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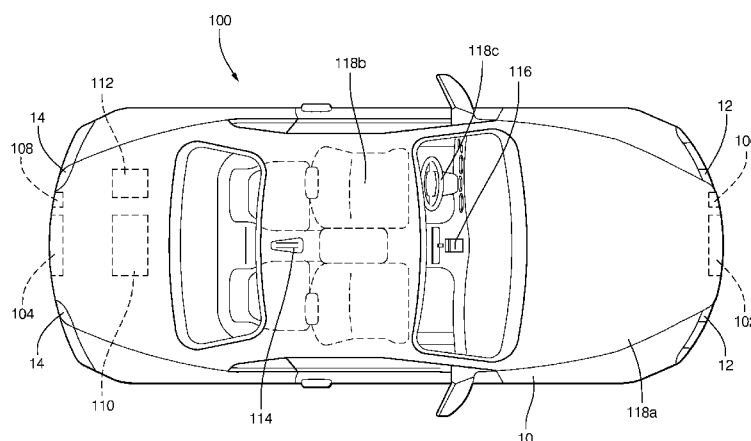


FIG. 1

(57) Abstract: A Light Emitting Diode vehicle-to- vehicle (LED V2V) communication system (100) is disclosed for use in vehicles traveling in a single file. The LED V2V communication system (100) includes front and rear LED arrays (102, 104) for transmitting encoded data to adjacent front and rear vehicles; front and rear optical receivers (106, 108) for receiving encoded data from adjacent front and rear vehicles; a central-processing-unit for processing and managing data flow between the LED arrays (102) and optical receivers (106); and a control bus (112) for routing communication between the CPU (110) and the vehicle (10)'s systems such as a Global Positioning Systems (GPS) (114)), driver infotainment system (116), and safety systems (118). The safety systems (118) may include audio or visual driver alerts (116), active braking, seat belt pretensioners (118b), air bags (118c), active steering, and the likes. A method for V2V communication using pulse LED is also disclosed.



PULSED LED VEHICLE TO VEHICLE COMMUNICATION SYSTEM

CROSS-REFERENCE TO RELATED APPLICATION

[0001] This application claims the benefit under 35 U.S.C. § 119(e) of U.S. Provisional Patent Application No. 62/112771, filed 06-Feb-2015, the entire disclosure of which is hereby incorporated herein by reference.

TECHNICAL FIELD OF INVENTION

[0002] The invention relates to the use of light emitting diodes for vehicle-to-vehicle communications for a plurality of vehicles traveling in a single file.

BACKGROUND OF THE INVENTION

[0003] For autonomous vehicles traveling in a single file down a stretch of road, it is advantageous for the vehicles to be able to send messages and data up and down the chain of vehicles to ensure that the vehicles are traveling within a safe distance from one another. This is true even for occupant controlled vehicles traveling down a single lane road. For example, if a lead vehicle needs to make a sudden deceleration, the lead vehicle could send information to the rear vehicles to alert the occupants and/or to instruct the rear vehicles to decelerate accordingly or activate the rear vehicles' safety systems, such as automatic braking or seat belt pretensioners, if collision is imminent.

[0004] It is known to utilizing radio frequency transmissions for relaying vehicle information such as distance between vehicles, speed, acceleration, and vehicle location from a lead vehicle to the rear vehicles. However, the use of radio

frequency transmissions require directional transmissions so that radio transmissions from vehicles in the adjacent lanes or opposing traffic do not interfere with the radio transmissions from the lead vehicle to the rear vehicles. Using radio frequency transmissions to communicate may require additional hardware, such as radars, lasers, or other components known in the art to measure the distance, speed, and acceleration between adjacent vehicles. This results in complexity of hardware requirements and data management systems, resulting in a costly vehicle-to-vehicle communication system.

[0005] Based on the foregoing and other factors, there remains a need for a low cost, directional, interference resistant communication system for vehicles traveling in single file.

SUMMARY OF THE INVENTION

[0006] The present disclosure provides a LED V2V Communication System for an on road vehicle. The LED V2V Communication System includes LED arrays for transmitting encoded data; optical receivers for receiving encoded data; a central-processing-unit (CPU) for processing and managing data flow between the LED arrays and optical receivers; and a control bus routing communication between the CPU and the vehicle's systems such as a satellite-based positioning system, driver infotainment system, and safety systems. The safety systems may include audio or visual driver alerts, active braking, seat belt pretensioners, air bags, and the likes.

[0007] The present disclosure also provides a method using pulse LED for vehicle-to-vehicle communication. The method includes the steps of receiving input information from an occupant or vehicle system of a transmitting vehicle; generating

an output information based on the input information of the transmit vehicle;
generating a digital signal based output information of the transmit vehicle; and
transmitting the digital signal in the form of luminous digital pulses to a receiving vehicle. The receiving vehicle then receives the digital signal in the form of luminous digital pulses; generates a received message based on received digital signal; generate an action signal based on received information; and relay the action signal to the occupant or vehicle system of the received vehicle. The step of transmitting the digital signal to a receive vehicle includes generating luminous digital pulses in the infra-red or ultra-violet frequency invisible to the human eye.

BRIEF DESCRIPTION OF THE DRAWINGS

[0008] The subject matter which is regarded as the invention is particularly pointed out and distinctly claimed in the claims at the conclusion of the specification. The foregoing and other features, and advantages of the invention are apparent from the following detailed description taken in conjunction with the accompanying drawings in which:

[0009] Figs. 1 is schematic representation showing an on road vehicle having an exemplary embodiment of the Light Emitting Diode Vehicle to Vehicle (LED V2V) Communication System of the current invention;

[0010] Fig. 2 is a schematic representation showing three vehicles traveling in a single file utilizing the LED V2V Communication System for inter vehicle communication; and

[0011] Fig. 3 is a block diagram showing information transfer from the front and rear vehicles to and from the center vehicle of Fig. 2.

DETAILED DESCRIPTION

[0012] Referring now to the Figures, the invention will be described with reference to a specific embodiment, without limiting same. Where practical, reference numbers for like components are commonly used among multiple figures.

[0013] Show in Fig. 1 is an on road vehicle 10 having an exemplary embodiment of the Light Emitting Diode Vehicle to Vehicle (LED V2V) Communication System 100 of the current invention. The LED V2V Communication System 100 includes LED arrays 102, 104 for transmitting encoded data; optical receivers 106, 108 for receiving encoded data; a central-processing-unit 110, hereafter the CPU 110, for processing and managing data flow between the LED arrays 102, 104 and optical receivers 106, 108; and a control bus 112 for routing communication between the CPU 110 and the vehicle's systems such as a satellite-based positioning system 114, driver infotainment system 116, and safety systems 118. The safety systems 118 may include audio or visual driver alerts 116, active braking 118a, seat belt pretensioners 118b, air bags 118c, and the likes.

[0014] A front facing LED array 102 configured to transmit an encoded digital signal in the form of light pulses and a front facing optical receiver 106 for receiving a digital signal in the form of light pulses are mounted to the front end of the vehicle. Similarly, mounted to the rear of the vehicle 10 are a rear facing LED array 104 configured to transmit a digital signal in the form of light pulses and a rear optical receiver 108 for receiving a digital signal in the form of light pulses.

[0015] Each of the front and rear LED arrays 102, 104 may include a plurality of individual LEDs that may be activated independently of each other within the LED

array. The advantage of this is that the each LED may transmit its own separate and distinct encoded digital signal. The front LED array 102 is positioned where it would be able to transmit unobstructed light pulses to a receiving vehicle immediately in front of the vehicle 10. Similarly, the rear LED array 104 is positioned where it would be able to transmit unobstructed light pulses to a receiving vehicle immediately behind the vehicle 10. For aesthetic purposes, the front LED array 102 may be incorporated in the front headlamp assembly of the vehicle 10 and the rear LED array 104 may be incorporated in the brake lamp assembly of the vehicle 10.

[0016] To avoid driver distraction, it is preferable that the LED arrays 102, 104 emit light pulses outside of the visible light spectrum to the human eye in order to avoid distraction to the drivers of other vehicles. A digital pulse signal is preferred over an analog signal since an analog signal may be subject to degradation as the light pulse is transmitted over harsh environmental conditions. It is preferable that that the LED arrays 102, 104 emit non-visible light in the infrared frequency to cut through increment weather conditions such as rain, fog, or snow. As an alternative, the LED arrays 102, 104 may emit light in the ultra-violet frequency range.

[0017] The front optical receiver 106 is mounted onto the front of the vehicle 10 such that the front optical receiver 106 has an unobstructed line of sight to a transmitting vehicle immediately in front of the vehicle 10. Similarly, the rear optical receiver 108 is mounted onto the rear of the vehicle 10 such that the rear optical receiver 108 has an unobstructed line of sight to a transmitting vehicle immediately in rear of the vehicle 10. As an alternative, the front LED array 102 and front optical receiver 106 may be integrated into a single unit to forming a front LED transceiver, which it is capable of transmitting and receiving a luminous pulse digital signal.

Similarly, the rear LED array 104 and rear optical receiver 108 may be integrated as a rear LED transceiver. It should be recognized that each of the exemplary vehicles discussed above in front and rear of vehicle 10 may function as both a receiving and transmitting vehicle, the relevance of which will be discussed below.

[0018] A CPU 110 is provided in the vehicle 10 and is configured to receive vehicle input information from a plurality of sources in the vehicle 10, such as text or voice information from the occupants or data information from the vehicle's GPS 114, and generates corresponding output information based on the input information. The CPU 110 then sends the output information to the front LED array 102, the rear LED array 104, or both, which then transmit the output information as a coded digital signal in the form of light pulses directed to the immediate adjacent front and/or rear vehicles. The CPU 110 is also configured to receive and process incoming messages from the front and rear optical receivers 106, 108, and generate an action signal based on the incoming message. A control bus 112 is provided to facilitate electronic communication between the CPU 110 and the vehicle's electronic features such the GPS 114, driver infotainment system 116, and safety systems 118.

[0019] Shown in Fig. 2 are three vehicles A, B, C (labeled as Veh. 1, Veh. 2, and Veh. 3, respectively) traveling in a single file formation down a common lane. Each of the three vehicles include an embodiment of the LED V2V Communication System 100 of the currently invention as detailed above. The first vehicle A is traveling ahead and in immediate front of the second vehicle B, which is traveling ahead of and in immediate front of the third vehicle C. While only three vehicles A, B, C are shown, the LED V2V Communication System is not limited to being used by only three vehicles. The LED V2V Communication System 100 is applicable to a

plurality of vehicles traveling in a single file where it is desirable to transmit information up and/or down the column of vehicles. For example, the first vehicle A may transmit data to the second vehicle B, and the second vehicle B may re-transmit the data to the third vehicle C, and so on and so forth until the data reaches a designated vehicle or the last vehicle down the chain. Alternatively, data may be transmitted by the last vehicle in the column of vehicles through each vehicle, in series, until the data arrives at the first vehicle A of the chain. For simplicity, the operation of the V2V Communication System will be explained with the three vehicles A, B, C shown and the second vehicle B will be the reference vehicle for illustration and discussion purposes. Each of the vehicles A, B, C may function as a transmitting and a receiving vehicle with respect to an adjacent vehicle in the chain.

[0020] Referring to Fig. 3, communications between vehicles may be initiated autonomously by the V2V Communication System 100 as a part of an overall vehicle safety system. By way of example, the CPU 110 instructs the front LED array 102 to transmit a predetermined digital signal, in the form of luminous pulses, in the direction of the front vehicle A (Veh 1). The rear reflectors 14 of front vehicle A, which are standard on all vehicles, reflect the pulse of light to the front optical receiver 102, which then sends a signal back to the CPU 110. To verify signal integrity, the CPU 110 compares the reflected digital signal with the transmitted digital signal, and if it matches, computes the distance between the central second vehicle B (Veh 2) and the front first vehicle A based on the time required for the pulse of light to travel to the front vehicle A and reflected back to the second vehicle B. This operation is continuously repeated and based on the rate in change of distance between the two vehicles A, B, the central-processing-unit determines whether the

vehicles A, B are traveling in a safe distance or if collision is likely. As provided above, the CPU 110 processes and manages the transfer of data to and from the LED arrays 102, 104 and optical receivers 106, 108, and the control bus 112 facilitates communication between the CPU 110 and the vehicles electronic features. If the CPU 110 determines that the vehicles are traveling in too close of a distance, the CPU 110 then sends a signal to the driver infotainment system 116 to visually or audibly alert the driver via an in-dash display or vehicle sound system. If the CPU 110 determines that collision is imminent, the CPU 110 could send a signal to the vehicle's braking system 118a to automatically decelerate the vehicle, or activate seat belt pretensioners 118b and air-bags 118c, and simultaneously, send transmit a signal to the adjacent rear vehicle C (Veh 3) using the rear LED array 104 to notify vehicle C that the second vehicle B is slowing. Automated driver early warning of unsafe proximity between adjacent vehicles provides for safer driving, less stress on the driver, and additional reaction time for the drivers.

[0021] As an additional safety measure for autonomous and/or driver controlled vehicles, the CPU of the first vehicle may receive vehicle location, direction, and speed information from the first vehicle's GPS system. The first vehicle transmits this information via the first vehicle's rear LED array directly to the second vehicle. The second vehicle's CPU may use algorithms to analyze the GPS data received from the first vehicle together with the second vehicle's own GPS data to determine if the two vehicles are traveling in too close of a distance or if collision is imminent. This determination is compared with the distance information calculated from the time it takes to transmit and received a pulse of light between vehicles to ensure accuracy and reliability of the data received from GPS. Just as the first vehicle

passing its GPS information to the second vehicle, the second vehicle passes its GPS information to the third vehicle, and so on and so forth.

[0022] Utilizing the V2V Communication System 100, direct audio or text communications between vehicles may be initiated by an occupant of a vehicle. For example, the occupant of the center vehicle may relay a message to the immediate vehicle in front or rear. As previously mentioned, the V2V Communication system 100 may transmit information down a string of vehicle traveling in a single file down a road. If an upfront vehicle encounters an accident, road obstruction, and/or traffic accident, information can be sent down in series through the string of vehicles to slow down or activate safety systems 118 of individual vehicles to ensure that the column of cars slows evenly to avoid vehicle-to-vehicle collisions. Emergency vehicles may utilize the V2V communication system 100 to warn a column of vehicles. For example, if an emergency vehicle is traveling up from behind, the emergency vehicle having a V2V communication system 100 may communicate the information up the column of vehicles to notify the drivers to pull their vehicles over to the side of the road to allow room for the emergency vehicle to pass.

[0023] While the invention has been described in detail in connection with only a limited number of embodiments, it should be readily understood that the invention is not limited to such disclosed embodiments. Rather, the invention can be modified to incorporate any number of variations, alterations, substitutions or equivalent arrangements not heretofore described, but which are commensurate with the spirit and scope of the invention. Additionally, while various embodiments of the invention have been described, it is to be understood that aspects of the invention may

include only some of the described embodiments. Accordingly, the invention is not to be seen as limited by the foregoing description.

CLAIMS

What is claimed is:

1. A vehicle-to-vehicle communication system (100) comprising:
 - a front light emitting diode (LED) array;
 - a central-processing-unit 110 (CPU 110) in communication with said front LED array (102);
 - wherein said central-processing-unit is configured to receive a vehicle (10) input information and generates a vehicle (10) output information based on the vehicle (10) input information, and send the vehicle (10) output information to said front LED array (102);
 - wherein said front LED array (102) is configured to receive the vehicle (10) output information from said central-processing-unit and generates a luminous digital signal based on the vehicle (10) output information.
2. The vehicle-to-vehicle communication system (100) of claim 1 further comprising:
 - a rear LED array (104);
 - wherein said central-processing-unit 110 is configured to send the vehicle (10) output information to said rear LED array (104);
 - wherein said rear LED array (104) is configured to receive the vehicle (10) output information from said central-processing-unit 110 and generates a luminous digital signal based on the vehicle (10) output information.

3. The vehicle-to-vehicle communication system (100) of claim 2 further comprising:
 - a front optical receiver (102); and
 - a rear optical receiver (108);wherein said front optical receiver (102) and rear optical receiver (108) are configured to receive luminous digital signals from adjacent front and rear vehicles, respectively, and generate incoming messages based on the received luminous digital signal, and sends the incoming messages to said central-processing-unit;
 - wherein said central-processing-unit is configured to receive said incoming messages, and generates action signals based on said incoming messages.
4. The vehicle-to-vehicle communication system (100) of claim 3, further comprising a
 - control bus (112) configured to receive action signals from said central-processing-unit and relays action signals to select vehicle (10) systems based on received action signals.
5. The vehicle-to-vehicle communication system (100) of claim 3, wherein said luminous digital signal comprises pulses of light.
6. The vehicle-to-vehicle communication system (100) of claim 5, wherein said luminous pulse signal is in the infra-red or ultra-violet range of the light spectrum not visible to the human eye.

7. A vehicle (10) having a vehicle-to-vehicle communication system (100), wherein said vehicle (10) comprising:
- a front light emitting diode (LED) array and a front optical receiver (102) mounted onto front of said vehicle (10);
 - a rear LED array (104) and a rear optical receiver (108) mounted onto rear of said vehicle (10); and
 - a central-processing-unit 110 in electronic communication with said LED arrays (102) and said optical receivers (106).
8. The vehicle (10) of claim 7, wherein:
- said central-processing-unit is configured to instruct LED arrays (102) to transmit a luminous pulse digital signal;
 - said LED arrays (102) are configured to transmit the luminous pulse digital signal to adjacent vehicles;
 - said optical receivers (106) are configured to receive a reflection of the luminous pulse digital signal from the adjacent vehicles; and
 - wherein said central-processing-unit is configured to calculate the relative distance, velocity, and acceleration of the adjacent vehicles based on the time difference between said LED arrays (102) transmitting luminous pulse digital signal and said optical receivers (106) receiving the reflection of the luminous pulse digital signal.

9. The vehicle (10) of claim 8, further comprising a control bus (112) in electronic communication with said central-processing-unit and a plurality of vehicle (10) safety systems (118).

10. The vehicle-to-vehicle communication system (100) of claim 9 further comprising a human to machine interface configured to receive voice or text data and generates an input information to said central processor unit,

wherein said central processor unit generates an output information based on the input information from said human to machine interface and sends output information to one of said LED arrays (102),

wherein said one of said LED arrays (102) generates a luminous pulse digital signal based on the vehicle (10) output information and transmit the voice or text data to adjacent vehicles.

11. A method of vehicle-to-vehicle communication comprising the steps of:

receiving an input information from an occupant or vehicle (10) system of a transmit vehicle (10);

generating a output information based on the input information of the transmit vehicle (10); and

generating a digital signal based output information of the transmit vehicle (10);

transmitting said digital signal in the form of luminous digital pulses to a receive vehicle (10).

12. The method of claim 11, further comprising the steps of:
- receiving said digital signal in the form of luminous digital pulses by a receive vehicle (10);
 - generating an incoming message based on said received digital signal;
 - generating an action signal based on incoming message; and
 - relaying said action signal to an occupant of the receiving vehicle (10) or a vehicle (10) system of the received vehicle (10).
13. The method of claim 12, wherein said luminous digital pulses are in the infra-red or ultra-violet frequency invisible to the human eye.

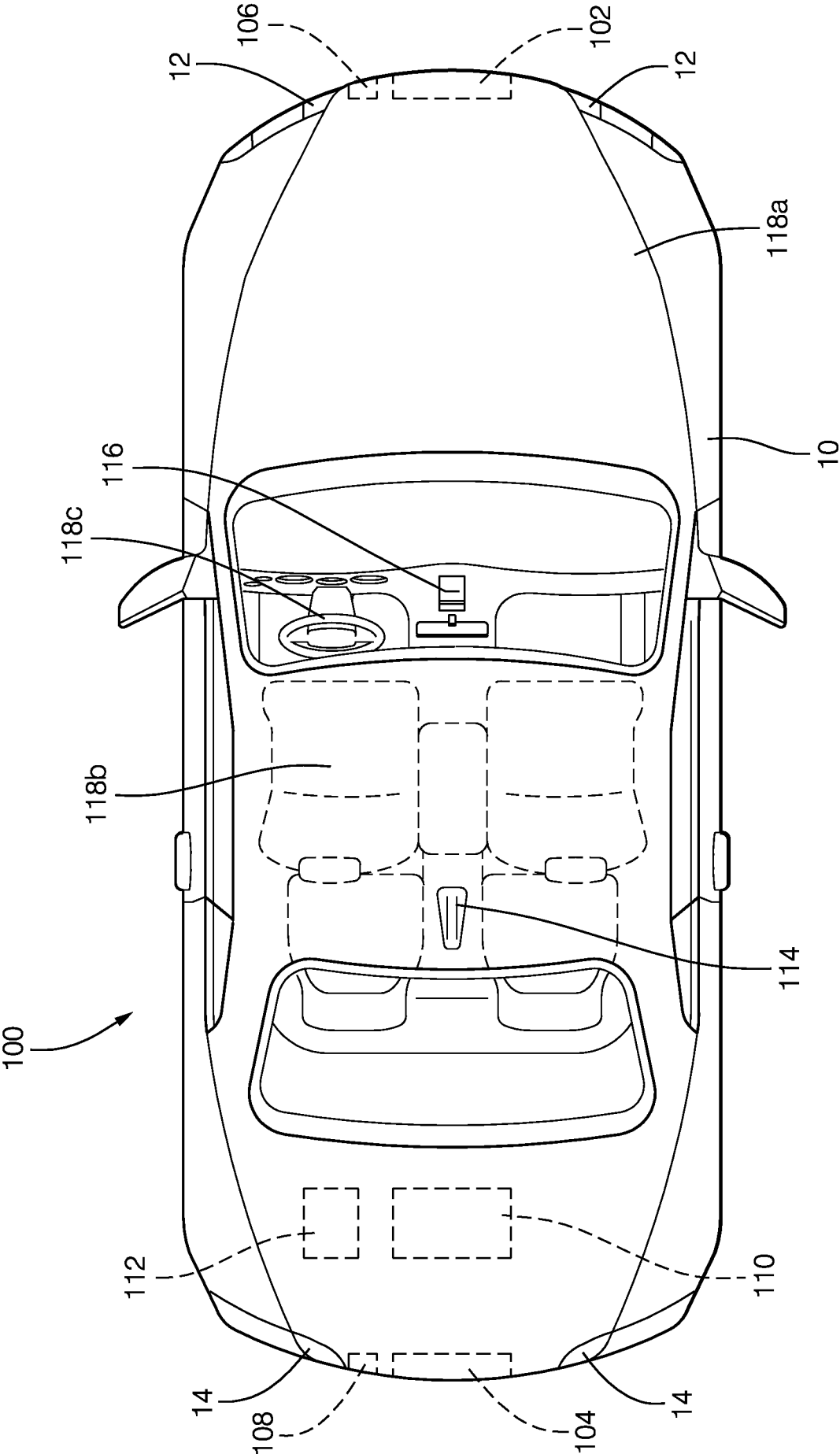


FIG. 1

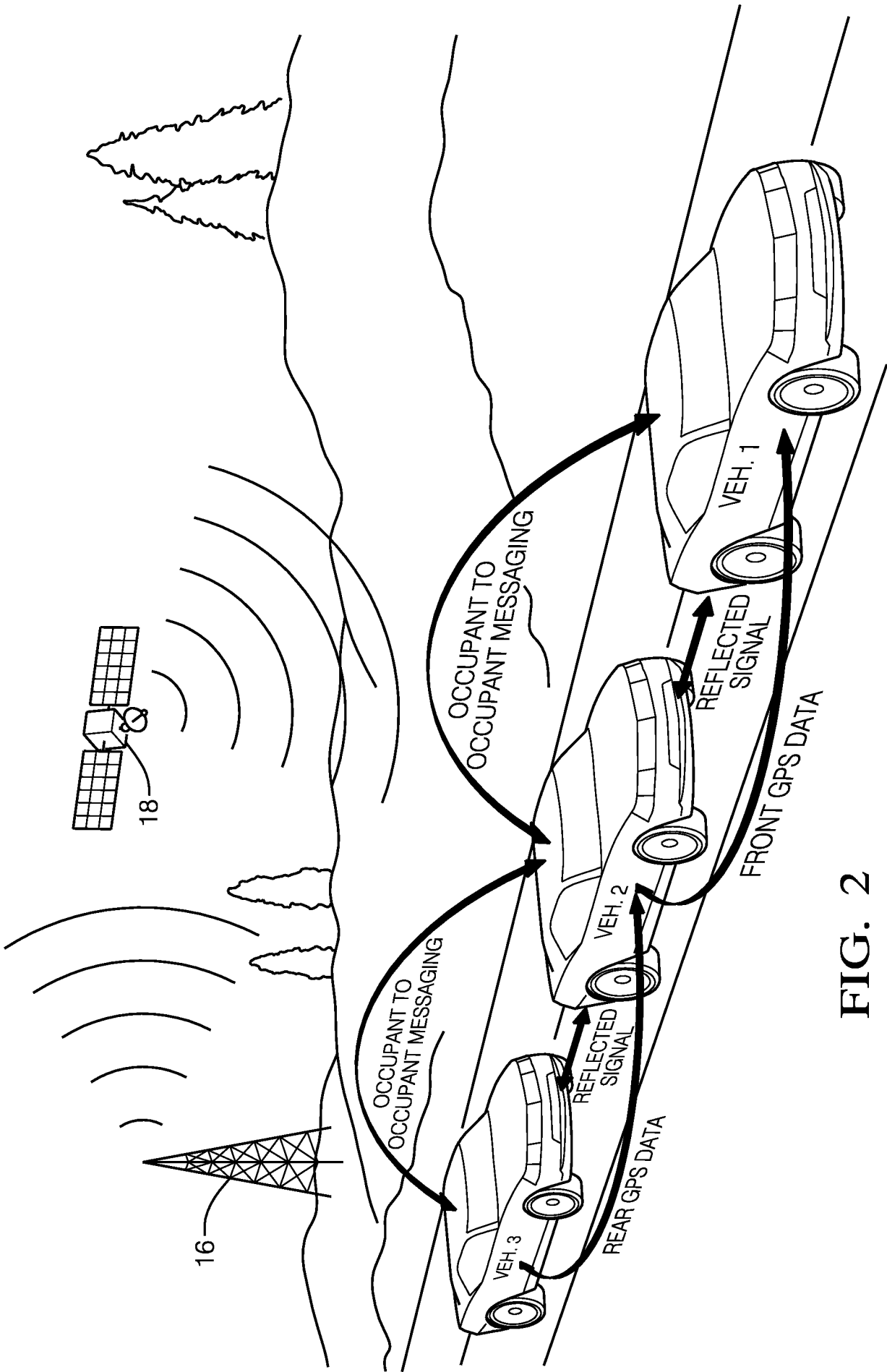
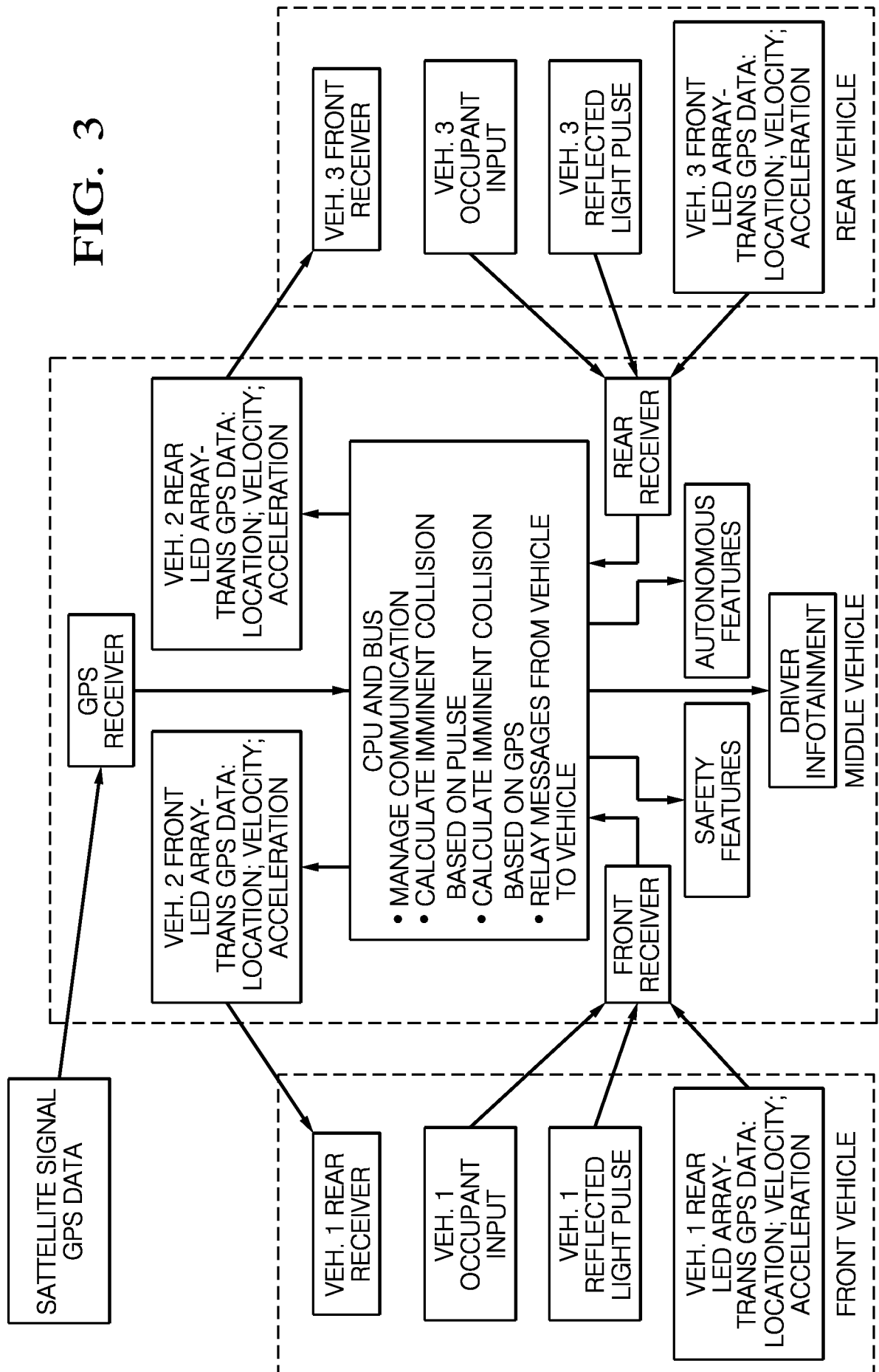


FIG. 2

FIG. 3



A. CLASSIFICATION OF SUBJECT MATTER**G08G 1/16(2006.01)i, G01S 17/93(2006.01)i, G01S 19/38(2010.01)i, G05D 1/02(2006.01)i**

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 1/16; B62D 41/00; B60R 1/00; G01S 17/93; G08G 1/04; G08G 1/123; G08G 1/0965; G08G 1/00; G08G 1/09; G01S 19/38; G05D 1/02

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

Korean utility models and applications for utility models

Japanese utility models and applications for utility models

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

eKOMPASS(KIPO internal) & Keywords: LED, communication, vehicle, interval, notice

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	KR 10-2010-0068944 A (INDUSTRY-ACADEMIC COOPERATION FOUNDATION, CHOSUN UNIVERSITY) 24 June 2010 See paragraphs [0028]-[0031]; claim 1; and figures 1-3.	7
Y		1-6, 8-13
Y	KR 10-1071914 B1 (KANG, JAE MIN) 11 October 2011 See paragraphs [0020]-[0027], [0039]; and figure 1.	1-6, 10-13
Y	JP 2008-003959 A (OMRON CORP.) 10 January 2008 See paragraphs [0007]-[0014], [0029]-[0034]; and figures 1-3.	8-10
A	KR 10-2001-0109873 A (KOREA INSTITUTE OF CONSTRUCTION TECHNOLOGY) 12 December 2001 See page 3, lines 3-23; claims 1-2, 4; and figures 1-3.	1-13
A	JP 2004-326705 A (SONY CORP.) 18 November 2004 See paragraphs [0011]-[0018], [0021]-[0026]; and figure 1.	1-13



Further documents are listed in the continuation of Box C.



See patent family annex.

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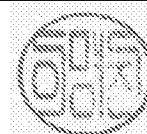
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INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No.

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Patent document cited in search report	Publication date	Patent family member(s)	Publication date
KR 10-2010-0068944 A	24/06/2010	KR 10-0996284 B1	23/11/2010
KR 10-1071914 B1	11/10/2011	WO 2012-124877 A1	20/09/2012
JP 2008-003959 A	10/01/2008	None	
KR 10-2001-0109873 A	12/12/2001	KR 10-0338121 B1	24/05/2002
JP 2004-326705 A	18/11/2004	None	