] In many applications, the results of the measurements of the measurement device need to be communicated to some other device. E.g. in the case of an occupancy sensor, the result of the measurement has to be communicated to other systems like a seat belt reminder or some active safety system like an airbag activator. Therefore, it is preferred that the measurement device is connected to a communication line for communication with another device. The communication line may be part of a bus system (e.g. together with the power supply line) and may comprise a plurality of wires. Communication may be one-way or two-way, digital or analogue.

[0018] It is preferred that operability of the measurement device is detectable by another device through the communication line. In other words, another device can determine whether or not the measurement device is (fully) operable by

receiving communication through the communication line or not receiving such communication. Normally, the measurement device is in an off state or a not-communicating state if the first ground line is not connected to ground. Thus, other devices cannot receive any signals from the measurement device through the communication line.

[0019] Normally, the measurement device, apart from detecting the capacitance of the sensing electrode, also processes the measurement result in order to identify whether there is an object in the detection space or not. In particular, the measurement device may be configured to output a signal indicative of the presence of the object. Such a signal may be output to the other device via the communication line. It may be a simple "binary" signal like "object present/not present" or it may contain some information on the classification of the object, e.g. the case of an occupancy sensor whether an adult or a child is seated on the respective seat.

[0020] As mentioned above, the inventive sensor arrangement may be used for an occupancy sensor. In such a case, the conducting structure is normally part of a vehicle interior, in particular of a vehicle seat. For instance, it may be a seat pan or seat frame made of metal. Also, the measurement device may be configured to detect the presence of an occupant on the vehicle seat. In other applications, the sensor arrangement may be used for hands-off detection, i.e. to detect whether at least one of the driver's hands is in contact with the steering wheel or not. In that case, the conducting structure is part of the vehicle steering wheel, e.g. the steering wheel frame or steering wheel core.

Brief Description of the Drawings

[0021] Further details and advantages of the present invention will be apparent from the following detailed description of not limiting embodiments with reference to the attached drawing, wherein:

Fig.1 is a schematic view showing an inventive capacitive sensor arrangement.

Description of Preferred Embodiments

[0022] Fig.1 by way of example illustrates an embodiment of a capacitive sensor arrangement 1 according to the invention. The sensor arrangement 1 comprises a

sensing electrode 2 which could be arranged in a vehicle seat as an occupancy sensor. The sensing electrode 2 is associated with a capacitance C_X relative to ground. The capacitance C_X is unknown and varies with the presence of an object 20 entering a detection space 12 of the sensing electrode 2. The object 20 could be the body of a person. The part of the capacitance C_X associated with the object 20 may be described as C_O. However, the total capacitance of the sensing electrode 2 also comprises a contribution C_S which results from the presence of a conducting structure 3 in the vicinity of the sensing electrode 2. The conducting structure 3 may be a metal structure like a seat frame in the vehicle or a metal core of the steering wheel. This capacitance C_S and therefore the total capacitance C_X largely depends on whether the structure 3 is connected to ground or not.

[0023] The sensing electrode 2 is connected to a measurement device 4 which is configured to detect the total capacitance C_X of the sensing electrode 2. For this purpose, the measurement device 4 may apply a sinusoidal voltage to the sensing electrode 2 and detect the flowing current. It is well-known that the capacitance is directly related to the current, the voltage and the frequency of the alternating voltage. In order to operate, the measurement device 4 needs to be supplied externally with power. A power supply line 5 is connected to the measurement device and to a control device 30, which supplies power e.g. from a vehicle battery, a generator or the like. The measurement device 4 is also connected to the control device 30 by a communication line 6, which may be part of one the same bus connection as the power supply line 5. The measurement device 4 may be configured to determine whether the object 20 is present or not and output a signal via the communication line 6 indicating the presence of the object 20. Also, the control device 30 may be able to detect whether or not the measurement device 4 is operable by the status of the communication line. E.g. if no communication from the measurement device 4 is received for a predetermined amount of time, this may be interpreted by the control device 30 as an inoperable state or off state of the measurement device 4.

[0024] The measurement device 4 is connected in series between the power supply line 5 and a first ground line 7. While the power supply line 5 supplies a voltage to the measurement device 4, the latter only becomes operable when it is

connected to ground via the first ground line 7. The first ground line 7 is connected to the structure 3 at a first connection point 8. Therefore, operability of the measurement device 4 depends on whether the structure 3 is connected to ground or not.

[0025] A second ground line 10 is connected to the structure 3 at a second connection point 9. This second ground line 10 is directly connected to ground. Therefore, as long as the first and second ground lines 7, 10 are intact, the measurement device 4 is operable and the measurement results are reliable since the structure 3 is connected to ground. It should be noted that the structure 3 may further be connected to ground by a secondary connection 11, which could be due to a mechanical connection to ground. E.g. if the structure 3 is a vehicle seat frame, this seat frame is mounted directly or indirectly to the vehicle body, which could also imply an electrical connection. However, such an electrical connection may be unreliable compared to the second ground line 10.

[0026] If the first ground line 7 is disconnected or both the second ground line 10 and the secondary connection 11 are disconnected, the measurement device 4 becomes inoperable. In this case, it cannot communicate with the control device 30, which detects the inoperability of the measurement device 4 and may output a corresponding warning signal.

[0027] In the embodiment shown, both connection points 8, 9 are located spaced-apart on the structure 3 so that at least a portion of the structure 3 is connected in series between the first ground line 7 and the second ground line 10. Alternatively, both connection points 8, 9 could be located on the same spot on the structure 3. Also, the second connection point 9 could be located away from the structure 3 on the first ground line 7. However, both of these options bear a certain risk that the connection of the measurement device 4 to ground could be maintained while the connection of the structure 3 to ground is lost.

List of Reference Symbols

1	capacitive sensor arrangement
2	sensing electrode
3	conducting structure
4	measurement device
5	power supply line
6	communication line
7, 10	ground line
8, 9	connection point
11	secondary connection
12	detection space
20	object
30	control device
CX, CO, CS	capacitance

P-IEE-473/LU

ANSPRÜCHE

1. Kapazitive Sensoranordnung (1) zum Erkennen eines Objekts (20), aufweisend

   - eine Messelektrode (2) mit einer Kapazität (C_X), die von dem Vorliegen des Objekts (20) in einem Erkennungsraum (12) abhängt;

   - eine Messvorrichtung (4), die mit der Messelektrode (2) verbunden und dafür ausgelegt ist, die Kapazität (C_X) der Messelektrode (2) zu erkennen;

   - eine leitfähige Struktur (3), wobei die Kapazität (C_X) der Messelektrode (2) von einem Erdungszustand der Struktur (3) abhängt;

   wobei die Messvorrichtung (4) an eine Stromversorgungsleitung (5) zur Verbindung mit einer Stromquelle (30) und an einen ersten Erdleiter (7) angeschlossen ist;

   die Funktionsfähigkeit der Messvorrichtung (4) davon abhängt, ob der erste Erdleiter (7) zumindest indirekt an Erde angeschlossen ist; und

   der erste Erdleiter (7) an die Struktur (3) angeschlossen ist.

2. Kapazitive Sensoranordnung gemäß Anspruch 1, dadurch gekennzeichnet, dass die Messvorrichtung (4) nur funktionsfähig ist, wenn der erste Erdleiter (7) zumindest indirekt an Erde angeschlossen ist.

3. Kapazitive Sensoranordnung gemäß Anspruch 1 oder 2, dadurch gekennzeichnet, dass die Struktur (3) durch einen zweiten Erdleiter (10) an Erde angeschlossen ist.

4. Kapazitive Sensoranordnung gemäß Anspruch 3, dadurch gekennzeichnet, dass zumindest ein Abschnitt der Struktur (3) in Reihe zwischen dem ersten (7) und dem zweiten Erdleiter (10) geschaltet ist.

5. Kapazitive Sensoranordnung gemäß einem der vorstehenden Ansprüche, dadurch gekennzeichnet, dass die Messvorrichtung (4) zur Kommunikation mit einer anderen Vorrichtung (30) an eine Kommunikationsleitung (6) angeschlossen ist.

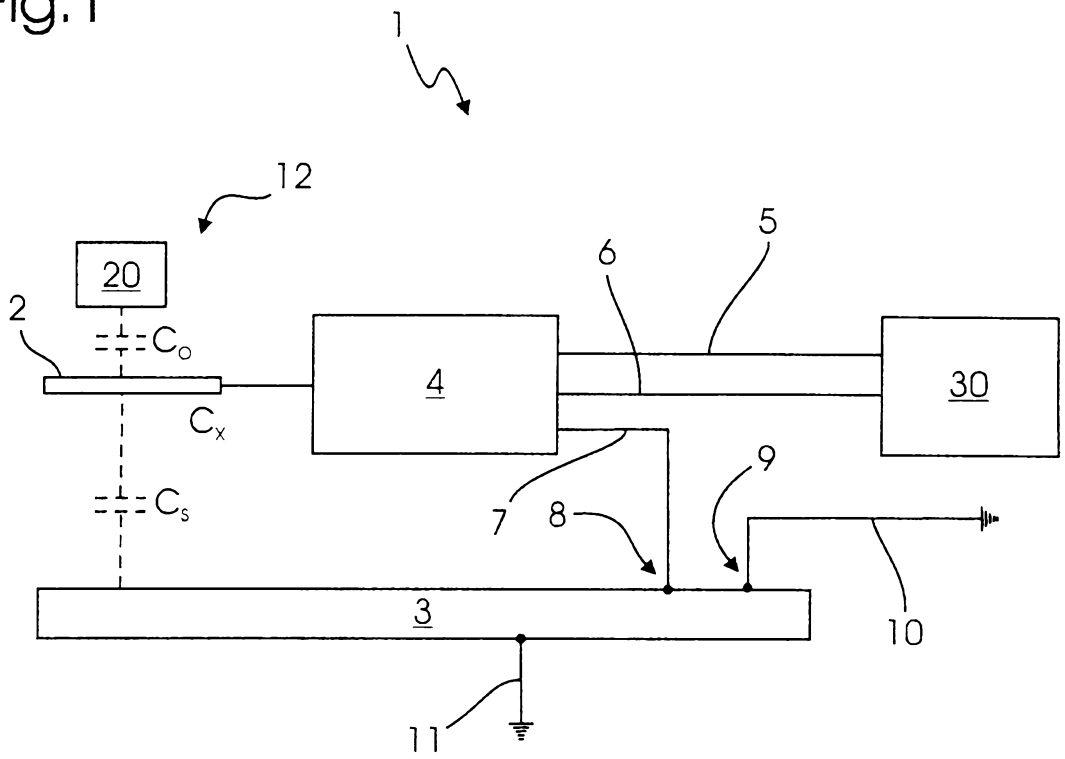
6. Kapazitive Sensoranordnung gemäß einem der vorstehenden Ansprüche, dadurch gekennzeichnet, dass die Funktionsfähigkeit der Messvorrichtung (4) von einer anderen Vorrichtung (30) durch die Kommunikationsleitung (6) erkennbar ist.

7. Kapazitive Sensoranordnung gemäß einem der vorstehenden Ansprüche, dadurch gekennzeichnet, dass die Messvorrichtung (4) dafür ausgelegt ist, ein Signal auszugeben, das das Vorliegen des Objekts (20) anzeigt.

8. Kapazitive Sensoranordnung gemäß einem der vorstehenden Ansprüche, dadurch gekennzeichnet, dass die Struktur (3) Teil eines Fahrzeuginnenraums, insbesondere eines Fahrzeugsitzes, ist.

9. Kapazitive Sensoranordnung gemäß einem der vorstehenden Ansprüche, dadurch gekennzeichnet, dass die Messvorrichtung (4) dafür ausgelegt ist, das Vorliegen eines Insassen auf dem Fahrzeugsitz zu erkennen.

Fig.1



Abstract

The invention relates to a capacitive sensor arrangement (1), comprising

- a sensing electrode (2) having a capacitance (C_X) which depends on the presence of the object (20) in a detection space (12);
- a measurement device (4) connected to the sensing electrode (2) and configured to detect the capacitance (C_X) of the sensing electrode (2);
- a conducting structure (3), wherein the capacitance (C_X) of the sensing electrode (2) depends on a grounded condition of the structure (3).

In order to provide means for a reliable capacitive measurement, the invention provides that the measurement device (4) is connected to a power supply line (5) for connection to a power source (30) and to a first ground line (7); operability of the measurement device (4) depends on the first ground line (7) being at least indirectly connected to ground; and the first ground line (7) is connected to the structure (3).

(Fig. 1)

LE GOUVERNEMENT
DU GRAND-DUCHÉ DE LUXEMBOURG
Ministère de l'Économie

National Application Number

LO 1703
LU 100330

SEARCH REPORT

in accordance with Article 35.1 a)
of the Luxembourg law on patents
dated 20 July 1992

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
X	US 2010/102833 A1 (UNO HIDEKI [JP] ET AL) 29 April 2010 (2010-04-29) * paragraph [0041] - paragraph [0072]; figures 1-4,6,7 *	1-9	INV. G01L1/14 G01D5/24 B60R21/015
X	US 2011/221459 A1 (UNO HIDEKI [JP] ET AL) 15 September 2011 (2011-09-15) * paragraph [0049] - paragraph [0059]; figures 1-6 *	1-9	
X	US 2002/024344 A1 (KATO RYOCHI [JP] ET AL) 28 February 2002 (2002-02-28) * paragraph [0068] - paragraph [0132]; figures 3-12 *	1-9	
X,D	WO 2014/122197 A1 (IEE SARL [LU]) 14 August 2014 (2014-08-14) * paragraph [0018] - paragraph [0029]; figures 1-2 *	1-9	

TECHNICAL FIELDS SEARCHED (IPC)

G01L
G01D
B60R

The present search report has been drawn up for all claims

	Date of completion of the search	Examiner
	9 March 2018	Gruss, Christian

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
Y : particularly relevant if combined with another document of the same category
A : technological background
O : non-written disclosure
P : intermediate document

T : theory or principle underlying the invention
E : earlier patent document, but published on, or after the filing date
D : document cited in the application
L : document cited for other reasons

& : member of the same patent family, corresponding document

1

ANNEX TO THE SEARCH REPORT ON LUXEMBOURG PATENT APPLICATION NO.

LO 1703
LU 100330

This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report. The members are as contained in the European Patent Office EDP file on
The European Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

09-03-2018

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 2010102833 A1	29-04-2010	JP 5146257 B2	20-02-2013
		JP 2010101862 A	06-05-2010
		US 2010102833 A1	29-04-2010
US 2011221459 A1	15-09-2011	JP 5560784 B2	30-07-2014
		JP 2011189763 A	29-09-2011
		US 2011221459 A1	15-09-2011
US 2002024344 A1	28-02-2002	NONE	
WO 2014122197 A1	14-08-2014	DE 112014000714 T5	29-10-2015
		LU 92149 A1	08-08-2014
		US 2015367751 A1	24-12-2015
		WO 2014122197 A1	14-08-2014

LE GOUVERNEMENT
DU GRAND-DUCHÉ DE LUXEMBOURG
Ministère de l'Économie

WRITTEN OPINION

File No.	Filing date *(day/month/year)*	Priority date *(day/month/year)*	Application No.
LO1703	29.06.2017		LU100330

International Patent Classification (IPC)
INV. G01L1/14 G01D5/24 B60R21/015

Applicant
IEE INTERNATIONAL ELECTRONICS & ENGINEERING S.A.

This report contains indications relating to the following items:

- ☒ Box No. I Basis of the opinion
- ☐ Box No. II Priority
- ☐ Box No. III Non-establishment of opinion with regard to novelty, inventive step and industrial applicability
- ☐ Box No. IV Lack of unity of invention
- ☒ Box No. V Reasoned statement with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement
- ☐ Box No. VI Certain documents cited
- ☐ Box No. VII Certain defects in the application
- ☐ Box No. VIII Certain observations on the application

Examiner
Gruss, Christian

Application No.
LU100330

WRITTEN OPINION

Box No. I Basis of the opinion

1. This opinion has been established on the basis of the latest set of claims filed before the start of the search.

2. With regard to any **nucleotide and/or amino acid sequence** disclosed in the application and necessary to the claimed invention, this opinion has been established on the basis of:

   a. type of material:

   ☐ a sequence listing

   ☐ table(s) related to the sequence listing

   b. format of material:

   ☐ on paper

   ☐ in electronic form

   c. time of filing/furnishing:

   ☐ contained in the application as filed.

   ☐ filed together with the application in electronic form.

   ☐ furnished subsequently.

3. ☐ In addition, in the case that more than one version or copy of a sequence listing and/or table relating thereto has been filed or furnished, the required statements that the information in the subsequent or additional copies is identical to that in the application as filed or does not go beyond the application as filed, as appropriate, were furnished.

4. Additional comments:

Box No. V Reasoned statement with regard to novelty, inventive step and industrial applicability; citations and explanations supporting such statement

1. Statement

Novelty	Yes:	Claims	
	No:	Claims	1-9
Inventive step	Yes:	Claims	
	No:	Claims	1-9
Industrial applicability	Yes:	Claims	1-9
	No:	Claims	

2. Citations and explanations

see separate sheet

Re Item V

Reasoned statement with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

1 References

Reference is made to the following documents:

D1 US 2010/102833 A1 (UNO HIDEKI [JP] ET AL) 29 April 2010

D2 US 2011/221459 A1 (UNO HIDEKI [JP] ET AL) 15 September 2011

D3 US 2002/024344 A1 (KATO RYOCHI [JP] ET AL) 28 February 2002

D4 WO 2014/122197 A1 (IEE SARL [LU]) 14 August 2014

Note: Document D4 is cited in the application.

2 Lack of novelty

The present application does not meet the criteria of patentability, because the subject-matter of claims 1 to 9 is not new.

2.1 Document D1 discloses:

-A capacitive sensor arrangement for detecting an object (Abstract) comprising:

-a sensing electrode have a capacitance which depends on the presence of an object in a detection space (see element 11 in the figures);

-a measurement device connected to the sensing electrode and configured to detect the capacitance of the sensing electrode (Element 20 connected to Element 11 by element 13 in the figures);

-a conducting structure, wherein the capacitance of the sensing electrode depends on a grounded condition of the structure (Element 4 in the figures);

-wherein the measurement device is connected to a power supply line for connection to a power source (see § 52 and figure 2, Element 21 connected to a 12V power supply) and to a first ground line (§ 48 and figure 2);

-operability of the measurement device depends on the first ground line being at least indirectly connected to the ground (see figures 2, 3, 4 or 6);

and the first ground line is connected to the structure (see § 48 and figure 2).

2.2 Documents D2 to D4 also discloses all features of claim 1 (see the references in the search report).

2.3 Documents D1 also discloses all features of dependent claims 2 to 9 (see the references in the search report).

2.4 Documents D2 also discloses all features of dependent claims 2 to 4 and 7 to 9 (see the references in the search report).

2.5 Documents D3 also discloses all features of dependent claims 2 and 7 (see the references in the search report).

2.6 Documents D4 also discloses all features of dependent claims 2 and 7 to 9 (see the references in the search report).

2.7 **Lack of inventive step**

The present application does not meet the criteria of patentability, because the subject-matter of dependent claims 3 to 6, 8 and 9 does not involve an inventive step since their additional features are obvious for the skilled person (when starting from one of the document D2 to D4 as closest prior art). The use of a second ground line (claim 3) is obvious for the skilled person, as it is when the first and second ground line are separated by a part of the conducting structure (claim 4). It is also obvious to connect a measurement device to another device (claim 5) for instance to communicate the measurement results or to be controlled by it. It is also obvious that a measurement device is in communication with another device (for instance a controller) which is aware of the status of the measuring device (claim 6). It is also obvious to use the know sensor of D3 in a vehicle seat for passenger presence detection (claim 8 and 9) since D3 gives a hint in direction (see § 132 of D3).

3 **Remarks**

The relevant background art disclosed in documents D1 to D3 is not mentioned in the description, nor are these documents identified therein.

Independent claim 1 is not in the two-part form, which in the present case would be appropriate, with those features known in combination from the prior art (D1) being placed in the preamble and the remaining features being included in the characterising part.