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[Continued on next page]

(54) Title: ADVANCED SAFETY COMMUNICATION SYSTEM

(57) Abstract: A method instrumenting in a lead vehicle at least one sensor or component which is capable of generating a signal or in general generating data, collecting some or all of the data; determining from the collected data relevant information regarding a determinable physical location of the lead vehicle; communicating the relevant data to: a receiver associated with one or more of said individuals including a driver of another vehicle or a pedestrian: a control system in the lead vehicle or a control system or component in the other vehicle, a billboard or to a news agency.

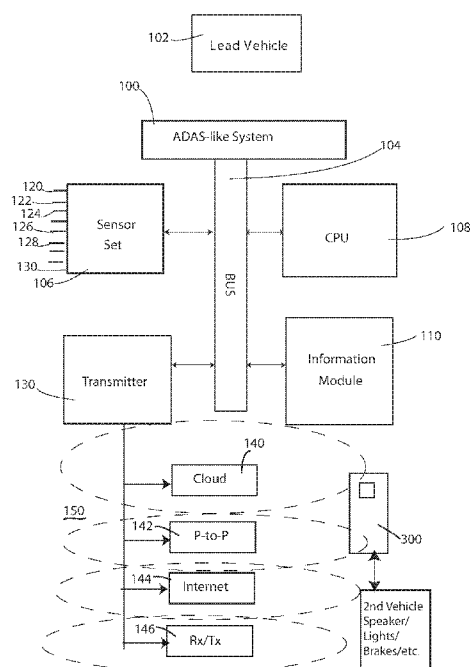


FIG - 1

SM, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, KM, ML, MR, NE, SN, TD, TG). **Published:**

— *with international search report (Art. 21(3))*

Advanced Safety Communication System

BACKGROUND AND SUMMARY OF THE INVENTION

[0001] The present invention generally relates to utilizing a lead vehicle to accumulate useful information about a roadway in front of or adjacent to the lead vehicle and to communicate this information in real time or delayed to a cell phone or to a similar receiver generally not associated with an ADAS (advanced driver assistance system) equipped vehicle.

[0002] Advanced driver assistance systems (ADAS) in general improve the interface between the driver and vehicle. The goal of this type of system is to enhance roadway safety of a particular instrumented vehicle and also to promote passenger, pedestrian as well as inter-vehicle communication and safety. One aspect of the present invention deals primarily with improving safety between an instrumented vehicle and non-instrumented vehicle.

[0003] The benefits of ADAS products and systems are well documented. These products are gaining acceptance and popularity however the market penetration rate is relatively slow. In order to increase the value of these systems the present invention proposes utilizing some or all of the data that can be accumulated by an ADAS system and to communicate this information to as many drivers and people as possible; in particular to communicate this information to those drivers and passengers of vehicles not equipped with an ADAS system.

The present invention includes:

- 1) A method of instrumenting in a lead vehicle at least one sensor or component which is capable of generating a signal or in general generating data,
- 2) collecting some or all of the data;
- 3) determining from the collected data relevant information regarding a determinable physical location of the lead vehicle; such

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relevant information may include one or more of the following: information regarding the condition of the vehicle, information regarding the environment surrounding the vehicle, and information relating to potential hazards.

4) communicating the relevant data to a receiver not associated with the lead vehicle including:

- a) a receiver associated with one or more of said individuals including a driver of another vehicle or a pedestrian,
- b) a control system in the lead vehicle or
- c) a control system or component in the other vehicle or
- d) a billboard or
- e) to a news agency.

Brief Description of the Drawings

[0004] Figure 1 diagrammatically illustrates the major components of the present system.

[0005] Figure 2 shows one aspect of the operation of the present system.

[0006] Figure 3 is a block diagram describing the overall operation of the present system.

[0007] Figure 4 shows another aspect of the present invention.

Detailed Description of the Drawings

[0008] Reference is made to figure 1 which shows the major components of the present invention. Figure 1 illustrates the general operation of a vehicle equipped with an ADAS system 100 capable of implementing the

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present invention. The system 100 is incorporated into a vehicle 102 which is also designated as a lead vehicle or alternatively vehicle 1.

[0009] The illustrated system may include an information bus 104 which is connected to a set of sensors or components 106; the output of any particular set of sensors or components is communicated to the CPU 108 which may include a module 110 designated as Information Module. The set of sensors may include a camera sensitive to predetermined frequencies of an electro-magnetic, EM, spectrum, radar, lidar, acoustic, sonar, an anti-skid system, traction control system, a GPS system, physical sensors including accelerometer, gyroscope, yaw sensor, any environmental sensors such as rain/temperature/pollen/odors or smells, tactile sensors which may include pedestrian bumper sensors or sensors in tires the output of which is representative of road conditions, and other sensors and systems found or proposed to be in an ADAS equipped vehicle. The output of module 110 may include a set of at least one item of relevant information as identified below. This item of relevant information may include a) the existence of the roadway hazard such as a crash or a pothole, b) a correlation of the roadway hazard with the location of the hazard as identified by a GPS system as well as the time T this relevant information was captured. The relevant information may identify whether or not a traction control system, TCS 120 or adaptive braking system ABS 122 of the vehicle is or has been activated. The relevant information may include local temperature from a temperature sensor 130. One of the sensors in the lead vehicle 100 may include a forward-looking camera 126 as well as a rear looking camera 128. For example, the forward-looking camera 126 in cooperation with a determination algorithm in the information module 110 might suggest the existence of the roadway hazard which, depending upon the circumstances, could be verified by the rear facing camera and algorithm. The output of each of the sensors or components, whether filtered or in their original state, is sent to another component of the system such as the CPU 108.

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[0010] In some situations it may be advantageous for the ADAS system in the lead vehicle 102 to be autonomous. In this case the information module will be located in the vehicle 102 and most probably located within and part of the CPU 108. The relevant data or information will be communicated to a transmitter 130 which then may be communicated to a cloud 140, a peer-to-peer network 142, to a local Internet 144 or to a local receiver/transmitter (Rx/Tx) 146a-n positioned along the roadway as illustrated in figure 2. As shown in figure 1, the lead vehicle is part of a network 150. This network will of course include the lead vehicle's ADAS system, a receiver 300 as described below and one of a cloud 140, peer-to-peer network 142, the internet 144, stationary receivers/transmitters (see figure 1) 146 and other communications devices.

[0011] The relevant information, whether in the cloud, or in a peer-to-peer network or within the Internet or in stationary roadway receivers/transmitters, will be available to be communicated to a receiver 300 which is remote from the ADAS system 100 in the lead vehicle. For example one such receiver would be a cell phone, another such portable receiver may be one of the new classes of the wearable electronics such as a watch worn by the driver of a secondary vehicle 102a, another receiver can be various stationary devices 146 such as road lights and mile marker or a digital billboard 148, see figure 2, which can communicate the relevant received information such as "collision ahead," "slow down," seek alternate route;" another such receiver can be an antenna 148a, a newsfeed which can transmit the relevant information via a phone or speaker, or billboard, etc.

[0012] The relevant information supplied to the receiver 300, for example a cell phone with a vehicle safety software "app" previously loaded on it, may receive relevant information to notify the driver of the potential roadway hazard, the time to reach such a roadway hazard and perhaps even an alternative route to take. Often cellular phones are connected to the radio of a vehicle; this is indicated by arrow 302. This relevant information can then be communicated to a 'speaker' or 'infotainment system' or some other

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system within the non-instrumented vehicle to audibly announce the hazard or perhaps to blink interior or exterior lights of the vehicle, activate a vehicle brake mechanism or some other mechanism to announce the safety hazard or other information to the driver of the non-instrumented vehicle.

[0013] Reference is briefly made to figure 2 which shows the lead vehicle 102 traveling upon a roadway 160 communicating and receiving information to and from each of the various stationary receivers 146a, 146b, 146_{n-1}, 146_n, which will then communicate the relevant information to subsequent vehicles 102a passing by the fixed receivers/transmitters. The information flow is diagrammatically shown as arrows 162.

[0014] Returning to figure 1, then in this manner the lead vehicle will sense, determine, calculate or estimate the existence of a roadway hazard, potential hazard, debris, pothole, collision, slipperiness of the roadway, amount of snow on the roadway or useful information, together referred to as relevant information to a user of a portable receiver 300 connected to a network 142. The manner in which the user of the portable receiver 300 is notified can vary. Such notification can be a beep or other audible signal, a blinking of the screen of the receiver and other similar means. The receiver 300, as mentioned, can be a cell phone, which may be connected to a radio or speaker of the other or following vehicle 102a. In this example the notification to the user of the receiver 300 can be an audible signal generated through the speaker or infotainment system of the following vehicle, (non-instrumented) 102a. .

[0015] Figure 3 shows the general operation of the present invention is to collect signals and other information and data 200 from sensors or components within the lead vehicle 102, then to determine (see block 202) from this information and data relevant information that may be useful to the driving public. This determination can be done onboard the lead vehicle 102 in an autonomous manner or the collected data, and information can be transmitted to a remote location where such a determination can be made.

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The existence of this relevant information is then communicated, see block 204, through one of the many possible networks 150 which also includes the lead vehicle and to the remote receiver 300. While the above discussion presumes the remote receiver 300 is carried by the driver of the subsequent vehicle 102a, it should be appreciated that the remote receiver need not be in a vehicle as the transmitted relevant information may be of interest to a pedestrian carrying the remote receiver. As previously mentioned the lead vehicle will be equipped with a plurality of sensors and consequently one of the steps in the present invention, as illustrated in blocks 204 and 300, in figure 3 is to also communicate this relevant information to the operator of the lead vehicle, as the operator/driver of the lead vehicle 102 may not realize the roadway hazard, see blocks 204 and 302.

[0016] Reference is made to figure 4 which illustrates another aspect of the present invention. Figure 4 shows an intersection of street 401 and street 402, however in general this intersection represents some determinable geolocation 404 which can in general be identified or located by a GPS in a vehicle, V1, also referred to by numeral 406. In figure 4, vehicle 406 is approaching geolocation 404. In figure 4 it is presumed each of the vehicles V1, V2 up through VN have an appropriate ADAS system which would include a GPS subsystem and many other sensors such as a front facing camera, temperature sensor, adaptive traction control, adaptive braking control. Each equipped vehicle can utilize the above defined procedures to generate relevant information as previously described. Again with reference to figure 4, this relevant information for vehicle V1 is identified as DATA (V1,T1) which can be interpreted as relevant data from vehicle V1 collected at the time T1. Similarly as vehicle V2 approaches geolocation 404 it will generate a similar data package of relevant information identified as DATA (V2, T2). Then as the nth instrumented vehicle approaches geolocation 404 it will generate a data package of relevant information designated as DATA (VN, TN), that is relevant data/information of vehicle VN collected at time TN. Each cluster of DATA is communicated to a

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network 410 such as a cloud network in which the aggregate data is analyzed to predict a longer term trend of the likely condition at the geolocation 404. By long term trend, this time can be anything from a few minutes to a significantly longer time interval such as a day, week, year etc. An example of very short term data collection is to transmit or collect the temperature at the location of the lead vehicle at T1. Alternatively, at a time T1 the camera of vehicle V1 may show the existence of an animal crossing the roadway. Another example could be a vehicle equipped with a pollen sensor could generate a signal relating to the amount of pollen in the air. Similar data can be collected from other instrumented vehicles at this same geolocation where the combined relevant data is analyzed over a given time period to identify instantaneous, or extended-time trends to identify an actual or likely hazard or other such relevant information. In this manner as subsequent ADAS or in general some equipped vehicle or vehicles or individuals with receivers 300 approach geolocation 404, an awareness signal can be sent to each instrumented vehicle or separate receiver that the probability of some incident is high and care should be exercised.

[0017] Many changes and modifications in the above-described embodiment of the invention can, of course, be carried out without departing from the scope thereof. Accordingly, that scope is intended to be limited only by the scope of the appended claims.

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Claims

- 1 1. A method instrumenting in a lead vehicle at least one sensor or
2 component or systems capable of generating a signal or in general
3 generating data;
4 collecting some or all of the data;
5 determining from the collected data relevant information regarding a
6 determinable physical location of or near the lead vehicle;
7 communicating the relevant data to a receiver not associated with
8 the lead vehicle including: a receiver associated with
9 a) one or more individuals including an operator of another
10 vehicle or a pedestrian;
11 b) a control system in the lead vehicle;
12 c) a control system or component in the other vehicle;
13 d) a billboard or other type of fixedly positioned
14 receiver/transmitter or
15 e) a news agency.
- 1 2. The method according to claim 1 including the further step of:
2 f) communicating the relevant data to a plurality of individuals
3 including a plurality of drivers or control systems in a set of second
4 vehicles behind the lead vehicle.
- 1 3. The method according to claim 1 including the step:
2 g) communication of the data to a cloud based server, to allow
3 distribution to other receivers.
- 1 4. The method according to claim 1 including the step of:
2 h) communicating the data by cellular, satellite, or any other form of
3 data transmission.

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- 1 5. The method according to claim 1 wherein the step of determining
2 from data includes the step of:
3 i) determining on-board the lead vehicle if an actual
4 emergency condition exists, if a potential emergency condition exists, or if
5 a relevant condition exists; or
6 i1) determining remote from the lead vehicle if an actual
7 emergency condition exists. if a potential emergency condition exists or if
8 a relevant condition exists.
- 1 6. The method according to claim 1 wherein the lead vehicle and any
2 other vehicle is a land (or water) based vehicle, and wherein the at least
3 one sensor is: sensitive to determinable EM frequencies, radar, lidar, light,
4 acoustic, sonar, environmental sensors including temperature, rain, pollen
5 odor, tactile wherein the step of collecting data includes collecting
6 information indicative of the condition at a geolocation
7 and wherein the step of determining includes the step of
8 differentiating a geolocation hazard from all of the objects in the range of a
9 particular sensor.
- 1 7. The method according to claim 1 wherein the steps of installing,
2 collecting, determining, generating and communicating are done
3 autonomously in the lead vehicle.
- 1 8. The method according to claim 1 wherein the sensor includes at
2 least one of: a camera sensitive to various EM frequencies including
3 visual, ultraviolet, infrared, radar, lidar, or acoustic sensor, environmental
4 sensor including temperature, rain, pollen, tactile.
- 1
1 9. The method according to claim 1 wherein the step of determining
2 relevant data includes one or all of the following steps: a) generating a
3 signal causing the lead vehicle to avoid a perceived roadway object, b)

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4 generating a signal causing the second vehicle to follow the trajectory of
5 the lead vehicle, c) generating a signal to cause the lead vehicle to
6 accelerate, move to a different lane, slow down or stop, d) generating a
7 signal to cause the second vehicle to accelerate, move to a different lane,
8 slow down or stop; e) generating a signal informing the operator of the
9 lead vehicle to avoid the perceived roadway object and/or to slow down or
10 f) generating a signal informing the operator of the other vehicle to avoid
11 the perceived roadway object and/or to slow down.

1 10. An advanced vehicular safety system comprising:
2 a lead vehicle having at least one sensor or component for
3 generating, collecting and/or transmitting data indicative of a condition of a
4 roadway or adjacent regions of the roadway upon which the lead vehicle is
5 traveling or about to travel;
6 first means for receiving data;
7 second means for determining, based upon the received data,
8 relevant information about the roadway including if an actual or perceived
9 roadway emergency or condition exists;
10 third means for transmitting information a) to at least one other
11 vehicle, such other vehicle being a vehicle not having such an array of
12 sensors or components, or b) to an individual to inform the individual of the
13 actual or perceived emergency or condition.

1 11. The system according to claim 10 including means for notifying the
2 operator of the lead vehicle of such actual or perceived emergency or
3 condition.

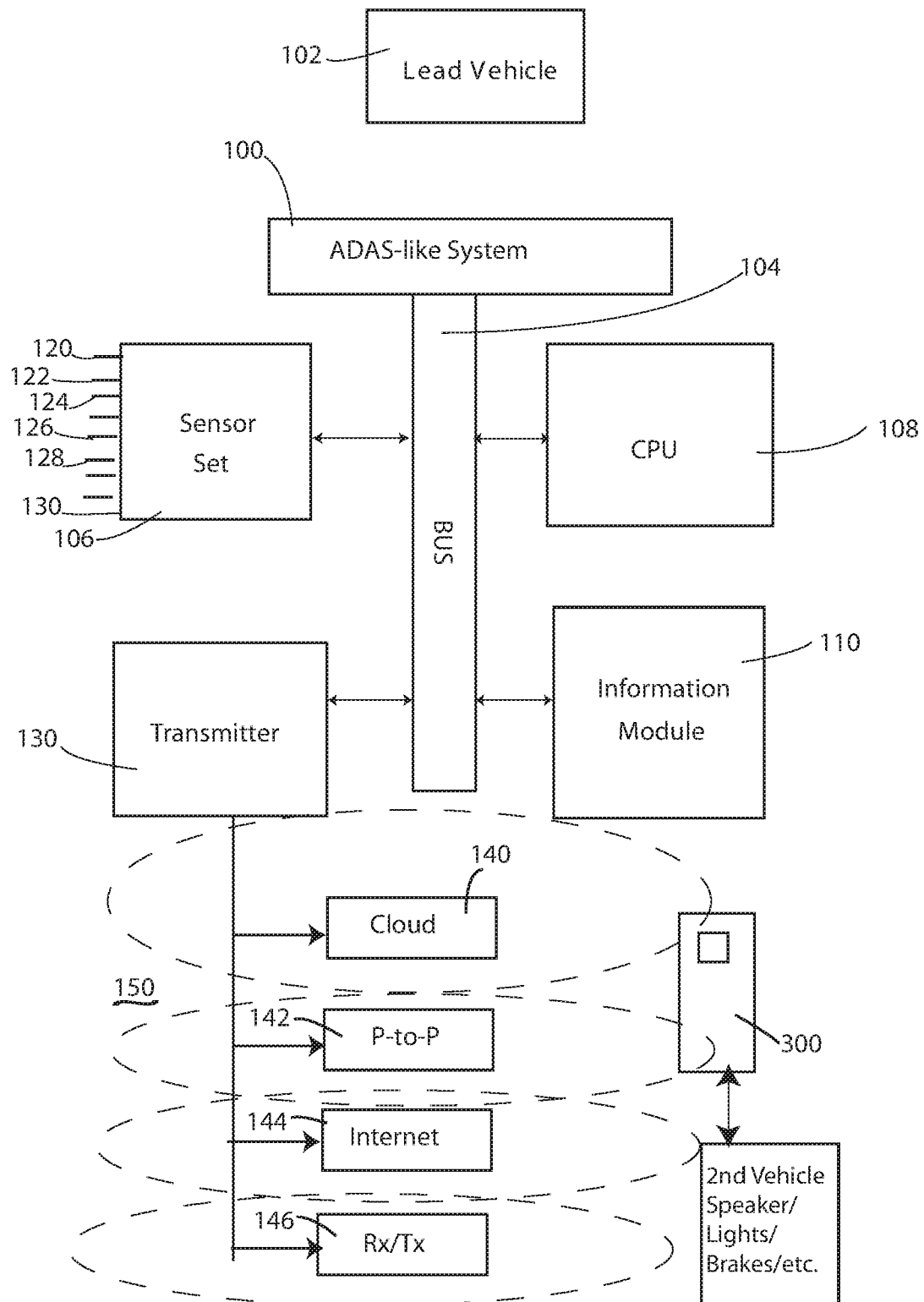


FIG - 1

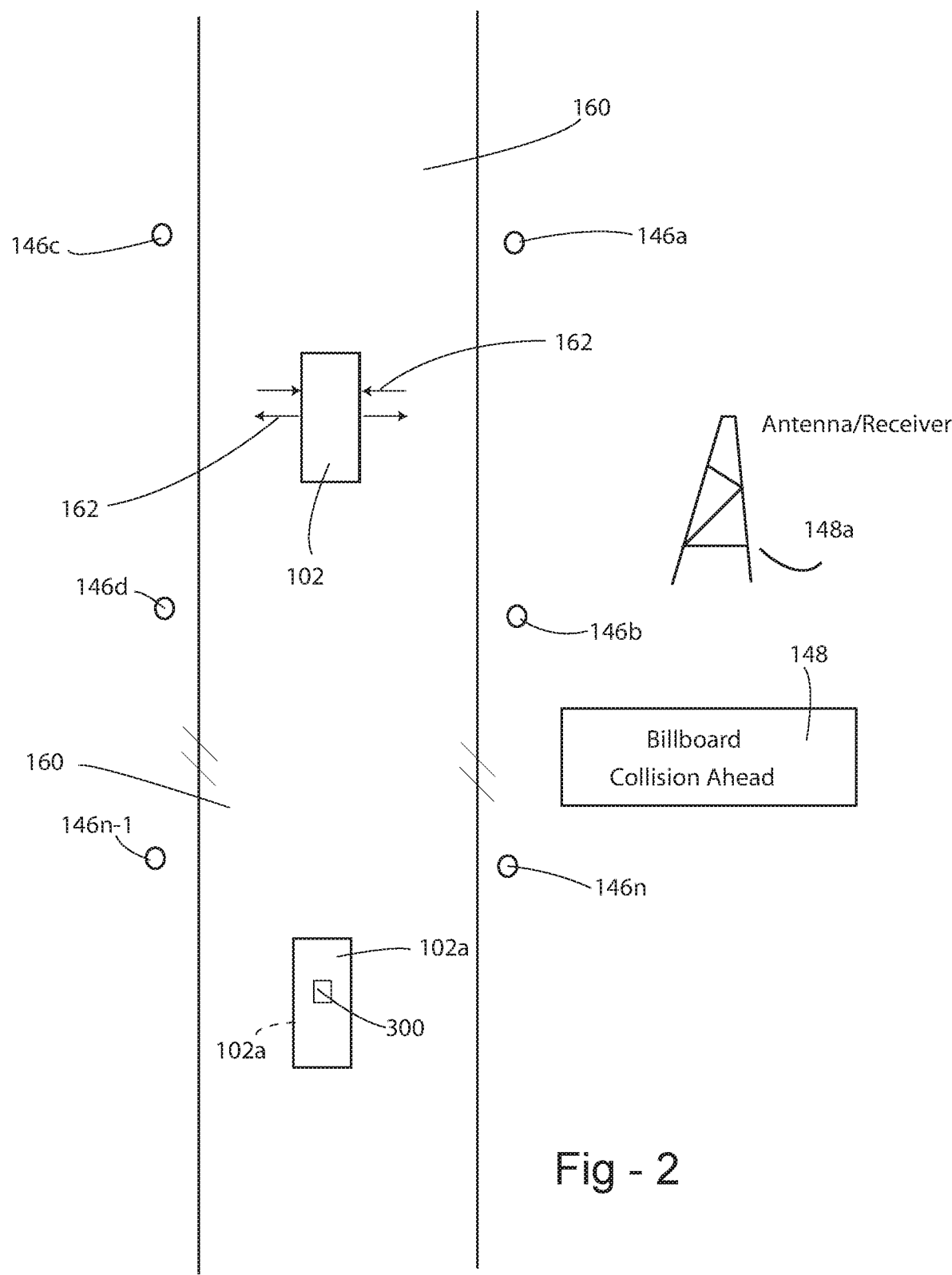


Fig - 2

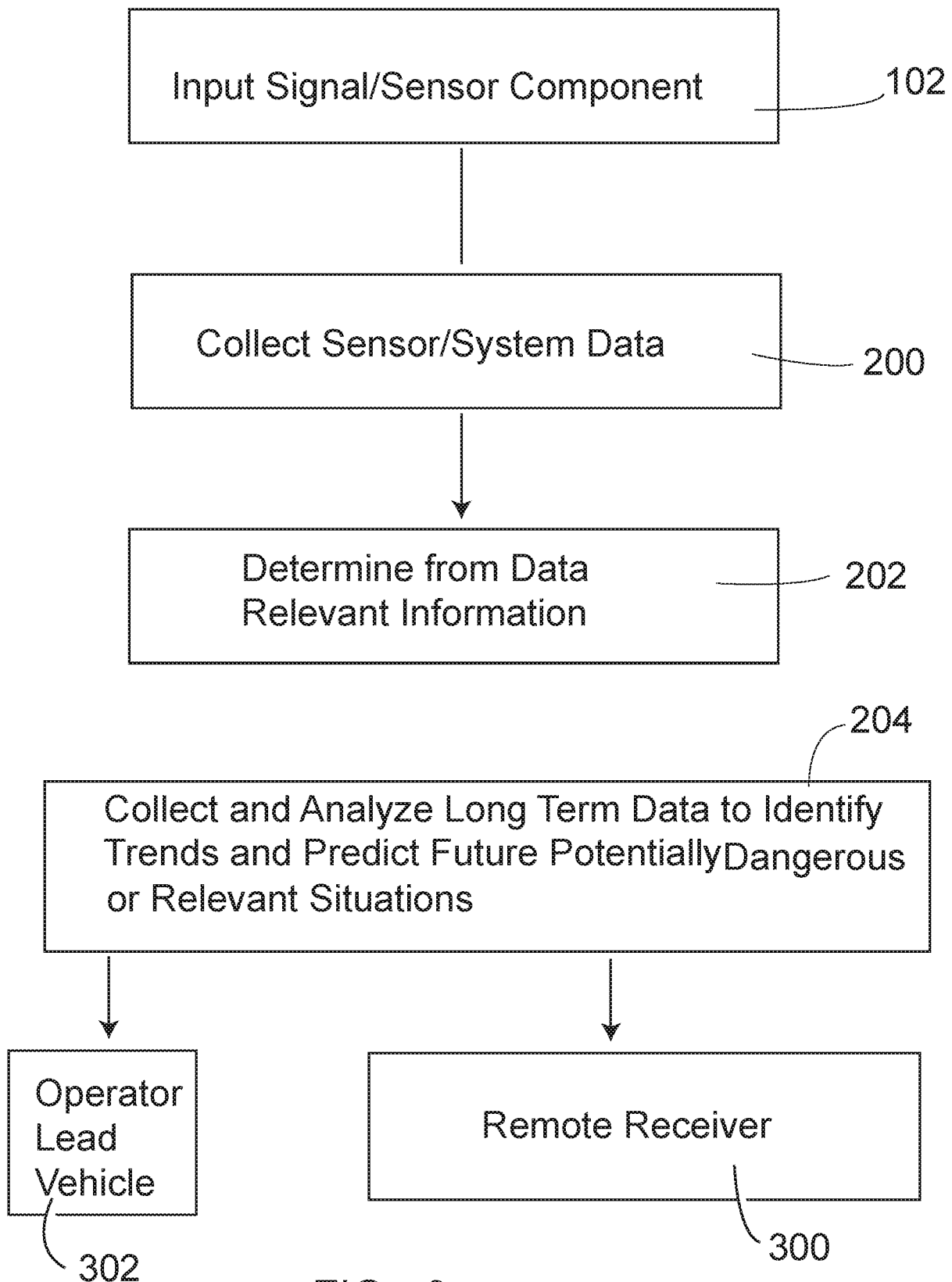


FIG - 3

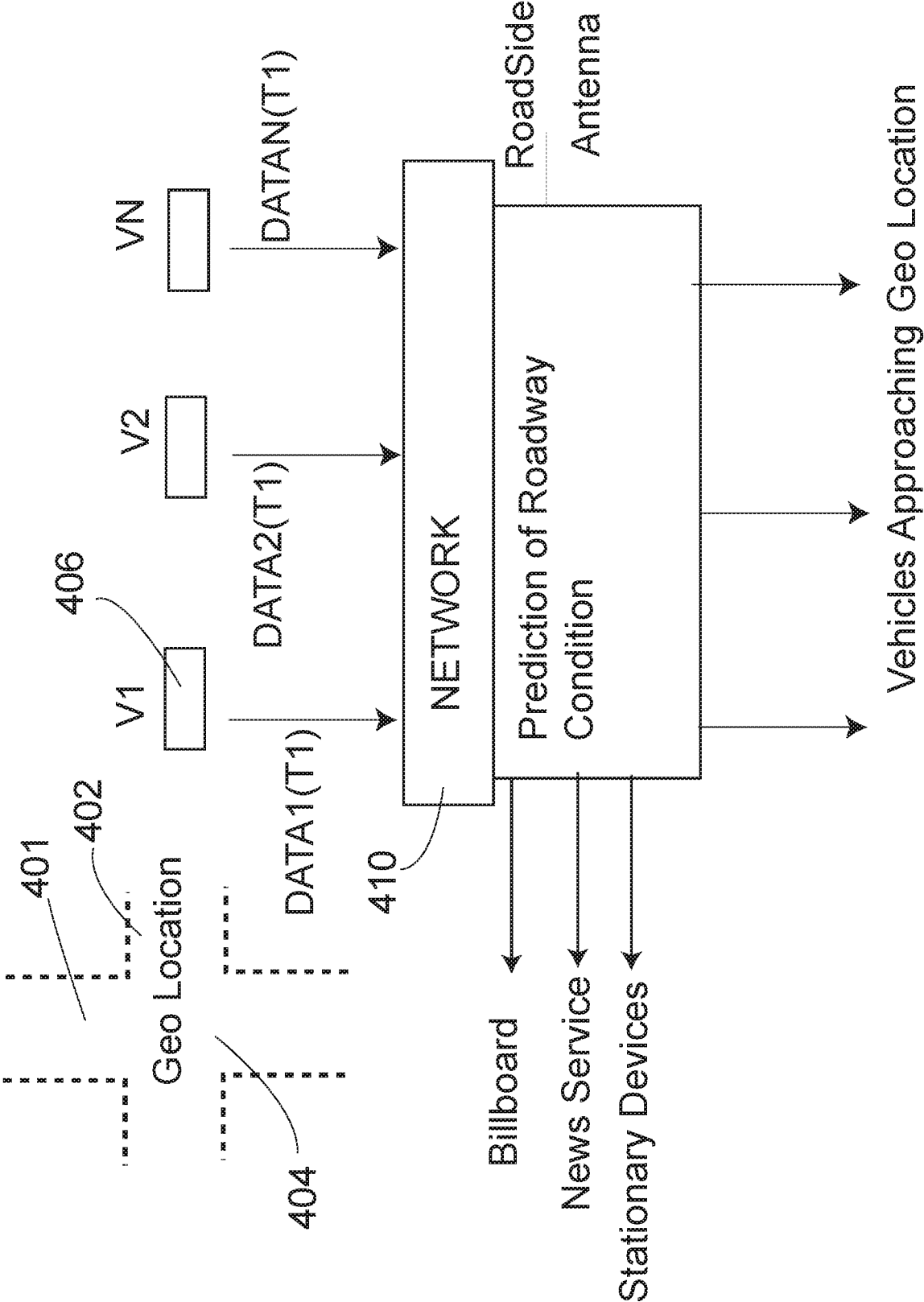


Fig -4

INTERNATIONAL SEARCH REPORT

International application No
PCT/US2016/014519

A. CLASSIFICATION OF SUBJECT MATTER

INV. G08G1/0967 G08G1/005 G08G1/01 G08G1/16 B60W30/09
ADD.

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

G08G B60W

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

EP0-Internal, WPI Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 2008/140318 A1 (BREED DAVID S [US]) 12 June 2008 (2008-06-12) abstract [0025], [0079], [0129], [0212], [0235], [0274], [0270] - [0275], [0277], [0281], [0282], [0285], [0293] - [0296], [0344] - [0349], [0367], [0363] - [0373], [0395], [0483], [0500], [0512] - [0514], [0528], [0549] - [0552] -----	1-11



Further documents are listed in the continuation of Box C.



See patent family annex.

* Special categories of cited documents :

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier application or patent but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

Date of the actual completion of the international search

4 April 2016

Date of mailing of the international search report

15/04/2016

Name and mailing address of the ISA/

European Patent Office, P.B. 5818 Patentlaan 2
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Pariset, Nadia

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US2016/014519

Box No. II Observations where certain claims were found unsearchable (Continuation of item 2 of first sheet)

This international search report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. ☐ Claims Nos.:
because they relate to subject matter not required to be searched by this Authority, namely:
2. ☒ Claims Nos.: 1-11(partially)
because they relate to parts of the international application that do not comply with the prescribed requirements to such an extent that no meaningful international search can be carried out, specifically:
see FURTHER INFORMATION sheet PCT/ISA/210
3. ☐ Claims Nos.:
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

Box No. III Observations where unity of invention is lacking (Continuation of item 3 of first sheet)

This International Searching Authority found multiple inventions in this international application, as follows:

1. ☐ As all required additional search fees were timely paid by the applicant, this international search report covers all searchable claims.
2. ☐ As all searchable claims could be searched without effort justifying an additional fees, this Authority did not invite payment of additional fees.
3. ☐ As only some of the required additional search fees were timely paid by the applicant, this international search report covers only those claims for which fees were paid, specifically claims Nos.:
4. ☐ No required additional search fees were timely paid by the applicant. Consequently, this international search report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:

Remark on Protest

- ☐ The additional search fees were accompanied by the applicant's protest and, where applicable, the payment of a protest fee.
- ☐ The additional search fees were accompanied by the applicant's protest but the applicable protest fee was not paid within the time limit specified in the invitation.
- ☐ No protest accompanied the payment of additional search fees.

FURTHER INFORMATION CONTINUED FROM PCT/ISA/ 210

Continuation of Box II.2

Claims Nos.: 1-11(partially)

1 Present claims 1-11 relate to an extremely large number of possible apparatus and methods, covering the more or less of the possible so-called V2X applications as well as all the stand-alone vehicle safety systems.

2 The initial phase of the search revealed a very large number of documents relevant to the issue of novelty. So many documents were retrieved that it is impossible to determine which parts of the claims 1-11 may be said to define subject-matter for which protection might legitimately be sought (Article 6 PCT).

3 In addition support and disclosure in the sense of Article 6 and 5 PCT is to be found however for only a very small proportion of the apparatus and methods claimed, see [0009], [0011], [0014], [0017].

4 For these reasons, the search was performed taking into consideration the non-compliance in determining the extent of the search of claims 1-11, which was restricted to a method instrumenting in a lead vehicle at least one sensor capable of generating a signal:

collecting data from said
at least one sensor;
determining from the collected data the
existence of the roadway hazard such as a crash or a pothole, regarding a
determinable physical location of or near the lead vehicle

communicating the relevant data to a receiver associated with an operator of another vehicle.

The applicant's attention is drawn to the fact that claims relating to inventions in respect of which no international search report has been established need not be the subject of an international preliminary examination (Rule 66.1(e) PCT). The applicant is advised that the EPO policy when acting as an International Preliminary Examining Authority is normally not to carry out a preliminary examination on matter which has not been searched. This is the case irrespective of whether or not the claims are amended following receipt of the search report or during any Chapter II procedure. If the application proceeds into the regional phase before the EPO, the applicant is reminded that a search may be carried out during examination before the EPO (see EPO Guidelines C-IV, 7.2), should the problems which led to the Article 17(2) declaration be overcome.

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No

PCT/US2016/014519

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 2008140318	A1	12-06-2008	NONE
