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(54) **Traffic information communication system, on-board communication device, and mobile terminal**

Verkehrsinformationskommunikationssystem, Bordkommunikationsvorrichtung und mobiles Endgerät

Système de communication d'informations de trafic, dispositif de communication embarqué, et terminal mobile

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Description

BACKGROUND OF THE INVENTION

1. Field of the Invention

[0001] The present invention relates to a traffic information communication system, and particularly to, technologies that perform radio communication between a road and a vehicle, between vehicles, and between a person and a vehicle using a radio communication device installed on the road, a radio communication device equipped in a vehicle, and a radio device equipped in a mobile terminal.

2. Description of the Related Art

[0002] Currently, technologies for previously preventing possible vehicular accidents are being studied. These technologies transmit and receive location information of a pedestrian and information on driving conditions of a vehicle by road-to-vehicle communication between a roadside unit installed on a road and an on-board unit (an on-board communication device) equipped in a vehicle, inter-vehicle communication employing on-board units equipped in a vehicle, and person-to-vehicle communication between an on-board unit equipped in a vehicle and a mobile terminal carried by a pedestrian to notify pedestrians or drivers of warning information for traffic safety. JP-A-H11(1999)-195196 or JP-A-2004-220143 relate to the invention described above.

[0003] JP-A-H11(1990)-195196 discloses a technology regarding an on-board information providing device that obtains peripheral information of its own vehicle and notifies the information to a driver by using an inter-vehicle communication means".

[0004] Further, JP-A-2004-220143 discloses a technology regarding an on-board communication device determining a degree of danger from the location information of a specific vehicle and pedestrian GPS (Global Positioning System) information received from a radio communication device carried by a pedestrian using a GPS receiver to notify a driver of possible danger, wherein the radio communication device also determines a degree of danger from the location information of a specific pedestrian and GPS information of a vehicle received from the on-board communication device using the GPS receiver to notify the pedestrian of possible danger.

[0005] The technology disclosed in JP-A-H11(1990)-19519 transmits and receives vehicle drive information including vehicle drive location information between its own vehicle and other vehicles running around the vehicle using an on-board communication device equipped in a vehicle to notify location information of peripheral vehicles to a driver. In a case where a number of vehicles are existent in a communication area of the on-board unit equipped in its own vehicle, however, the concentration of traffic may cause a delay in a notifying process from a vehicle that is positioned at a location dangerous to its own vehicle due to data coming from other vehicles. This may result in a difficulty to notify the danger to the driver at an appropriate timing.

[0006] Further, JP-A-2004-220143 is directed to a radio communication system that carries out direct radio communication between an on-board communication device equipped in a vehicle and a pedestrian portable radio communication device carried by a pedestrian. The pedestrian portable radio communication device calculates a relative distance between a vehicle and a pedestrian from GPS information of the pedestrian that is received from a GPS unit equipped in the pedestrian portable radio communication device and GPS information of the vehicle that is received from the vehicle and, if the calculated result shows any danger, notifies it to the pedestrian. However, if a number of pedestrians exist around the vehicle, determination of degree of danger from the relative distance between a vehicle and a pedestrian may make unnecessary notifications to a pedestrian who need not be notified to, such as a pedestrian moving behind the vehicle or in the direction of being far away from the vehicle. This type of communication may cause useless power consumption of the mobile terminal or radio communication device.

[0007] US 2005/0073438 A1 discloses a conventional traffic communication system which forms the basis of the preamble of the present independent claims.

SUMMARY OF THE INVENTION

[0008] The present invention is defined in the present independent claims. The subclaims relate to preferred modifications.

[0009] Disclosed is an on-board unit that may notify a driver at appropriate timing of vehicle drive information from a vehicle dangerous to its own vehicle even in a case where there are a number of vehicles near its own vehicle within a radio communication system that performs radio communication of road traffic information, vehicle drive information, and location information of a pedestrian by using road-to-vehicle communication, inter-vehicle communication, and person-to-vehicle communication. The portable radio communication device used for radio communications between a vehicle and a pedestrian notifies a pedestrian of only the inevitable danger information, such as information on an approaching vehicle, among the received vehicle drive information, and this enables to provide an inter-vehicle or person-to-vehicle communication system that may reduce processing loads of the portable radio device.

[0010] That is, disclosed is a traffic information communication system in which an on-board communication device equipped in a vehicle and a mobile terminal carried by a pedestrian perform radio communication, wherein the on-board communication device includes a navigation unit that obtains at least location information of its own vehicle equipped with the on-board communi-

cation device and vehicle drive information including a vehicle ID identifying the on-board communication device, and a communication device unit that broadcasts the vehicle drive information obtained by the navigation unit at a predetermined frequency and outputs vehicle drive information received from an on-board communication device of another vehicle or pedestrian information received from the mobile terminal to the navigation unit, and the navigation unit adds under-detection-of-a-to-be-watched-vehicle information that detects a vehicle ID of a to-be-watched vehicle as a to-be-watched vehicle to vehicle drive information of its own vehicle and transmits the information in the case of detecting a vehicle that may affect the drive safety of its own vehicle from the vehicle drive information received by the on-board communication device or the pedestrian information.

[0011] In the disclosed traffic information communication system, the navigation unit of the on-board communication device adds information that detects a vehicle ID of a to-be-watched vehicle as a to-be-watched vehicle to the vehicle drive information of its own vehicle and transmits the information in the case of detecting the other vehicle approaching in a traveling direction of its own vehicle from the vehicle drive information received by the communication device unit of the on-board communication device.

[0012] In the disclosed traffic information communication system an on-board communication device of the other vehicle or mobile terminal that receives the under-detection-of-a-to-be-watched-vehicle information performs at least one of operations that a transmission frequency of the own-transmitted vehicle drive information or pedestrian information increases and transmission power of the vehicle drive information or pedestrian information increases in a case where the to-be-watched vehicle ID or to-be-watched terminal ID included in the received under-detection-of-a-to-be-watched-vehicle information is identical to its vehicle ID or terminal ID.

[0013] The on-board communication device of the other vehicle or mobile terminal that receives the under-detection-of-a-to-be-watched-vehicle information includes an output unit outputting information that it is a to-be-watched vehicle or to-be-watched pedestrian and notifying a driver or pedestrian in a case where the received to-be-watched vehicle ID or to-be-watched terminal ID is identical to its vehicle ID or terminal ID.

[0014] The on-board communication device of the other vehicle or mobile terminal that receives the under-detection-of-a-to-be-watched-vehicle information reduces the transmission frequency of the own-transmitted vehicle drive information or pedestrian information transmitted from the on-board communication device in a case where the received to-be-watched vehicle ID or to-be-watched terminal ID is not identical to its vehicle ID or terminal ID.

[0015] The disclosed traffic information communication system further includes a roadside communication device on a road, wherein the on-board communication device transmits information that detects a to-be-watched vehicle to the roadside communication device in the case of detecting a vehicle or pedestrian that may affect the drive safety of its own vehicle from the drive information or pedestrian information received by the on-board communication device while receiving road information wirelessly transmitted from the roadside communication device.

[0016] The roadside communication that receives the under-detection-of-a-to-be-watched-vehicle information decreases the transmission frequency in a case where transmission priority of currently transmitted road information is lower than transmission frequency of the under-detection-of-a-to-be-watched-vehicle information.

[0017] Disclosed is also an on-board communication device equipped in a vehicle to broadcast vehicle drive information of the vehicle equipped with the on-board communication device to another vehicle driving around the vehicle. The on-board communication device includes a navigation unit that obtains at least location information of its own vehicle equipped with the on-board communication device and vehicle drive information including a vehicle ID specifying the communication device, and a communication device unit that broadcasts the vehicle drive information obtained by the navigation unit at a predetermined frequency and outputs vehicle drive information received from an on-board communication device of another vehicle to the navigation unit, wherein the navigation unit adds under-detection-of-a-to-be-watched-vehicle information that detects a vehicle ID of a to-be-watched vehicle as a to-be-watched vehicle to vehicle drive information of its own vehicle and transmits the information in the case of detecting a vehicle that may affect the drive safety of its own vehicle from the vehicle drive information received by the on-board communication device.

[0018] In the disclosed on-board communication device, the navigation unit adds information that detects a vehicle ID of a to-be-watched vehicle as a to-be-watched vehicle to the vehicle drive information of its own vehicle and transmits the information in the case of detecting the other vehicle approaching in a drive direction of its own vehicle from the vehicle drive information received by the communication device unit.

[0019] In the disclosed on-board communication device, an on-board communication device of the other vehicle that receives the under-detection-of-a-to-be-watched-vehicle information performs at least one of operations that a transmission frequency of the own-transmitted vehicle drive information increases and transmission power of the vehicle drive information increases in a case where the to-be-watched vehicle ID included in the received under-detection-of-a-to-be-watched-vehicle information is identical to its vehicle ID.

[0020] The on-board communication device of the other vehicle that receives the under-detection-of-a-to-be-watched-vehicle information includes an output device outputting information that it is a to-be-watched vehicle

and notifying a driver in a case where the received to-be-watched vehicle ID is identical to its vehicle ID.

[0021] The on-board communication device of the other vehicle that receives the under-detection-of-a-to-be-watched-vehicle information reduces the transmission frequency of the own-transmitted vehicle drive information in a case where the received to-be-watched vehicle ID is not identical to its vehicle ID.

[0022] Disclosed is also a mobile terminal carried by a pedestrian to transmit pedestrian information of the pedestrian to a vehicle driving around the pedestrian. The mobile terminal includes a location information obtaining unit that obtains pedestrian information of the pedestrian carrying the mobile terminal; an inter-vehicle radio communication unit that transmits the pedestrian information obtained by the location information obtaining unit at a predetermined transmission frequency while vehicle drive information is received from an on-board communication device equipped in a vehicle and receives vehicle drive information from the on-board communication device of the vehicle; and a vehicle information processing unit that increases the transmission frequency of the pedestrian information in a case where a terminal ID of a to-be-watched terminal included in the received vehicle drive information is identical to the terminal ID of the own mobile terminal.

[0023] The present invention may stop communication of unnecessary information with respect to road-to-vehicle, inter-vehicle, and person-to-vehicle communications that notify warning information to a driver or pedestrian for traffic safety in comparison with the prior art, and this enables to provide an on-board communication device and a portable communication device such as a mobile terminal that notify the driver or pedestrian at appropriate timing of danger at a appropriate timing. Furthermore, the present invention may reduce power consumption of the portable communication device such as a mobile terminal carried by the pedestrian.

BRIEF DESCRIPTION OF THE DRAWINGS

[0024]

Fig. 1 is a block diagram illustrating a construction of an on-board unit according to an exemplary embodiment of the present invention;

Fig. 2 is a block diagram illustrating a construction of navigation control unit included in an on-board unit according to an exemplary embodiment of the present invention;

Fig. 3 is a block diagram illustrating a construction of a radio communication unit included in an on-board unit according to an exemplary embodiment of the present invention;

Fig. 4 is a block diagram illustrating a construction of a communication control unit included in an on-board unit according to an exemplary embodiment of the present invention;

Figs. 5A and 5B are views illustrating the content of exemplary vehicle drive information that is transmitted and received between vehicles according to an exemplary embodiment of the present invention;

Fig. 6 depicts a vehicle arrangement for illustrating an exemplary case where a vehicle performs radio communication with the other vehicles according to an exemplary embodiment of the present invention;

Fig. 7 is a flowchart illustrating an exemplary vehicle drive process in a case where the navigation control unit according to the present invention performs transmission/reception of vehicle drive information to/from another vehicle according to an exemplary embodiment of the present invention;

Fig. 8 is a flowchart illustrating an exemplary detection process of detecting a to-be-watched vehicle among vehicles driving around its own vehicle by a navigation control unit according to an exemplary of the present invention;

Fig. 9 is a flowchart illustrating an exemplary update process of vehicle drive information in a vehicle drive information process performed by the navigation control unit 101 according to an exemplary embodiment of the present invention;

Fig. 10 is a flowchart illustrating an exemplary control process performed by a communication processing unit according to an exemplary embodiment of the present invention;

Fig. 11 is a flowchart illustrating the details of an exemplary data reception process according to an exemplary embodiment of the present invention;

Fig. 12 is a flowchart illustrating transmission and reception of vehicle drive information between its own vehicle and a two-wheeled vehicle in an exemplary processing operation of the vehicle drive information in a case where the two-wheeled vehicle is detected as a to-be-watched vehicle by its own vehicle according to an exemplary embodiment of the present invention;

Fig. 13 is a view illustrating an exemplary display screen displayed on an output unit of a navigation unit according to an exemplary embodiment of the present invention;

Fig. 14 is a view illustrating another exemplary display screen displayed on an output unit of a navigation unit according to an exemplary embodiment of the present invention;

Fig. 15 is a view illustrating an exemplary embodiment of accumulating vehicle drive information received from each of the other vehicles in the other vehicle drive information storing unit included in the navigation control unit in a case where no to-be-watched vehicles are detected according to an exemplary embodiment of the present invention;

Fig. 16 is a view illustrating an exemplary embodiment of accumulating vehicle drive information received from each of the other vehicles in other vehicle drive information storing unit included in the nav-

igation control unit in a case where any to-be-watched vehicle is detected according to an exemplary embodiment of the present invention;

Fig. 17 is a view illustrating an exemplary embodiment of accumulating vehicle drive information received from each of the other vehicles in the other vehicle drive information storing unit included in the navigation control unit in a case where no to-be-watched vehicles are detected according to an exemplary embodiment of the present invention;

Fig. 18 is a view illustrating an exemplary embodiment of accumulating vehicle drive information received from each of the other vehicles in the other vehicle drive information storing unit included in the navigation control unit in a case where any to-be-watched vehicle is detected according to an exemplary embodiment of the present invention;

Fig. 19 is a flowchart illustrating an exemplary vehicle drive information process in a case where the navigation control unit transmits and receives vehicle drive information to/from another vehicle according to an exemplary embodiment of the present invention;

Fig. 20 is a view illustrating an exemplary embodiment of accumulating vehicle drive information received from each of the other vehicles in the other vehicle drive information storing unit included in the navigation control unit in a case where any to-be-watched vehicle is detected according to an exemplary embodiment of the present invention;

Fig. 21 is a view illustrating a case where an error occurs upon accumulating vehicle drive information received from each of the other vehicles in the other vehicle drive information storing unit included in the navigation control unit in a case where any to-be-watched vehicle is detected according to an exemplary embodiment of the present invention;

Fig. 22 depicts a vehicle arrangement for illustrating an exemplary case where its own vehicle performs radio communication with the other vehicles according to an exemplary embodiment of the present invention;

Fig. 23 is a flowchart illustrating an exemplary vehicle drive information process in a case where the navigation control unit performs a transmission and reception process of vehicle drive information with another vehicle and a transmission and reception process with a roadside unit according to an exemplary embodiment of the present invention;

Fig. 24 is a flowchart illustrating an exemplary reception process of information from the roadside unit in the vehicle drive information process by the navigation control unit according to an exemplary embodiment of the present invention;

Fig. 25 is a block diagram illustrating an exemplary on-board communication device according to an exemplary embodiment of the present invention;

Fig. 26 is a block diagram illustrating an exemplary construction of a navigation control unit included in an on-board communication device according to an exemplary embodiment of the present invention;

Figs. 27A and 27B are a view illustrating exemplary content of vehicle drive information according to an exemplary embodiment of the present invention;

Fig. 28 is a block diagram illustrating an exemplary construction of a mobile terminal according to an exemplary embodiment of the present invention;

Figs. 29A and 29B are views illustrating exemplary content of pedestrian information according to an exemplary embodiment of the present invention;

Fig. 30 depicts a vehicle-pedestrian arrangement for illustrating the location of a moving vehicle and a moving pedestrian after p seconds from the location at the first time, and a communication area according to an exemplary embodiment of the present invention;

Fig. 31 is a flowchart illustrating an exemplary case where a mobile terminal carried by a pedestrian transmits and receives vehicle drive information and pedestrian information to/from a vehicle according to an exemplary embodiment of the present invention;

Fig. 32 is a flowchart illustrating an exemplary vehicle drive information process in a case where the navigation control unit performs a transmission and reception process of vehicle drive information with another vehicle and a transmission and reception process with a mobile terminal carried by a surrounding pedestrian according to an exemplary embodiment of the present invention;

Fig. 33 is a flowchart illustrating an exemplary reception process of pedestrian information from a mobile terminal in a vehicle drive information process by the navigation control unit according to an exemplary embodiment of the present invention; and

Fig. 34 is a flowchart illustrating an exemplary inter-vehicle communication process in the vehicle information processing unit 505 included in the mobile terminal A 500 according to an exemplary embodiment of the present invention.

DETAILED DESCRIPTION OF THE ILLUSTRATED EMBODIMENTS

[0025] Hereinafter, exemplary embodiments of the present invention will be described in more detail with reference to accompanying drawings. In addition, the same reference numerals refer to the same constitutional elements in the drawings, and therefore, repetitive descriptions will be omitted.

First Embodiment

[0026] In the first embodiment, in a case where there is a vehicle that calls a driver's attention around its own vehicle, driver attention information is displayed on a nav-

igation device display unit, and the vehicle ID (Identification) of the detected vehicle is added to its own vehicle transmission information to be transmitted.

[0027] The traffic information communication system according to the first embodiment of the present invention will be described with reference to accompanying drawings. Fig. 1 is a block diagram illustrating a construction of an on-board unit in a traffic information communication system according to an exemplary embodiment of the present invention.

[0028] The reference numeral "400" refers to its own vehicle, and "401" refers to a vehicle A.

[0029] In its own vehicle 400, the reference numeral "100" refers to a navigation unit equipped with a navigation function that guides a driver to a destination, "101" refers to a navigation control unit that performs a control process of each unit included in the navigation unit 100, "102" refers to an output unit, such as a speaker that output voice information or a monitor that displays image information, and "103" refers to an input unit that enables the driver to perform an input operation, such as setup of a destination, to the navigation unit 100. Further, the reference numeral "200" refers to a communication device unit that wirelessly communicates vehicle driver information that represents a vehicle driving conditions with the vehicle A401, "201" refers to a radio communication unit that transmits vehicle drive information of its own vehicle and receives vehicle drive information from the vehicle A401 that runs around its own vehicle 400, "202" refers to an antenna that is used for transmission and reception of radio data from the radio communication unit 201, and "203" refers to a communication control unit that performs transmission and reception of data between the communication device unit 200 and the navigation unit 100. Further, the reference numeral "300" refers to an on-board communication unit (an on-board unit) that includes the navigation unit 100 and the communication device unit 200.

[0030] Its own vehicle 400 is equipped with the on-board communication unit 300. The vehicle A401, which drives near its own vehicle 400, is equipped with the on-board communication unit 300 to perform transmission and reception of vehicle drive information. The vehicle drive information that is communicated by the communication device unit 200 includes, for example, its own vehicle ID, a drive location, a speed, a drive direction, a brake, and an accelerator state. Detailed descriptions will be given with reference to Figs. 5A and 5B.

[0031] In Fig. 1, the navigation control unit 101 performs a process of guiding a driver to a designated destination by input information inputted from the input unit 103. When the driver enters the destination through the input unit 103, road information from the current location of its own vehicle 400 up to the destination is searched to display path information of driving road on the output unit 102.

[0032] The drive location of its own vehicle is pinpointed on the map displayed on the output unit 102 during drive and driving guide information is outputted by a voice through the output unit 102 to guide the driver up to the destination. Vehicle drive information received from the on-board communication unit 300 equipped in the other vehicle A401 received via the communication control unit 203 is analyzed to display the analyzed information on the output unit 102.

[0033] The output unit 102 may include a display that displays various types of information such as map information or traffic congestion information that is outputted by the navigation control unit 101 or a speaker that audibly outputs route guide information that is outputted by the navigation control unit 101 under the control of the navigation control unit 101. It should be noted that the output unit 102 is not limited to a device or apparatus for displaying images, or a device or apparatus for outputting voice information, and may include other devices or apparatuses that provide information to a driver, operator, or manipulator. For example, the output unit 102 may include a vibrating device or apparatus that makes a notification of attention or warning information by vibration.

[0034] The input unit 103 is an operation unit for entering predetermined processing operation requests or various types of information necessary for the driver to set up a destination, for which its own vehicle 400 is heading, to the navigation unit 100 and this includes an input operation panel (keyboards, touch panels, etc.). The various types of information entered by the driver through the input unit 103 are outputted to the navigation control unit 101. It should be noted that the input unit 103 is not limited to a device or apparatus used as the input operation panel, or a device or apparatus of outputting voice information, and may include other devices or apparatuses that are operated and inputted according to a driver's, an operator's, or a manipulator's intentions, operations, or variation of biological information. For example, the input unit 103 may include a device or apparatus of detecting the sightline, motions of an eye, a face, direction of a head, a slope, an angle, rotation, motion, biological information including a pulse, blood pressure, etc. to perform an input process.

[0035] Fig. 2 is a block diagram illustrating an exemplary construction of the navigation control unit 101 shown in Fig. 1. The reference numeral "1011" refers to an acceleration sensor that detect the vehicle speed, "1012" refers to a GPS (Global Positioning System) that obtains information on a place or location of a vehicle, "1013" refers to a gyro that detects the traveling direction of a vehicle, "1014" refers to a map information recording unit that records map information for displaying a current place or destination, "1015" refers to a vehicle information acquisition unit that acquires vehicle drive information on a driving conditions, "1016" refers to other vehicle drive information storing unit that stores vehicle drive information on a driving conditions that is received from other vehicles, and "1017" refers to a control unit that controls the navigation unit 100.

[0036] In Fig. 2, the acceleration sensor 1011 detects

the speed of its own vehicle 400 and simultaneously outputs an electrical signal representing the detected speed to the control unit 1017.

[0037] The GPS 1012 obtains current location information of its own vehicle 400 and simultaneously outputs the obtained current location information of its own vehicle 400 to the control unit 1017 by communicating with plural GPS satellites.

[0038] The gyro 1013 detects the traveling direction of its own vehicle 400 and simultaneously outputs the detected traveling direction of its own vehicle 400 to the control unit 1017.

[0039] The map information recording unit 1014 records map information for displaying the current location or destination of its own vehicle 400 to the output unit 102 under the control of the control unit 1017. The map information recording unit 1014 outputs designated map information in response to a request from the control unit 1017.

[0040] The vehicle information acquisition unit 1015 obtains and outputs an operation state of its own vehicle 400 such as a drive speed, rotational number or torque of an engine, brake, accelerator state, and the like in response to a request from the control unit 1017.

[0041] The control unit 1017 performs each process to be described later in response to a request or various types of information inputted from the input unit 103. During drive, the control unit 1017 acquires a vehicular speed detection signal from the acceleration sensor 1011, a current location information of its own vehicle 400 from the GPS 1012, and traveling direction information of its own vehicle 400 from the gyro 1013, reads map information on surroundings of a drive position of its own vehicle among the map information recorded in the map information recording unit 1014, and displays a drive location of its own vehicle on the output unit 102. Further, the rotational number or torque of the engine may be adapted to be obtained based on a control signal processed by a control system of the engine or a detection signal detected upon control.

[0042] In a case where a driver inputs a destination through the input unit 103 to perform setup of a navigation drive request that guides the driver up to the destination, the control unit 1017 calculates a drive path from the current location up to the destination to perform a guiding process up to the destination along the designated route by output of a voice or image. Further, the communication device unit 200 (the communication control unit 203 and the radio communication unit 201) analyzes vehicle drive information received from other vehicles and outputs information on vehicles driving around to the output unit 102.

[0043] A specific example of drive information treated by the control unit 1017 will be described later with reference to Figs. 5A and 5B.

[0044] Fig. 3 is a block diagram illustrating an exemplary construction of the radio communication unit 201 included in the on-board unit shown in Fig. 1. The reference numeral "2011" refers to a transmission unit that performs a transmission process of data in response to a request from a radio communication processing unit 2014, "2012" refers to a reception unit that receives data from the antenna 202, "2013" refers to a switch that switches between a transmission process and a reception process, and "2014" refers to the radio communication processing unit that performs a switching process of the switch 2013 and input/output of data to the transmission unit 2011, the reception unit 2012, and the communication control unit 203.

[0045] In Fig. 3, the radio communication processing unit 2014 checks a usage situation of surrounding radio transmission channels upon receiving a data transmission request from the communication control unit 203, and, if no channels are used, sets up transmission data to the transmission unit 2011 so that the switch 2013 switches to the transmission unit 2011 side to perform data transmission. If any channels are used, the radio communication processing unit 2014 holds transmission to avoid collisions of transmission data and performs a transmission process only after it is confirmed that the channels are not used any more.

[0046] This access control method for radio communications is called CSMA/CA (Carrier Sense Multiple Access with Collision Avoidance) and has been standardized in IEEE802.11 as an access control scheme for MAC (Media Access Control) layers of wireless LANs (Local Area Networks).

[0047] Upon completion of the transmission process, the switch 2013 switches into the reception unit 2012 side. Further, in a case where data is received to the reception unit 2012, the data is transmitted to the communication control unit 203 through the radio communication processing unit 2014.

[0048] Fig. 4 is a block diagram illustrating an exemplary construction of the communication control unit 203 included in the on-board unit shown in Fig. 1. The reference numeral "2031" refers to a navigation interface unit that inputs and outputs data to/from the navigation control unit 101 of the navigation unit 100, "2032" refers to a communication control processing unit that performs an input/output control process of data to each of the radio communication unit 201 and the navigation unit 100, "2033" refers to a transmission data storing unit that temporarily stores transmission data in response to a request from the navigation unit 100, "2034" refers to a reception data storing unit that temporarily stores reception data received from the radio communication unit 201, and "2035" refers to an inter-vehicle communication interface unit that performs an input/output of data between the communication control processing unit 2032 and the radio communication unit 201.

[0049] Figs. 5A and 5B are views illustrating the content of exemplary vehicle drive information that is transmitted and received between vehicles according to an exemplary embodiment of the present invention. Fig. 5A depicts a table that represents the content of vehicle drive

information that is transmitted and received between vehicles and transmitted to a pedestrian. Further, Fig. 5B depicts a data format of vehicle drive information transmitted to the communication device unit 200.

[0050] Data items include its own vehicle ID that is a number specifying its own vehicle, a kind of a vehicle that represents the type of its own vehicle, a latitude, a longitude, and an altitude of identifying a place where its own vehicle is driving, a vehicle speed that represents the traveling speed of its own vehicle, acceleration that represents traveling acceleration of its own vehicle, direction that represents traveling orientation of its own vehicle, BRAKE that represents a usage state of a brake, ACCEL that represents a usage state of an accelerator, and a to-be-watched vehicle ID that represents a vehicle ID of a vehicle necessary to watch, which is detected from vehicle drive information received from the other vehicles. Data amount, unit, and other contents of each data item have been represented in Fig. 5A. In addition, even though the data amount of a to-be-watched vehicle ID is adapted to have 2 bytes in Fig. 5B, data amount of more than 2 bytes may be adopted to cope with plural vehicles.

[0051] Moreover, even though the content of BRAKE or ACCEL has been adapted to have "ON:OFF" in Fig. 5A, the present invention is not limited to the two-value information, and may adopt such information that sequentially represents data amount in response to a usage state of the brake or accelerator.

[0052] When receiving the vehicle drive information, the navigation control unit 101 converts the vehicle drive information into the vehicle drive information data format shown in Figs. 5A and 5B and then request a transmission to the communication device unit 200.

[0053] Fig. 6 depicts a vehicle arrangement for illustrating an exemplary case where its own vehicle 400 performs radio communication with the other vehicles according to an exemplary embodiment of the present invention.

[0054] The reference numeral "402" refers to a two-wheeled vehicle that is equipped with the on-board communication unit 300 similarly to the vehicle A401 and drives near its own vehicle 400, "403" refers to a vehicle B that is equipped with the on-board communication unit 300 similarly to the vehicle A401 and drives near its own vehicle 400, "404" refers to a vehicle C that is equipped with the on-board communication unit 300 similarly to the vehicle A401 and drives around its own vehicle 400, "405" refers to a vehicle D that is equipped with the on-board communication unit 300 similarly to the vehicle A401 and drives around its own vehicle 400, "406" refers to a vehicle E that is equipped with the on-board communication unit 300 similarly to the vehicle A401 and drives around its own vehicle 400, and "407" refers to a vehicle F that is equipped with the on-board communication unit 300 similarly to the vehicle A401 and drives around its own vehicle 400.

[0055] The reference numeral "800" refers to a communication area A where communication may be done between the radio communication unit 201 of the on-board communication unit 300 equipped in its own vehicle 400 and the radio communication unit 201 of the on-board communication unit 300 equipped in each of the two-wheeled vehicle 402, the vehicle B403, the vehicle C404, the vehicle D405, the vehicle E406, and the vehicle F407 that drive around its own vehicle 400, "810" to an position "s" where its own vehicle 400 is driving, and "910" to a position "t" where its own vehicle 400 is driving afterwards.

[0056] Fig. 7 is a flowchart illustrating an exemplary vehicle drive process in a case where the navigation control unit 101 according to the present invention performs transmission/reception of vehicle drive information to/from another vehicle according to an exemplary embodiment of the present invention.

[0057] When the navigation control unit 101 starts processing of vehicle drive information, it is determined in the step S701 whether or not there is a vehicle drive information reception notification. If not, the process proceeds to the step S708 and if any, the process proceeds to the step S702.

[0058] In the step S702, it is determined whether or not the to-be-watched vehicle ID of the received vehicle drive information is identical to its own vehicle ID. If not identical, the step S707 is performed, and if identical, the step S703 is performed. That is, it is confirmed in the step S702 whether its own vehicle is detected by the other vehicles as a to-be-watched vehicle.

[0059] It is determined in the step S703 whether or not its own vehicle drive information update period is set at high speed. If not set at high speed, the step S704 is performed and if set at high speed, the step S706 is performed.

[0060] In the step S704, its own vehicle drive information update period timer is set at high speed and then the step S705 is carried out. In the step S705, a high-speed setup request of the transmission period timer is made to the communication control unit 203 and then the step S706 is performed. Here, its own vehicle drive information update timer is a period timer that updates the vehicle drive information of its own vehicle 400. The navigation control unit 101 obtains the vehicle drive information of its own vehicle whenever the timer expires, and reactivates the timer. In the meanwhile, the communication control unit 203 performs a transmission process of the vehicle drive information set by the navigation control unit 101 when the transmission period timer expires and reactivates the transmission period timer. Further, when receiving a high-speed setup request, the communication control unit 203 sets the transmission period timer at high speed, so that the transmission interval of subsequent its own vehicle drive information becomes shorter. Detailed descriptions on process by the communication control unit 203 will be given later with reference to the flowchart shown in Fig. 10.

[0061] In the step S706, a to-be-watched vehicle ID

detection timer restarts, and then step S707 is performed. Here, the to-be-watched vehicle ID detection timer is a timer that determines whether its own vehicle set as a to-be-watched vehicle is maintained as the to-be-watched vehicle from the other vehicles. That is, in the step S706, the timer is updated in the period when its own vehicle remains as a to-be-watched vehicle, and the high-speed setup of step S704 is maintained.

[0062] In the step S707, a to-be-watched vehicle detection process is performed and then the step S708 is performed. That is, it is determined in the step S707 whether or not there exists any to-be-watched vehicle from data received from the other vehicles, for example, as described later with reference to Fig. 8.

[0063] In the step S708, it is determined whether or not its own vehicle drive information update timer is expires. If it is determined that the timer expires, the step S709 is performed, and otherwise, the step S710 is performed.

[0064] In the step S709, a vehicle drive information update process is performed and then the step S710 is performed. That is, a transmission process of its own vehicle drive information is performed in the step S709, for example, as described later with reference to Fig. 9.

[0065] In the step S710, it is determined whether or not the to-be-watched vehicle information ID detection timer expires. If it is determined that the timer expires, the step S711 is performed, and otherwise, the process shown in Fig. 7 (vehicle drive information process by the navigation control unit 101) ends.

[0066] In the step S711, the drive information update period timer of its own vehicle is set as a usual setup and then the step S712 is performed. That is, in the step S711, the timer update process set in the step S706 is not executed and its own vehicle is determined to be released from setup as the to-be-watched vehicle, so that the setup of the timer returns to the usual transmission period of its own vehicle drive information.

[0067] In the step S712, the transmission period timer of the communication control unit 203 is set as a usual setup and then the process shown in Fig. 7 ends.

[0068] Fig. 8 is a flowchart illustrating an exemplary detection process of detecting a to-be-watched vehicle among vehicles driving around its own vehicle in the vehicle drive information process by the navigation control unit 101 according to an exemplary of the present invention. Although a left-turn drive support process is exemplified in the flowchart where the two-wheeled vehicle 402 approaching its own vehicle 400 at a left and rear side is detected as a to-be-watched vehicle in Fig. 6 when its own vehicle 400 is about to turn left at the front intersection in front thereof, other drive support processes such as a right-turn drive support process or anti-collision support process may also be carried out.

[0069] For example, a to-be-watched vehicle detection process is executed in the step S707 and then the step S708 is performed. That is, it is determined in the step S707 whether or not there is any to-be-watched vehicle through data received from the other vehicles as described in the exemplary embodiment shown in Fig. 8.

[0070] To begin with, the received vehicle drive information is stored in the other vehicle drive information storing unit 1016 in the step S801 and then the step S802 is performed.

[0071] In step 802, the distance and location from its own vehicle are calculated from information on locations and directions of its own vehicle and another vehicle in the step S802 and then the step S803 is performed.

[0072] It is determined in the step S803 whether or not its own vehicle is approaching a left-turn intersection from drive information, such as location of its own vehicle, and map information. If approaching, the step S804 is performed, and otherwise, the step S810 is performed.

[0073] In the step S804, it is determined whether or not a two-wheeled vehicle is detected at the rear side of its own vehicle. If detected, the step S805 is performed, and otherwise, the step S810 is performed.

[0074] In the step S805, it is determined whether or not any two-wheeled vehicle already displayed is detected. If detected, the step S808 is performed, and otherwise, the step S806 is performed.

[0075] In the step S806, information shown in Fig. 13 is displayed on the output unit 102, notifying a two-wheeled vehicle approaching at a rear side. The process proceeds to the step 807.

[0076] In the step S807, the received vehicle ID is set as a to-be-watched vehicle ID of its own vehicle transmission information and then the process shown in Fig. 8 ends (or, the step S708 shown in Fig. 7 is performed).

[0077] In the step S808, it is determined whether or not there is updated the data previously received. If updated, the step S809 is executed to perform an update of the position in which the approaching vehicle is indicated, and otherwise, the process shown in Fig. 8 ends (or, the step S708 shown in Fig. 7 is performed).

[0078] In the step S810, it is determined whether or not such information that a two-wheeled vehicle is approaching at a rear side is displayed. If displayed, the step S811 is performed, and otherwise, the process shown in Fig. 8 ends (or, the step S708 shown in Fig. 7 is performed).

[0079] In the step S811, such information that the two-wheeled vehicle is approaching at the rear side is paused to be displayed and then the step S812 is performed.

[0080] In the step S812, the setup of the vehicle drive information of its own vehicle as the to-be-watched vehicle ID done in the step S807 is released, and then the process shown in Fig. 8 ends (or, the step S708 shown in Fig. 7 is performed).

[0081] Fig. 9 is a flowchart illustrating an exemplary update process of vehicle drive information in a transmitted vehicle drive information process performed by the navigation control unit 101 according to an exemplary embodiment of the present invention.

[0082] For example, a vehicle drive information update process is performed in the step S709 of Fig. 7, and then

the step S710 is performed. That is, a drive information update process of its own vehicle is performed in the step S709 as described with reference to Fig. 9.

[0083] Firstly, its own vehicle drive information is obtained in the step S901, and then the step S902 is performed. Its own vehicle drive information includes, for example, items or contents shown in Figs. 5A and 5B.

[0084] In the step S902, an update request of its own vehicle drive information (transmission request of its own vehicle drive information) is made to the communication control unit 203, and then the step S903 is performed.

[0085] In the step S903, the drive information update period timer of its own vehicle is restarted, and then the process shown in Fig. 9 ends (or, the step S710 shown in Fig. 7 is performed).

[0086] Fig. 10 is a flowchart illustrating an exemplary control process performed by the communication control unit 203 according to an exemplary embodiment of the present invention. In the flowchart shown in Fig. 10, a data reception process of data from the radio communication unit 201, an update request process of vehicle drive information from the navigation unit 100, and a transmission request process of vehicle drive information are performed.

[0087] In the step S1001, it is determined by the radio communication unit 201 whether or not data is received. If received, the step S1002 is performed, and otherwise, the step S1003 is performed.

[0088] In the step S1002, a data reception process is performed by the communication control processing unit 2032, and then the step S1003 is performed. Detailed descriptions on the exemplary embodiment will be given later with reference to Fig. 11.

[0089] In the step S1003, it is determined whether or not a vehicle drive information update request is received from the navigation unit 100. If received, the step S1004 is performed, and otherwise, the step S1005 is performed.

[0090] In the step S1004, a vehicle drive information update process is performed, and then the step S1005 is performed.

[0091] In the step S1005, it is determined whether or not a setup request of the vehicle drive information transmission period timer is received from the navigation unit 100. If received, the step S1006 is performed, and otherwise, the step S1007 is performed.

[0092] In the step S1006, an update process of the transmission period timer setup is performed, and then the step S1007 is performed. That is, a variation request of the timer setup performed in the step S705 or step S702 is received in the step S1006 to set a transmission period.

[0093] In the step S1007, it is determined whether or not the transmission period timer of its own vehicle drive information is ended. If ended, the step S1008 is performed, and otherwise, the process shown in Fig. 10 ends.

[0094] In the step S1008, a transmission data setup instruction is made to the radio communication unit 201, and the step S1009 is performed.

[0095] In the step S1009, the transmission period timer is restarted, and then the process shown in Fig. 10 ends.

[0096] Fig. 11 is a flowchart illustrating the detail of an exemplary data reception process by the communication control unit 203 according to an exemplary embodiment of the present invention. Fig. 11 depicts, for example, a data reception process performed by the communication control processing unit 2032 in the step S1002 of Fig. 10.

[0097] In the step S1101, it is determined whether or not there is reception data received in the reception data storing unit 2034. If it is determined that there is reception data, the step S1102 is performed, and otherwise, the process shown in Fig. 11 ends, and then, for example, the step S1003 shown in Fig. 10 is performed.

[0098] In the step S1102, it is determined whether or not the reception data has been received. If received, the step S1103 is performed, and otherwise, the step S1104 is performed.

[0099] In the step S1103, such data as already received is discarded and then the process shown in Fig. 11 ends.

[0100] In the step S1104, data stored in the reception data storing unit 2034 is outputted to the navigation unit 100, and then the process shown in Fig. 11 ends.

[0101] Fig. 12 is a flowchart illustrating transmission and reception of vehicle drive information between its own vehicle and a two-wheeled vehicle in an exemplary processing operation of the vehicle drive information in a case where the two-wheeled vehicle 402 is detected as a to-be-watched vehicle by its own vehicle 400 according to an exemplary embodiment of the present invention. The direction of time lapsing is from top to down in Fig. 12.

[0102] In Fig. 12, its own vehicle 400 executes a transmission process S1201 of vehicle drive information while drive. In this case, its own vehicle 400 broadcasts vehicle drive information S1202 at time m0, and thereafter, continues to broadcast the vehicle drive information S1202 every time interval s[s] (times m1, m2, m3, m4, m5, m6, ...).

[0103] In the meanwhile, the two-wheeled vehicle 402 executes a transmission process S1203 of vehicle drive information. In this case, the two-wheeled vehicle 402 receives the vehicle drive information transmitted from its own vehicle 400 at time m0 and transmits drive information S1204 of its own vehicle (the two-wheeled vehicle 402) at time w1. Thereafter, the two-wheeled vehicle 402 continues to transmit the drive information S1204 every time interval t[s] (times w2, w3, and w4).

[0104] Its own vehicle 400 designates the two-wheeled vehicle 402 as a to-be-watched vehicle at time m2, and adds a to-be-watched vehicle ID to the vehicle drive information and transmits it (S1204). At this time, the two-wheeled vehicle 402 receives the vehicle drive information to which the to-be-watched vehicle ID is added and recognizes that its own vehicle has been considered as

the to-be-watched vehicle. As its own vehicle becomes considered as a to-be-watched vehicle, the two-wheeled vehicle 402 changes the transmission frequency from the time interval t[s] to the time interval u[s] (times w5, w6, w7, w8, w9, w10) which is shorter than the time interval t[s] correspondingly, and then transmits the drive information of its own vehicle (S1205) (where, t>u).

[0105] When it is determined that the two-wheeled vehicle 402 is not designated as the to-be-watched vehicle any more at time m4, its own vehicle 400 transmits the vehicle drive information without addition of the to-be-watched vehicle ID (S1206). The two-wheeled vehicle 402 receives the vehicle drive information and then returns the transmission frequency to the original frequency based on information regarding release from designation of its own vehicle as the to-be-watched vehicle (S1207). That is, the two-wheeled vehicle 402 changes the transmission interval setup of the vehicle drive information of its own vehicle into the time interval t[s].

[0106] Thereafter, its own vehicle 400 broadcasts the vehicle drive information S1202 at times m5 and m6, and the two-wheeled vehicle 402 also transmits the vehicle drive information S1204 at times w11, w12, w13, ..., at the time interval t[s].

[0107] Fig. 13 is a view illustrating when detecting a vehicle approaching its own vehicle by the navigation control unit 101 of the navigation unit 100 receiving the vehicle drive information from the other vehicles, an example of displaying the contents thereof on the output unit 102. The reference numeral "1301" refers to an indication A when it is notified that there is a two-wheeled vehicle approaching from a left and rear side.

[0108] Road map information and the approaching two-wheeled vehicle are displayed on the output unit 102 of the navigation unit 100 equipped in its own vehicle 400 and simultaneously a telop saying, "A two-wheeled vehicle is running at the left and rear side. Please watch out.", is generated or such a voice is outputted from a speaker (not shown) included in the output unit 102.

[0109] Fig. 14 is a view illustrating an exemplary screen displaying it on the output unit 102 that its own vehicle is detected by the other vehicles a to-be-watched vehicle by the navigation control unit 101 of the navigation unit 100 receiving the vehicle drive information from the other vehicles. The reference numeral "1401" refers to an indication B when it is notified to the driver that the self two-wheeled vehicle is detected as a to-be-watched vehicle by a left-turn signal of the vehicle located at the right and front side.

[0110] Road map information and the approaching vehicle are displayed on the output unit 102 of the navigation unit 100 equipped in the two-wheeled vehicle 402 and simultaneously a telop saying, "A vehicle is running at the right and front side. Please watch out.", is generated or such a voice is outputted from a speaker (not shown) included in the output unit 102.

[0111] Fig. 15 is a view illustrating an exemplary embodiment of accumulating vehicle drive information received from each of the other vehicle the other vehicles in the other vehicle drive information storing unit 1016 included in the navigation control unit 101 in a case where no to-be-watched vehicles are detected in its own vehicle 400 according to an exemplary embodiment of the present invention. Fig. 16 is a view illustrating an exemplary embodiment of accumulating vehicle drive information received from each of the other vehicle the other vehicles in the other vehicle drive information storing unit 1016 included in the navigation control unit 101 in a case where any to-be-watched vehicle is detected in its own vehicle 400 according to an exemplary embodiment of the present invention.

[0112] When no to-be-watched vehicles are detected with respect to the horizontal axis, time t, as shown in Fig. 15, "vehicle A, vehicle B, vehicle C, vehicle D, vehicle E, vehicle F, two-wheeled vehicle, vehicle A, vehicle B, vehicle C, vehicle D, vehicle E, vehicle F, two-wheeled vehicle, vehicle A, vehicle B, vehicle C, vehicle D, ..." and drive information of the whole vehicles are stored in the other vehicle drive information storing unit 1016 at the same time interval. Accordingly, the drive information is stored at the same time interval (time m) with respect to all the vehicles including the two-wheeled vehicle 402.

[0113] When a to-be-watched vehicle is detected, however, vehicle A, vehicle B, vehicle C, two-wheeled vehicle, vehicle D, vehicle E, vehicle F, two-wheeled vehicle, vehicle A, vehicle B, vehicle C, two-wheeled vehicle, vehicle D, vehicle E, vehicle F, two-wheeled vehicle, vehicle A, vehicle B,..." and drive information of the two-wheeled vehicle 402 deemed as a to-be-watched vehicle are transmitted at a shorten transmission period (time interval n, where n<m). Therefore, only the drive information from two-wheeled vehicle 402 is frequently received and this raises receiving success rate of the drive information of the two-wheeled vehicle 402.

[0114] Fig. 17 is a view illustrating a state where vehicle drive information is stored when a communication error occurs while the vehicle drive information received from each of the other vehicle the other vehicles is accumulated in the other vehicle drive information storing unit 1016 included in the navigation control unit 101 in a case where no to-be-watched vehicles are detected according to an exemplary embodiment of the present invention.

[0115] Fig. 18 is a view illustrating a state where vehicle drive information is stored when a communication error occurs while the vehicle drive information received from each of the other vehicle the other vehicles is accumulated in the other vehicle drive information storing unit 1016 included in the navigation control unit 101 in a case where any to-be-watched vehicle is detected according to an exemplary embodiment of the present invention.

[0116] It Fig. 17, when a reception error occurs upon reception of drive information of the two-wheeled vehicle 402, the interval (time p) from the reception time to when the next drive information of the two-wheeled vehicle 402 is received is lengthened, and if no to-be-watched vehicle is detected, it needed to be waited as much correspond-

ingly.

[0117] It is found, however, that in a case where any to-be-watched vehicle is detected, the transmission interval is shortened (time q, where q<p) when a reception error occurs upon reception of drive information of the two-wheeled vehicle 402 which is a to-be-watched vehicle, and thus the interval from the reception time to when the next drive information of the two-wheeled vehicle 402 is shortened, and the reception time or interval is reduced.

[0118] In addition, the two-wheeled vehicle 402 which recognized that its own vehicle has been considered as a to-be-watched vehicle increased the transmission frequency of its drive information in the above exemplary embodiment. However, transmission power alone or both the transmission power and transmission frequency may also be adapted to be increased as well as increase of the transmission frequency.

[0119] As described above, its own vehicle obtains vehicle drive information of a to-be-watched vehicle to ensure safety until its own vehicle drives at a safe location upon finding the to-be-watched vehicle while driving according to the first embodiment. In a case where the to-be-watched vehicle exists within a caution region, its own vehicle surely obtain the information on the to-be-watched vehicle by increasing the transmission frequency for the to-be-watched vehicle.

[0120] Further, in a case where a number of vehicles are located near its own vehicle or errors occur due to deterioration of communication environments, its own vehicle may improve delay in processing of data received from the to-be-watched vehicle by increasing the transmission frequency for the to-be-watched vehicle. Second Embodiment

[0121] In the second embodiment, drive warning information is displayed on the output unit 102 of the navigation unit 100 in a case where a vehicle is detected which is necessary to notify the driver. Then, the detected to-be-watched vehicle ID is added to the vehicle drive information of its own vehicle and the added information is transmitted. Further, transmission frequency of the vehicle drive information of its own vehicle is set low for the other vehicles than the vehicle having the to-be-watched vehicle ID among the other vehicles.

[0122] The traffic information communication system according to the second embodiment of the present invention will be described with reference to the drawings.

[0123] Fig. 19 is a flowchart illustrating an exemplary vehicle drive information process in a case where the navigation control unit 101 transmits and receives vehicle drive information to/from another vehicle according to an exemplary embodiment of the present invention.

[0124] The flowchart shown in Fig. 19 is the one where steps S1801, S1802, S1803, and S1804 are further added to the flowchart shown in Fig. 7. Here, the added steps will be only described and the others will be excluded from the descriptions.

[0125] In Fig. 19, it is determined by the navigation control unit 101 in the step S701 whether or not there is a vehicle drive information reception notification and if not, the step S708 is performed, and if any, the step S1801 is performed.

[0126] In the step S1801, it is determined whether or not its own vehicle ID setup is included in designation of a to-be-watched vehicle ID of the received vehicle drive information. If included, the step S702 is performed, and otherwise, the step S707 is performed. That is, in a case where its own vehicle ID setup is included in the to-be-watched vehicle ID, in the step S1801, the transmission period interval is changed to be short (to have high-speed transmission frequency) for the to-be-watched vehicle and transmission period interval is changed to be long (to have low-speed transmission speed) for the other vehicles than the to-be-watched vehicle. Further, in a case where there is no setup of the to-be-watched vehicle ID, a detection process of the other vehicle the other vehicles are performed.

[0127] In the step S702, it is determined whether or not the received to-be-watched vehicle ID is identical to its own vehicle ID. If not identical, the step S1802 is performed, and if identical, the step S703 is performed. That is, in the step S702, it is confirmed whether or not its own vehicle has been detected as a to-be-watched vehicle by the other vehicles.

[0128] In the step S1802, it is determined whether or not its own vehicle drive information update period is set to be long (to have low-speed transmission frequency). If not, the step S1803 is performed, and if set to have low-speed transmission frequency, the step S706 is performed.

[0129] In step S1803, the drive information update period timer of its own vehicle is set to have a low speed, and then the step S1804 is performed.

[0130] In the step S1804, the transmission period timer in the communication control unit 203 is set to have a low speed, and the S706 is performed.

[0131] The other steps are equal to those shown in Fig. 7.

[0132] Fig. 20 is a view illustrating an exemplary embodiment of accumulating vehicle drive information received from each of the other vehicle the other vehicles in other vehicle drive information storing unit 1016 included in the navigation control unit 101 in a case where any to-be-watched vehicle is detected according to an exemplary embodiment of the present invention.

[0133] Fig. 21 is a view illustrating a case where an error occurs upon accumulating vehicle drive information received from each of the other vehicle the other vehicles in the other vehicle drive information storing unit 1016 included in the navigation control unit 101 in a case where any to-be-watched vehicle is detected according to an exemplary embodiment of the present invention.

[0134] Fig. 20 depicts that reception frequency of vehicle drive information of the to-be-watched two-wheeled vehicle 402 is increased according to increase of the transmission frequency of the two-wheeled vehicle 402

and thus decrease of the transmission frequency of the vehicles other than the to-be-watched vehicle.

[0135] Fig. 21 depicts a situation where a communication error occurs in the case of the transmission frequency shown in Fig. 20. It can be seen that even though such a communication errors occurs upon transmission of the vehicle drive information of the two-wheeled vehicle 402, the interval from the first reception of data (vehicle drive information) from the two-wheeled vehicle 402 to the next reception is shorten because the transmission interval is short.

[0136] As described above, its own vehicle obtains vehicle drive information of a to-be-watched vehicle to confirm its safety until driving at a safe location in a case where its own vehicle detects existence of the to-be-watched vehicle while driving according to the second embodiment. In a case where the to-be-watched vehicle is existent within a caution region, its own vehicle increases the transmission frequency of the to-be-watched vehicle to reduce the communication frequency of the other vehicles than the to-be-watched vehicle, and this enables its own vehicle to obtain the information on the to-be-watched vehicle more surely.

[0137] Further, its own vehicle may improve delay in processing data received from the to-be-watched vehicle in a case where a number of vehicles exist around its own vehicle or errors occur due to deterioration of communication environments.

[0138] In addition, the vehicle which recognized that its own vehicle has been considered as a to-be-watched vehicle increased the transmission frequency of its drive information in the above exemplary embodiment. However, transmission power alone or both the transmission power and transmission frequency may also be adapted to be increased as well as increase of the transmission frequency.

Third Embodiment

[0139] In the third embodiment, drive warning information is displayed on a navigation device display unit for a driver in a case where a vehicle is detected which is necessary to notify to the driver. Then, the detected to-be-watched vehicle ID is added to the transmission information of its own vehicle and the added information is transmitted. Transmission frequency is set to be low for the other vehicles than the vehicle having the to-be-watched vehicle ID among the other vehicles. Further, in a case where a roadside unit is installed around, a request is made to lower the frequency of transmission of information to the roadside unit.

[0140] The traffic information communication system according to the third embodiment of the present invention will be described with reference to Fig. 22, Fig. 23, and Fig. 24.

[0141] Fig. 22 depicts a vehicle arrangement for illustrating an exemplary case where its own vehicle 400 performs radio communication with the other vehicles and a roadside unit 2201 installed at an intersection in the traffic information communication system according to an exemplary embodiment of the present invention. The reference numeral "2201" refers to a roadside unit that performs transmission and reception of traffic information or disaster information to/from a vehicle by radio communications. The other constitutional elements are equal to those shown in Fig. 6.

[0142] Fig. 23 is a flowchart illustrating an exemplary vehicle drive information process in a case where the navigation control unit 101 performs a transmission and reception process of vehicle drive information with another vehicle and a transmission and reception process with the roadside unit 2201 according to an exemplary embodiment of the present invention.

[0143] Fig. 24 is a flowchart illustrating an exemplary reception process of information from the roadside unit 2201 in the vehicle drive information process by the navigation control unit 101 according to an exemplary embodiment of the present invention.

[0144] The flowchart shown in Fig. 23 is the one where steps S2301 and S2302 are further added to the flowchart shown in Fig. 7. Here, the added steps will be only described and the others will be excluded from the descriptions.

[0145] When processing of vehicle drive information is started by the navigation control unit 101, it is determined in the step S2301 whether or not there is a reception notification from the roadside unit 2201. If any, the step S2302 is performed, and otherwise, the step S701 is performed.

[0146] In the step S2302, information is received from the roadside unit 2201, and the step S701 is performed.

[0147] The step S701 is equal to that shown in Fig. 7.

[0148] The step S2302 will be described in more detail with reference to Fig. 24.

[0149] In Fig. 24, it is firstly determined in the step S2401 whether or not detection of any to-be-watched vehicle is in progress. If not, the step S2402 is performed, and if in progress, the step S2405 is performed.

[0150] In the step S2402, it is determined whether or not a request is being made to the roadside unit 2201 to lower the transmission frequency. If being requested, the step S2403 is performed, and otherwise, the step S2404 is performed.

[0151] In the step S2403, a request is made to the roadside unit 2201 to normalize the transmission frequency of traffic information or disaster information transmitted from the roadside unit 2201, and then the step S2404 is performed.

[0152] In the step S2404, such information as received from the roadside unit 2201 is displayed and then the process shown in Fig. 24 (the step S2302 in Fig. 23) ends.

[0153] Further, in the step S2405, a request is made to the roadside unit 2201 to lower the transmission frequency to reduce the transmission frequency of traffic information or disaster information transmitted from the roadside unit 2201, and then the process shown in Fig.

24 (the step S2302 in Fig. 23) ends.

[0154] Its own vehicle obtains vehicle drive information of a to-be-watched vehicle to confirm its safety until driving at a safe location in a case where its own vehicle detects existence of the to-be-watched vehicle while driving according to the above-described third embodiment. In a case where the to-be-watched vehicle is existent within a caution region, its own vehicle increases the transmission frequency of the to-be-watched vehicle to reduce the frequency of communication with the roadside unit and the other vehicles than the to-be-watched vehicle, and this enables its own vehicle to obtain the information on the to-be-watched vehicle more surely.

[0155] Further, its own vehicle may improve delay in processing data received from the to-be-watched vehicle in a case where a number of vehicles exist around its own vehicle or errors occur due to deterioration of communication environments.

[0156] Furthermore, even though traffic information communication system of the present invention is operated to reduce the transmission frequency of transmission to the roadside unit 2201 in the exemplary embodiment in a case where the on-board communication unit 300 is detecting any to-be-watched vehicle, a priority may be set between the traffic information or disaster information received from the roadside unit 2201 and the notification processing information from the other vehicles by inter-vehicle communications, so that in a case where the information received from the roadside unit 2201 has a higher priority, no request of reducing the transmission frequency is made to the roadside unit 2201 and a request of decreasing the transmission frequency of vehicle drive information is made to the other vehicles communicated by the on-board communication unit 300.

Fourth Embodiment

[0157] In the fourth embodiment, when detecting a pedestrian approaching its own vehicle, its own vehicle adds the detected terminal ID to the vehicle drive information and transmits the added information. This enables the received mobile terminal to recognize the existence of any dangerous vehicle through the notification from the vehicle. Further, there is no need of calculating the distance between his/her location and the vehicle thanks to the received vehicle information, and this enables save consumption power for operating process.

[0158] The traffic information communication system will be described with reference to Figs. 25 to 34 according to the exemplary embodiment of the present invention.

[0159] Fig. 25 is a block diagram illustrating an exemplary on-board communication device (on-board unit) in the traffic information communication system according to an exemplary embodiment of the present invention.

[0160] The reference numeral "400" refers to its own vehicle, "401" refers to a vehicle A, "600" refers to a pedestrian A, and "500" refers to a mobile terminal A carried by the pedestrian A.

[0161] In its own vehicle 400, the reference numeral "1000" refers to a navigation unit equipped with a navigation function that guides a driver to a destination, "2501" to a navigation control unit that performs a control process of each unit included in the navigation unit 1000, "102" to an output unit, such as a speaker that outputs voice information or monitor that displays image information, and "103" to an input unit that enables the driver to make an input, such as setup of a destination, to the navigation unit 1000. Further, the communication device unit 200 is equal to that shown in Fig. 1. The reference numeral "3000" refers to an on-board communication device that includes the navigation unit 1000 and the communication device unit 200.

[0162] Its own vehicle 400 is equipped with the on-board communication device 3000. The vehicle A401 drives around its own vehicle 400 and is equipped with the on-board communication unit 300 to perform transmission and reception of vehicle drive information. The vehicle drive information that is communicated by the communication device unit 200 includes, for example, its own vehicle ID, a drive location, a speed, a drive direction, a brake, and an accelerator state. Detailed descriptions will be given with reference to Figs. 27A and 27B.

[0163] Fig. 26 is a block diagram illustrating an exemplary inner construction of the navigation control unit 2501 according to an exemplary embodiment of the present invention. The navigation control unit 2501 shown in Fig. 26 is the one where a pedestrian information storing unit 2601 is added to the navigation control unit 101 shown in Fig. 2 to store pedestrian information received from the mobile terminal A 500 carried by the pedestrian A600 that is located around. The other constructions are equal to those shown in Fig. 2.

[0164] Figs. 27A and 27B are views illustrating exemplary content of vehicle drive information transmitted from its own vehicle 400 to a surrounding pedestrian according to an exemplary embodiment of the present invention. Fig. 27A depicts a table representing the content of vehicle drive information that is transmitted and received between vehicles and transmitted to the pedestrian. Further, Fig. 27B depicts a data format of vehicle drive information transmitted to the communication device unit 200.

[0165] In Figs. 27A and 27B, a new data item "to-be-watched terminal ID", which is an ID of a detected terminal approaching its own vehicle, is added to the data items shown in Figs. 5A and 5B, which represents the ID of a to-be-watched terminal that is detected from the pedestrian information received from the mobile terminal carried by the surrounding pedestrian. In addition, even though the data amount of a to-be-watched vehicle ID is adapted to have 2 bytes in Fig. 27B, data amount of more than 2 bytes may be adopted to cope with plural vehicles and plural pedestrians. Moreover, even though the content of BRAKE or ACCEL has been adapted to have "ON:OFF" in Fig. 27A, the present invention is not limited

to the two-value information, and may adopt such information that sequentially represents data amount in response to a usage state of the brake or accelerator.

[0166] In Fig. 25, when receiving the vehicle drive information, the navigation control unit 2501 converts the vehicle drive information into the vehicle drive information data format shown in Fig. 27B and submits a transmission request to the communication device unit 200.

[0167] Fig. 28 is a block diagram illustrating an exemplary construction of the mobile terminal A 500 according to an exemplary embodiment of the present invention, which receives drive information from the other vehicle and transmits location information of the self terminal or pedestrian information that represents the traveling direction to the other vehicle the other vehicles.

[0168] The reference numeral "501" refers to an output unit that outputs voice information or displays image information, "502" refers to an input unit that performs an input operation such as voice input or start of data communication, "503" refers to a mobile terminal radio communication unit that performs radio communication with a center device or voice call with another mobile terminal, "504" refers to an inter-vehicle radio communication unit that performs radio communication with the communication device unit 200 equipped in a vehicle driving around, "505" refers to a vehicle information processing unit that processes and analyzes vehicle drive information received from a vehicle driving around to generate pedestrian information and performs transmission control, "506" refers to a location information obtaining unit that is equipped with a GPS to obtain the location information (for example, latitude or longitude) and calculates the traveling direction, and "507" refers to a mobile terminal control unit that entirely controls the mobile terminal A 500.

[0169] In Fig. 28, when the pedestrian A600 performs an input operation, such as a voice call or data communication connection start, through the input unit 502 of the mobile terminal A 500, the mobile terminal control unit 507 makes a radio communication connection processing request to the mobile terminal radio communication unit 503 in response to the inputted content.

[0170] The mobile terminal radio communication unit 503 conducts radio communication connection with a requesting source in response to the connection request made by the mobile terminal control unit 507 and then outputs a radio communication connection completion response to the mobile terminal control unit 507.

[0171] Upon receiving the radio communication connection completion response from the mobile terminal radio communication unit 503, the mobile terminal control unit 507 controls the output unit 501 to execute a radio communication connection notification indication. Thereafter, the mobile terminal control unit 507 carries out data communication or voice call according to the content inputted by the pedestrian A600.

[0172] Further, the mobile terminal control unit 507 controls the output unit 501 to display reception so that the pedestrian A600 notices the reception when receiving a reception notification from the mobile terminal radio communication unit 503. Then, the mobile terminal control unit 507 performs radio communication connection in response to the content inputted by the pedestrian A600 through the input unit 502.

[0173] Figs. 29A and 29B are a view illustrating exemplary content of pedestrian information that is transmitted from the mobile terminal A 500 to the other vehicle according to an exemplary embodiment of the present invention, which includes, for example, information on location or traveling direction of a pedestrian. Fig. 29A depicts a table representing the content of pedestrian information transmitted from the mobile terminal of the pedestrian. And, Fig. 29B depicts a data format when the pedestrian information is transmitted to the communication device unit 200 of its own vehicle 400. Data items include a portable ID that represents a number specifying a self mobile terminal, a latitude and longitude that represent the location of the self mobile terminal, and a direction that represents traveling direction of the pedestrian. Data amount, unit, and other contents are represented with respect to each data item in Fig. 29A.

[0174] In Fig. 28, the vehicle information processing unit 505 obtains the pedestrian information such as place and direction from the location information obtaining unit 506, converts the pedestrian information into the pedestrian information data format shown in Fig. 29B, and makes a transmission request to the inter-vehicle radio communication unit 504 at a predetermined timing.

[0175] Fig. 30 depicts a vehicle-pedestrian arrangement for illustrating the location of the moving vehicle 400, the pedestrian A600 and another pedestrian B610 after p seconds from the location at the first time, and a communication area according to an exemplary embodiment of the present invention. The reference numeral "510" refers to a mobile terminal B that has the same construction and functions as the mobile terminal A 500, "610" to a pedestrian B carrying the mobile terminal B501, and "900" to a communication area B where communication may be done by the radio communication unit 201 of the on-board communication device 3000 equipped in its own vehicle 400 and the inter-vehicle radio communication unit 504 equipped in the mobile terminal A 500 and the mobile terminal B510. The reference numeral "810" refers to a position s where its own vehicle 400 was driving before p seconds, "820" to a position u where the pedestrian A600 was walking before p seconds, "830" to a position x where the pedestrian B610 was walking before p seconds, "910" to a position t where its own vehicle 400 is currently driving, "920" to a position v where the pedestrian A600 is currently walking, and "930" to a position y where the pedestrian B601 is currently walking.

[0176] Fig. 31 is a flowchart illustrating an exemplary case where the mobile terminal A 500 transmits and receives vehicle drive information and pedestrian information to/from its own vehicle 400 according to an exemplary embodiment of the present invention. The direction

of time lapsing is from top to down in Fig. 31.

[0177] In Fig. 31, its own vehicle 400 executes a transmission process S3101 of vehicle drive information while driving. In this case, its own vehicle 400 broadcasts vehicle drive information S3102 at time k0, and thereafter, continues to broadcast the vehicle drive information S3102 every time interval s[s] (times k1, k2, ...).

[0178] In the meanwhile, the mobile terminal A 500 receives the vehicle drive information transmitted from its own vehicle 400 at time k0, and starts a transmission process S3103 of the pedestrian information S3104 of the pedestrian at time f1. Thereafter, the mobile terminal A 500 continues to transmit the pedestrian information every time interval t[s] (times f2...). For example, the mobile terminal A 500 transmits the pedestrian information S3105 at time f2.

[0179] In a case where a to-be-watched terminal ID is added to the vehicle drive information S3106 transmitted from the communication device unit 200 of its own vehicle 400 at time k3, and it is determined by the mobile terminal A 500 receiving it that the to-be-watched terminal ID is the self terminal ID, an attention indication is displayed (S3107) on the output unit 501 of the mobile terminal A 500, and the pedestrian information S3108 is transmitted.

[0180] Thereafter, at time k6, if the navigation unit 1000 of its own vehicle 400 transmits the vehicle drive information S3109 without addition of the to-be-watched terminal ID, or the mobile terminal A 500 determines that the added to-be-watched terminal ID is identical to the self mobile terminal ID, the mobile terminal A 500 ends displaying the attention indication on the output unit 501 (S3110).

[0181] Fig. 32 is a flowchart illustrating an exemplary vehicle drive information process in a case where the navigation control unit 2501 performs a transmission and reception process of vehicle drive information with another vehicle and a transmission and reception process with the mobile terminal A 500 carried by the surrounding pedestrian A600 according to an exemplary embodiment of the present invention.

[0182] The flowchart shown in Fig. 32 is the one where steps S3201 and S3202 are added to the flowchart shown in Fig. 7. Accordingly, the other steps than the added steps will be excluded from the descriptions.

[0183] When the navigation control unit 2501 starts processing of vehicle drive information, it is determined in the step S3201 whether or not there is any pedestrian information reception notification. If any, the step S3202 is performed, and otherwise, the step S701 is performed.

[0184] In the step S3202, the received pedestrian information is subjected to a reception process and the step S701 is performed.

[0185] The step S701 is equal to that shown in Fig. 7.

[0186] Fig. 33 is a flowchart illustrating an exemplary reception process of pedestrian information from the mobile terminal A 500 in a vehicle drive information process by the navigation control unit 2501 according to an exemplary embodiment of the present invention.

[0187] In Fig. 33, when pedestrian information reception process starts, the received pedestrian information is stored in the pedestrian information storing unit 2601 in the step S3301, and then the step S3302 is performed.

[0188] In the step S3302, distance from its own vehicle is calculated from location or direction information, and then the step S3303 is performed.

[0189] In the step S3303, it is determined whether or not the distance from its own vehicle becomes shorter than the previously obtained one. If shorter, the step S3304 is performed, and otherwise, the step S3310 is performed.

[0190] In the step S3304, it is determined whether or not traveling direction of the pedestrian is one approaching its own vehicle. If approaching, the step S3305 is performed, and otherwise, the step S3310 is performed.

[0191] In the step S3305, the received reception ID of the mobile terminal is set as an approaching detection terminal ID, and then step S3306 is performed.

[0192] In the step S3306, it is determined whether or not the set approaching detection terminal ID is the one that has already been displayed. If already displayed, the step S3308 is performed, and otherwise, the step S3307 is performed.

[0193] In the step S3307, a pedestrian approaching indication is displayed on the output unit 102, and then the pedestrian information reception process shown in Fig. 33 ends.

[0194] In the step S3308, it is determined whether or not the data previously received is updated. If updated, the step S3309 is performed, and otherwise, the pedestrian information reception process shown in Fig. 33 ends.

[0195] In the step S3309, part of updated information is displayed on the output unit 102, and then the pedestrian information reception process shown in Fig. 33 ends.

[0196] In the step S3310, it is determined whether or not a pedestrian approaching indication is displayed. If displayed, the step S3311 is performed, and otherwise, the step S3312 is performed.

[0197] In the step S3311, the pedestrian approaching indication ends to be displayed and then the step S3312 is performed.

[0198] In the step S3312, it is determined whether or not the receiving mobile terminal ID is set as a to-be-watched terminal ID. If set as the to-be-watched terminal ID, the step S3313 is performed, and otherwise, the pedestrian information reception process shown in Fig. 33 ends.

[0199] In the step S3313, the setup as the to-be-watched terminal ID is released (cleared), and then the pedestrian information reception process shown in Fig. 33 ends.

[0200] Fig. 34 is a flowchart illustrating an exemplary inter-vehicle communication process in the vehicle information processing unit 505 included in the mobile terminal A 500 according to an exemplary embodiment of the

present invention.

[0201] In the step S3401, it is determined whether or not data is received from the inter-vehicle radio communication unit 504. If received, the step S3402 is performed, and otherwise, the step S3409 is performed.

[0202] In the step S3402, the inter-vehicle radio communication unit 504 is set to be in communication, and then the step S3403 is performed.

[0203] In the step S3403, it is determined whether or not the data from the inter-vehicle radio communication unit 504 is the one that has already been received. If already received, the step S3404 is performed, and otherwise, the step S3405 is performed.

[0204] In the step S3404, the data is discarded and then the process shown in Fig. 34 ends.

[0205] In the step S3405, it is determined whether or not the to-be-watched terminal ID is identical to the self terminal ID. If identical, the step S3406 is performed, and otherwise, the step S3407 is performed.

[0206] In the step S3406, a vehicle approaching indication is displayed on the output unit 501 and then the step S3407 is performed.

[0207] In the step S3407, it is determined whether or not a pedestrian information transmission period timer starts to be activated. If not activated, the step S3408 is performed, and if activated, the step S3411 is performed.

[0208] In the step S3408, the pedestrian information transmission period timer starts to be activated and then the step S3411 is performed.

[0209] Also, it is determined in the step S3409 whether or not there is any reception for a predetermined period of time. If no reception for the predetermined period of time, the step S3410 is performed and otherwise the step S3411 is performed.

[0210] If there is no data reception for the predetermined period of time in the step S3410, the inter-vehicle radio communication unit 504 is set to be in communication pause, and then the step S3411 is performed.

[0211] In the step S3411, it is determined whether or not the pedestrian information transmission period timer is complete to count. If complete, the step S3412 is performed and otherwise the process shown in Fig. 34 ends.

[0212] In the step S3412, it is determined whether or not the inter-vehicle radio communication unit 504 is in communication. If in communication, the step S3413 is performed and otherwise the process shown in Fig. 34 ends.

[0213] In the step S3413, the location information of the pedestrian is obtained, and then the step S3414 is performed.

[0214] In the step S3414, pedestrian information is generated and transmitted, and then the step S3415 is performed.

[0215] In the step S3415, the pedestrian information transmission period timer starts to be activated, and then the process shown in Fig. 34 ends.

[0216] That is, the state of the inter-vehicle radio communication unit 504 is set to be in communication to perform a pedestrian information transmission process every predetermined period while the inter-vehicle radio communication unit 504 receives data from the other vehicles, and the state is set to be in communication pause to stop the pedestrian information transmission process when the inter-vehicle radio communication unit 504 receives no data for a predetermined period of time.

[0217] In addition, the pedestrian who recognized that he/she has been considered as a to-be-watched pedestrian increased the transmission frequency of its drive information in the fourth embodiment. However, transmission power alone or both the transmission power and transmission frequency may also be adapted to be increased as well as increase of the transmission frequency.

[0218] Furthermore, a mobile terminal carried by the pedestrian has been employed in the fourth embodiment. However, in the fourth embodiment, the present invention is not limited to the mobile terminal and may include any portable communication device such as professional radio devices.

[0219] According to the above-described fourth embodiment, the present invention may obtain vehicle drive information of a to-be-watched vehicle until its own vehicle drives at a safe location in the case of detecting existence of a to-be-watched pedestrian during drive. Further, the present invention makes it possible to notify only the pedestrian who requires caution because the detection of the to-be-watched pedestrian is performed when the pedestrian is determined to approach its own vehicle from checked operations of the pedestrian. Furthermore, the present invention may alleviate processing load for detection and save battery consumption for the pedestrian (mobile terminal) because the detection of a to-be-watched pedestrian is conducted on the vehicle side.

Claims

1. A traffic information communication system in which an on-board communication device (300; 3000) equipped in a vehicle (400-407) and a mobile terminal (500) carried by a pedestrian (600) perform radio communication, wherein the on-board communication device (300; 3000) includes:

   a navigation unit (100; 1000) that is adapted to obtain at least location information of its own vehicle (400) equipped with the on-board communication device (300; 3000) and vehicle drive information including a vehicle ID specifying the own vehicle (400); and
   a communication device unit (200) that is adapted to broadcast the vehicle drive information obtained by the navigation unit (100; 1000) at a predetermined frequency and to output vehicle drive information received from an on-board

communication device of another vehicle (401-407) or pedestrian information received from the mobile terminal (500) to the navigation unit (100; 1000),

characterised in that

the navigation unit (100; 1000) is adapted to add a vehicle ID specifying said other vehicle (402) as a to-be-watched vehicle or a terminal ID specifying said mobile terminal (500) as a to-be-watched terminal to the vehicle drive information of its own vehicle (400) and to transmit the vehicle drive information to the communication device unit (200), in the case of detecting the other vehicle (402) or the mobile terminal (500) approaching in a drive direction of its own vehicle (400) from the vehicle drive information received by the communication device unit (200) of the on-board communication device (300; 3000), and

the on-board communication device (300; 3000) of the other vehicle (401-407) or the mobile terminal (500) that receives the vehicle drive information is adapted to increase a transmission frequency or transmission power of the own vehicle drive information or pedestrian information, in a case where the to-be-watched vehicle ID or to-be-watched terminal ID included in the received vehicle drive information is identical to its own vehicle ID or terminal ID, and to reduce said transmission frequency, in a case where the received to-be-watched vehicle ID or to-be-watched terminal ID is not identical to its vehicle ID or terminal ID.

2. The system of claim 1, wherein the on-board communication device (300; 3000) of the other vehicle (401-407) or the mobile terminal (500) that receives the vehicle drive information includes an output unit (102; 501) for outputting information that it is a to-be-watched vehicle (402) or to-be-watched pedestrian (600) and notifying a driver or pedestrian (600), in a case where the received to-be-watched vehicle ID or to-be-watched terminal ID is identical to its own vehicle ID or terminal ID.

3. The system of claim 1 or 2, further comprising a roadside communication device (2201) on a road,

wherein the on-board communication device (300; 3000) is adapted to transmit the vehicle drive information to the roadside communication device (2201), in the case of detecting a vehicle (402) or pedestrian (600) that may affect the drive safety of its own vehicle (400) from the vehicle drive information or pedestrian information received by the on-board communication device (300; 3000) while receiving road information wirelessly transmitted from the roadside communication device (2201).

4. The system of claim 3, wherein the roadside communication device (2201) that receives the vehicle drive information is adapted to decrease a transmission frequency, in a case where a transmission priority of currently transmitted road information is lower than the transmission frequency of the received vehicle drive information.

5. An on-board communication device (300; 3000) equipped in a vehicle (400) to perform radio communication to another vehicle (401-407) and a mobile terminal (500) carried by a pedestrian (600), the on-board communication device (300; 3000) comprising:

a navigation unit (100; 1000) that is adapted to obtain at least location information of its own vehicle (400) equipped with the on-board communication device (300; 3000) and vehicle drive information including a vehicle ID specifying the own vehicle (400); and

a communication device unit (200) that is adapted to broadcast the vehicle drive information obtained by the navigation unit (100; 1000) at a predetermined frequency and to output vehicle drive information received from an on-board communication device of another vehicle (401-407) or pedestrian information received from the mobile terminal (500) to the navigation unit (100; 1000),

characterised in that

the navigation unit (100; 1000) is adapted to add a vehicle ID specifying said other vehicle (402) as a to-be-watched vehicle or a terminal ID specifying said mobile terminal (500) as a to-be-watched terminal to the vehicle drive information of its own vehicle (400) and to transmit the vehicle drive information to the communication device unit (200), in the case of detecting the other vehicle (402) or the mobile terminal (500) approaching in a drive direction of its own vehicle (400) from the vehicle drive information received by the communication device unit (200) of the on-board communication device (300; 3000), and

the on-board communication device (300; 3000) of the other vehicle (401-407) or the mobile terminal (500) that receives the vehicle drive information is adapted to increase a transmission frequency or transmission power of the own vehicle drive information or pedestrian information, in a case where the to-be-watched vehicle ID or to-be-watched terminal ID included in the received vehicle drive information is identical to its own vehicle ID or terminal ID, and to reduce said transmission frequency, in a case where the received to-be-watched vehicle ID or to-be-watched terminal ID is not identical to its vehicle

ID or terminal ID.

6. The device of claim 5, wherein the on-board communication device of the other vehicle (401-407) that receives the vehicle drive information includes an output device (102) for outputting information that it is a to-be-watched vehicle (402) and notifying a driver, in a case where the received to-be-watched vehicle ID is identical to its own vehicle ID.

7. A mobile terminal (500) carried by a pedestrian (600) to perform radio communication to an on-board communication device (300; 3000) equipped in a vehicle (400), the mobile terminal (500) comprising:

a location information obtaining unit (506) that is adapted to obtain pedestrian information including a terminal ID specifying the own mobile terminal (500);
an inter-vehicle radio communication unit (504) that is adapted to transmit the pedestrian information obtained by the location information obtaining unit (506) at a predetermined transmission frequency while vehicle drive information is received from the on-board communication device (300; 3000) and to receive vehicle drive information from the on-board communication device (300; 3000),
characterised by a vehicle information processing unit (505) that is adapted to increase the transmission frequency or a transmission power of the own vehicle drive information or the pedestrian information in a case where a terminal ID of a to-be-watched terminal included in the received vehicle drive information is identical to the terminal ID of the own mobile terminal (500).

8. The terminal of claim 7, further comprising an output unit (501) that is adapted to output an attention indication to the pedestrian (600) carrying the mobile terminal (500), in a case where the terminal ID of the to-be-watched terminal included in the vehicle drive information received by the vehicle information processing unit (505) is identical to the terminal ID of the own mobile terminal (500).

Patentansprüche

1. Verkehrsinformationskommunikationssystem, in dem eine bordseitige Kommunikationsvorrichtung (300; 3000) als Ausrüstung in einem Fahrzeug (400-407) und ein mobiles Endgerät (500), das von einem Fußgänger (600) getragen wird, Funkkommunikation durchführen, wobei die bordseitige Kommunikationsvorrichtung (300; 3000) aufweist:

eine Navigationseinheit (100; 1000), die dazu ausgelegt ist, wenigstens eine Ortsinformation eines eigenen Fahrzeugs (400), das mit der bordseitigen Kommunikationsvorrichtung (300; 3000) ausgerüstet ist, und eine Fahrzeugfahrtinformation zu erhalten, die eine das eigene Fahrzeug (400) spezifizierende Fahrzeug-ID enthält, und
eine Kommunikationsvorrichtungseinheit (200), die dazu ausgelegt ist, die durch die Navigationseinheit (100; 1000) erhaltene Fahrzeugfahrtinformation auf einer vorbestimmten Frequenz auszusenden und Fahrzeugfahrtinformation, die von einer bordseitigen Kommunikationsvorrichtung eines anderen Fahrzeugs (401-407) empfangen wurde, oder Fußgängerinformation, die aus dem mobilen Endgerät (500) empfangen wurde, an die Navigationseinheit (100; 1000) auszugeben,
dadurch gekennzeichnet, dass
die Navigationseinheit (100; 1000) dazu ausgelegt ist, eine das andere Fahrzeug (402) als zu beobachtendes Fahrzeug spezifizierende Fahrzeug-ID oder eine das mobile Endgerät (500) als zu beobachtendes Endgerät spezifizierende Endgerät-ID zu der Fahrzeugfahrtinformation eines eigenen Fahrzeugs (400) hinzuzufügen und die Fahrzeugfahrtinformation zu der Kommunikationsvorrichtungseinheit (200) zu senden, falls das andere Fahrzeug (402) oder das mobile Endgerät (500) aus der durch die Kommunikationsvorrichtungseinheit (200) der bordseitigen Kommunikationsvorrichtung (300; 3000) empfangenen Fahrzeugfahrtinformation als sich in einer Fahrtrichtung des eigenen Fahrzeugs (400) nähernd erfasst wird, und
die bordseitige Kommunikationsvorrichtung (300; 3000) des anderen Fahrzeugs (401-407) oder das mobile Endgerät (500), das die Fahrzeugfahrtinformation empfängt, dazu ausgelegt ist, eine Sendefrequenz oder eine Sendeleistung der eigenen Fahrzeugfahrtinformation oder Fußgängerinformation zu erhöhen, falls die zu beobachtende Fahrzeug-ID oder die zu beobachtende Endgerät-ID, die in der empfangenen Fahrzeugfahrtinformation enthalten ist, identisch ist mit der eigenen Fahrzeug-ID oder Endgerät-ID, und die Sendefrequenz zu reduzieren, falls die empfangene zu beobachtende Fahrzeug-ID oder zu beobachtende Endgerät-ID nicht identisch mit seiner Fahrzeug-ID oder Endgerät-ID ist.

2. System nach Anspruch 1, wobei die bordseitige Kommunikationsvorrichtung (300; 3000) des anderen Fahrzeugs (401-407) oder das mobile Endgerät (500), das die Fahrzeugfahrtinformation empfängt, eine Ausgabeeinheit (102; 501) aufweist, um Infor-

mation, dass es sich um ein zu beobachtendes Fahrzeug (402) oder einen zu beobachtenden Fußgänger (600) handelt, auszugeben und einem Fahrer oder Fußgänger (600) mitzuteilen, falls die empfangene zu beobachtende Fahrzeug-ID oder zu beobachtende Endgerät-ID identisch mit der eigenen Fahrzeug-ID oder Endgerät-ID ist.

3. System nach Anspruch 1 oder 2, ferner mit einer streckenseitigen Kommunikationsvorrichtung (2201) auf einer Straße,
wobei die bordseitige Kommunikationsvorrichtung (300; 3000) dazu ausgelegt ist, die Fahrzeugfahrtinformation zu der streckenseitigen Kommunikationsvorrichtung (2201) zu senden, falls, während Streckeninformation empfangen wird, die drahtlos von der streckenseitigen Kommunikationsvorrichtung (2201) gesendet wird, aus der durch die bordseitige Kommunikationsvorrichtung (300; 3000) empfangenen Fahrzeugfahrtinformation oder Fußgängerinformation ein Fahrzeug (402) oder ein Fußgänger (600) erfasst wird, der die Fahrtsicherheit des eigenen Fahrzeugs (400) beeinträchtigen könnte.

4. System nach Anspruch 3, wobei die streckenseitige Kommunikationsvorrichtung (2201), die die Fahrzeugfahrtinformation empfängt, dazu ausgelegt ist, eine Sendefrequenz zu verringern, falls eine Sendepriorität der gegenwärtig gesendeten Streckeninformation niedriger ist als die Sendefrequenz der empfangenen Fahrzeugfahrtinformation.

5. Bordseitige Kommunikationsvorrichtung (300; 3000) als Ausrüstung in einem Fahrzeug (400) um Funkkommunikation mit einem anderen Fahrzeug (401-407) und einem mobilen Endgerät (500) durchführen, das von einem Fußgänger (600) getragen wird, wobei die bordseitige Kommunikationsvorrichtung (300; 3000) aufweist:

eine Navigationseinheit (100; 1000), die dazu ausgelegt ist, wenigstens eine Ortsinformation eines eigenen Fahrzeugs (400), das mit der bordseitigen Kommunikationsvorrichtung (300; 3000) ausgerüstet ist, und eine Fahrzeugfahrtinformation zu erhalten, die eine das eigene Fahrzeug (400) spezifizierende Fahrzeug-ID enthält, und
eine Kommunikationsvorrichtungseinheit (200), die dazu ausgelegt ist, die durch die Navigationseinheit (100; 1000) erhaltene Fahrzeugfahrtinformation auf einer vorbestimmten Frequenz auszusenden und Fahrzeugfahrtinformation, die von einer bordseitigen Kommunikationsvorrichtung eines anderen Fahrzeugs (401-407) empfangen wurde, oder Fußgängerinformation, die aus dem mobilen Endgerät (500) empfangen wurde, an die Navigationseinheit (100; 1000) auszugeben,
dadurch gekennzeichnet, dass
die Navigationseinheit (100; 1000) dazu ausgelegt ist, eine das andere Fahrzeug (402) als zu beobachtendes Fahrzeug spezifizierende Fahrzeug-ID oder eine das mobile Endgerät (500) als zu beobachtendes Endgerät spezifizierende Endgerät-ID zu der Fahrzeugfahrtinformation eines eigenen Fahrzeugs (400) hinzuzufügen und die Fahrzeugfahrtinformation zu der Kommunikationsvorrichtungseinheit (200) zu senden, falls das andere Fahrzeug (402) oder das mobile Endgerät (500) aus der durch die Kommunikationsvorrichtungseinheit (200) der bordseitigen Kommunikationsvorrichtung (300; 3000) empfangenen Fahrzeugfahrtinformation als sich in einer Fahrtrichtung des eigenen Fahrzeugs (400) nähernd erfasst wird, und
die bordseitige Kommunikationsvorrichtung (300; 3000) des anderen Fahrzeugs (401-407) oder das mobile Endgerät (500), das die Fahrzeugfahrtinformation empfängt, dazu ausgelegt ist, eine Sendefrequenz oder eine Sendeleistung der eigenen Fahrzeugfahrtinformation oder Fußgängerinformation zu erhöhen, falls die zu beobachtende Fahrzeug-ID oder die zu beobachtende Endgerät-ID, die in der empfangenen Fahrzeugfahrtinformation enthalten ist, identisch ist mit der eigenen Fahrzeug-ID oder Endgerät-ID, und die Sendefrequenz zu reduzieren, falls die empfangene zu beobachtende Fahrzeug-ID oder zu beobachtende Endgerät-ID nicht identisch mit seiner Fahrzeug-ID oder Endgerät-ID ist.

6. Vorrichtung nach Anspruch 5, wobei die bordseitige Kommunikationsvorrichtung des anderen Fahrzeugs (401-407), das die Fahrzeugfahrtinformation empfängt, eine Ausgabeeinheit (102) aufweist, um Information, dass es sich um ein zu beobachtendes Fahrzeug (402) handelt, auszugeben und einem Fahrer mitzuteilen, falls die empfangene zu beobachtende Fahrzeug-ID oder zu beobachtende Endgerät-ID identisch mit der eigenen Fahrzeug-ID ist.

7. Von einem Fußgänger (600) getragenes mobiles Endgerät (500), um Funkkommunikation mit einer bordseitigen Kommunikationsvorrichtung (300; 3000) als Ausrüstung in einem Fahrzeug (400) durchzuführen, wobei das mobile Endgerät (500) aufweist:

eine Ortsinformationsgewinnungseinheit (506), die dazu ausgelegt ist, Fußgängerinformation zu erhalten, die eine das eigene mobile Endgerät (500) spezifizierende Endgerät-ID enthält,
einer Zwischenfahrzeug-Funkkommunikations-

einheit (504), die dazu ausgelegt ist, die durch die Ortsinformationsgewinnungseinheit (506) erhaltene Fußgängerinformation auf einer vorbestimmten Sendefrequenz auszusenden, während Fahrzeugfahrtinformation aus der bordseitigen Kommunikationsvorrichtung (300; 3000) empfangen wird, und Fahrzeugfahrtinformation aus der bordseitigen Kommunikationsvorrichtung (300; 3000) zu empfangen,
gekennzeichnet durch eine Fahrzeuginformationsverarbeitungseinheit (505), die dazu ausgelegt ist, die Sendefrequenz oder eine Sendeleistung der eigenen Fahrzeugfahrtinformation oder der Fußgängerinformation zu erhöhen, falls eine Endgerät-ID eines zu beobachtenden Endgeräts, die in der empfangenen Fahrzeugfahrtinformation enthalten ist, identisch ist mit der Endgerät-ID des eigenen mobilen Endgeräts (500).

8. Endgerät nach Anspruch 7, ferner mit einer Ausgabeeinheit (501), die dazu ausgelegt ist, eine Achtungsanzeige an den Fußgänger (600) auszugeben, der das mobile Endgerät (500) trägt, falls die Endgerät-ID des zu beobachtenden Endgeräts, die in der Fahrzeugfahrtinformation enthalten ist, die durch die Fahrzeuginformationsverarbeitungseinheit (505) empfangen wurde, identisch ist mit der Endgerät-ID des eigenen mobilen Endgeräts (500).

Revendications

1. Système de communication d'informations de trafic dans lequel un dispositif de communication embarqué (300 ; 3000) équipé dans un véhicule (400 - 407) et un terminal mobile (500) porté par un piéton (600) exécutent une communication radio, dans lequel le dispositif de communication embarqué (300 ; 3000) comprend :

une unité de navigation (100 ; 1000) qui est adaptée pour obtenir au moins des informations de position de son véhicule personnel (400) muni du dispositif de communication embarqué (300 ; 3000) et des informations de conduite du véhicule comprenant un ID de véhicule spécifiant le véhicule personnel (400), et
une unité de dispositif de communication (200) laquelle est adaptée pour diffuser les informations de conduite du véhicule obtenues par l'unité de navigation (100 ; 1000) à une fréquence prédéterminée et pour délivrer en sortie des informations de conduite du véhicule reçues en provenance d'un dispositif de communication embarqué d'un autre véhicule (400 - 407) ou d'informations de piéton reçues en provenance du terminal mobile (500) à l'unité de navigation (100 ; 1000),
caractérisé en ce que
l'unité de navigation (100 ; 1000) est adaptée pour ajouter un ID de véhicule spécifiant ledit autre véhicule (402) comme étant un véhicule à observer ou un ID de terminal spécifiant ledit terminal mobile (500) comme étant un terminal à observer aux informations de conduite de véhicule de son véhicule personnel (400) et pour transmettent des informations de conduite du véhicule à l'unité de dispositif de communication (200), dans le cas de la détection de l'autre véhicule (402) ou du terminal mobile (500) se rapprochant dans une direction de conduite de son véhicule personnel (400) depuis les informations de conduite du véhicule reçues par l'unité de dispositif de communication (200) du dispositif de communication embarqué (300 ; 3000), et
le dispositif de communication embarqué (300 ; 3000) de l'autre véhicule (401 - 407) ou le terminal mobile (500) qui reçoit les informations de conduite du véhicule est adapté pour augmenter une fréquence de transmission ou une puissance de transmission des informations de conduite du véhicule personnel ou des informations de piéton, dans un cas où l'ID du véhicule à observer ou l'ID du terminal à observer compris dans les informations de conduite du véhicule reçues est identique à son ID de véhicule personnel ou à son ID de terminal, et pour réduire ladite fréquence de transmission, dans un cas où l'ID du véhicule à observer reçu ou l'ID du terminal à observer n'est pas identique à son ID de véhicule ou à son ID de terminal.

2. Système selon la revendication 1, dans lequel le dispositif de communication embarqué (300 ; 3000) de l'autre véhicule (401 - 407) ou le terminal mobile (500) qui reçoit les informations de conduite du véhicule comprend une unité de sortie (102 ; 501) pour délivrer en sortie des informations indiquant qu'il s'agit d'un véhicule à observer (402) ou d'un piéton à observer (600) et informer un conducteur ou un piéton (600), dans le cas où l'ID du véhicule à observer reçu ou de l'ID du terminal à observer est identique à son ID de véhicule personnel ou à son ID de terminal.

3. Système selon la revendication 1 ou 2, comportant en outre un dispositif de communication au bord de la route (2201) sur une route,
dans lequel le dispositif de communication embarqué (300 ; 3000) est adapté pour transmettre des informations de conduite de véhicule au dispositif de communication au bord de la route (2201), dans le cas de la détection d'un véhicule (402) ou d'un piéton (600) qui peut affecter la sécurité de conduite de son

véhicule personnel (400) depuis les informations de conduite du véhicule ou les informations de piéton reçues par le dispositif de communication embarqué (300 ; 3000) lors de la réception d'informations routières transmises sans fil depuis le dispositif de communication au bord de la route (2201).

4. Système selon la revendication 3, dans lequel le dispositif de communication au bord de la route (2201) qui reçoit les informations de conduite du véhicule est adapté pour réduire une fréquence de transmission, dans un cas où une priorité de transmission des informations routières actuellement transmises est inférieure à la fréquence de transmission des informations de conduite du véhicule reçues.

5. Dispositif de communication embarqué (300 ; 3000) équipé dans un véhicule (400) pour effectuer une communication radio avec un autre véhicule (401 - 407) et un terminal mobile (500) porté par un piéton (600), le dispositif de communication embarqué (300 ; 3000) comportant :

une unité de navigation (100 ; 1000) qui est adaptée pour obtenir au moins des informations de position de son véhicule personnel (400) muni du dispositif de communication embarqué (300 ; 3000) et des informations de conduite du véhicule comprenant un ID du véhicule spécifiant le véhicule personnel (400), et
une unité de dispositif de communication (200) laquelle est adaptée pour diffuser les informations de conduite du véhicule obtenues par l'unité de navigation (100 ; 1000) à une fréquence prédéterminée et pour délivrer en sortie des informations de conduite du véhicule reçues en provenance d'un dispositif de communication embarqué d'un autre véhicule (400 - 407) ou d'informations de piéton reçues en provenance du terminal mobile (500) à l'unité de navigation (100 ; 1000),
caractérisé en ce que
l'unité de navigation (100 ; 1000) est adaptée pour ajouter un ID de véhicule spécifiant ledit autre véhicule (402) comme étant un véhicule à observer ou un ID de terminal spécifiant ledit terminal mobile (500) comme étant un terminal à observer aux informations de conduite de véhicule de son véhicule personnel (400) et pour transmettent des informations de conduite du véhicule à l'unité de dispositif de communication (200), dans le cas de la détection de l'autre véhicule (402) ou du terminal mobile (500) se rapprochant dans une direction de conduite de son véhicule personnel (400) depuis les informations de conduite du véhicule reçues par l'unité de dispositif de communication (200) du dispositif de communication embarqué (300 ; 3000), et
le dispositif de communication embarqué (300 ; 3000) de l'autre véhicule (401 - 407) du terminal mobile (500) qui reçoit les informations de conduite du véhicule est adapté pour augmenter une fréquence de transmission ou une puissance de transmission des informations de conduite du véhicule personnel ou des informations de piéton, dans un cas où l'ID du véhicule à observer ou l'ID du terminal à observer compris dans les informations de conduite du véhicule reçues est identique à l'ID du véhicule personnel ou à l'ID du terminal, et pour réduire ladite fréquence de transmission, dans un cas où l'ID du véhicule à observer reçu ou l'ID du terminal à observer n'est pas identique à son ID de véhicule ou à son ID de terminal.

6. Dispositif selon la revendication 5, dans lequel le dispositif de communication embarqué de l'autre véhicule (401 - 407) qui reçoit les informations de conduite du véhicule comprend un dispositif de sortie (102) pour délivrer en sortie des informations indiquant qu'il s'agit d'un véhicule à observer (402) et informer un conducteur, dans le cas où l'ID du véhicule à observer reçu est identique à son ID de véhicule personnel.

7. Terminal mobile (500) porté par un piéton (600) pour effectuer une communication radio avec un dispositif de communication embarqué (300 ; 3000) équipé dans un véhicule (400), le terminal mobile (500) comportant :

une unité d'obtention d'informations de position (506) laquelle est adaptée pour obtenir des informations de piéton comprenant un ID de terminal spécifiant le terminal mobile personnel (500),
une unité de communication radio inter-véhicule (504) laquelle est adaptée pour transmettre des informations de piéton obtenues par l'unité d'obtention d'informations de position (506) à une fréquence de transmission prédéterminée alors que les informations de conduite du véhicule sont reçues en provenance du dispositif de communication embarqué (300 ; 3000) et pour recevoir des informations de conduite du véhicule en provenance du dispositif de communication embarqué (300 ; 3000),
caractérisé par une unité de traitement d'information du véhicule (505) qui est adaptée pour augmenter la fréquence de transmission ou une puissance de transmission des informations de conduite du véhicule personnel ou des informations de piéton dans le cas où un ID de terminal d'un terminal à observer compris dans les informations de conduite du véhicule reçues est

identique à l'ID de terminal du terminal mobile personnel (500).

8. Terminal selon la revendication 7, comportant en outre une unité de sortie (501) laquelle est adaptée pour délivrer en sortie une indication d'attention au piéton (600) portant le terminal mobile (500), dans le cas où l'ID de terminal du terminal à observer compris dans les informations de conduite du véhicule reçues par l'unité de traitement d'informations de véhicule (505) est identique à l'ID de terminal du terminal mobile personnel (500).

FIG. 1

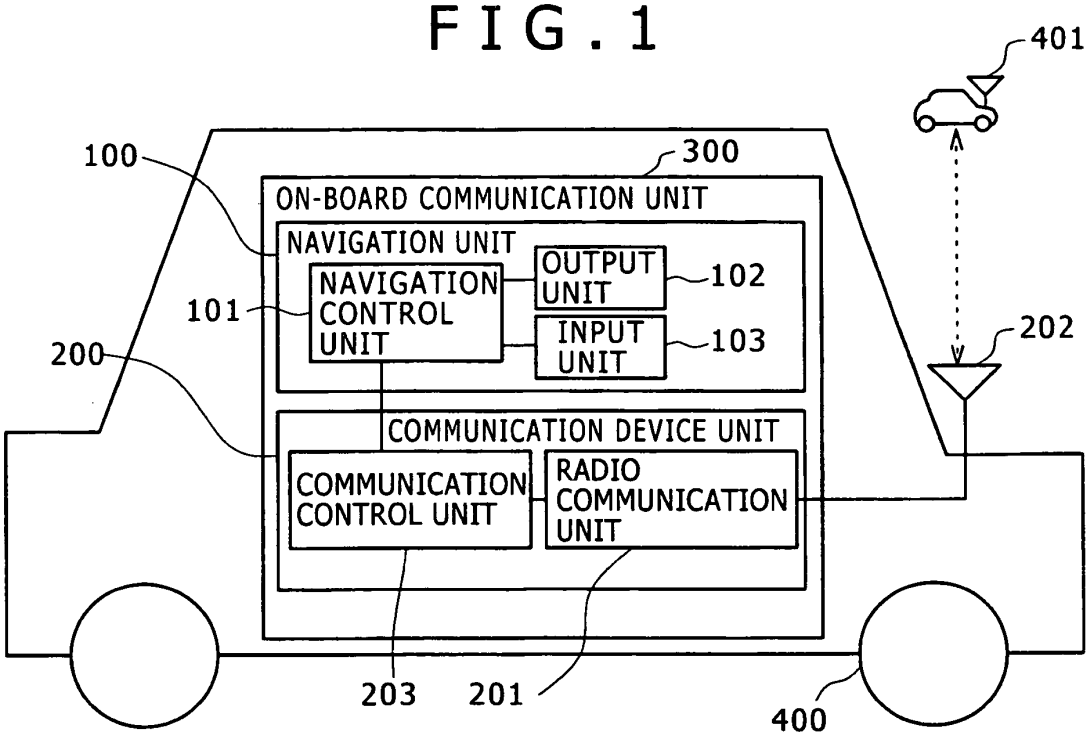

401
100
300
ON-BOARD COMMUNICATION UNIT
NAVIGATION UNIT
NAVIGATION CONTROL UNIT
OUTPUT UNIT
102
101
INPUT UNIT
103
200
202
COMMUNICATION DEVICE UNIT
COMMUNICATION CONTROL UNIT
RADIO COMMUNICATION UNIT
203
201
400

FIG. 2

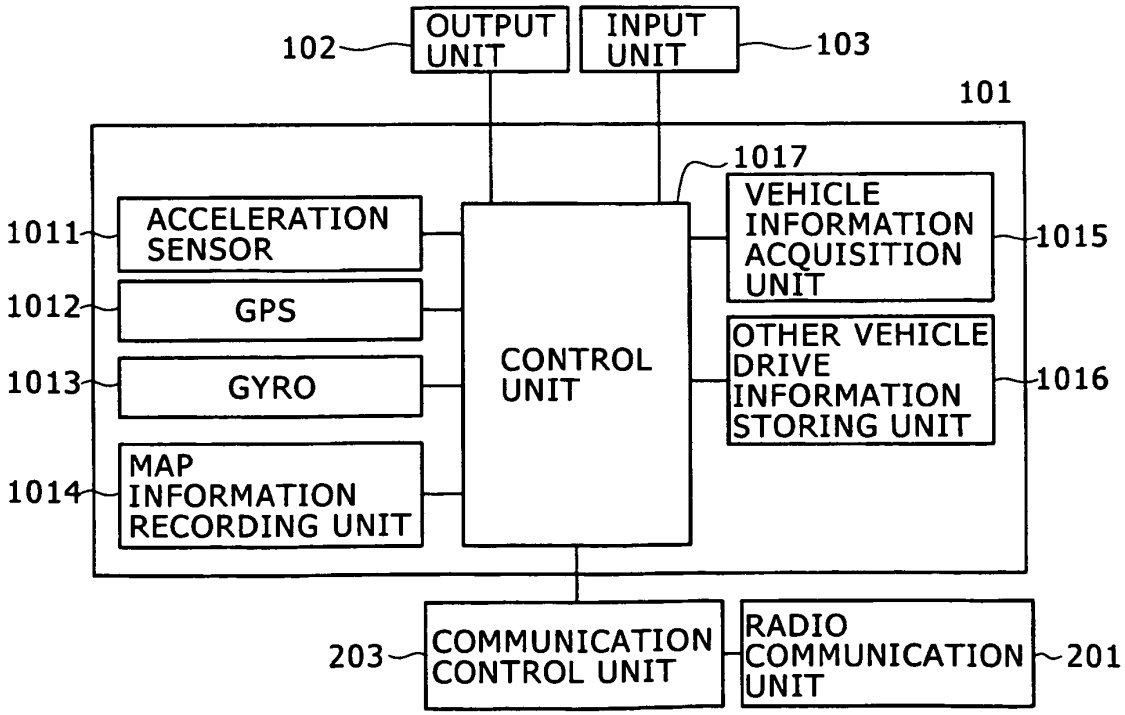

102
OUTPUT UNIT
INPUT UNIT
103
101
1017
1011
ACCELERATION SENSOR
VEHICLE INFORMATION ACQUISITION UNIT
1015
1012
GPS
CONTROL UNIT
OTHER VEHICLE DRIVE INFORMATION STORING UNIT
1013
GYRO
1016
1014
MAP INFORMATION RECORDING UNIT
203
COMMUNICATION CONTROL UNIT
RADIO COMMUNICATION UNIT
201

FIG. 3

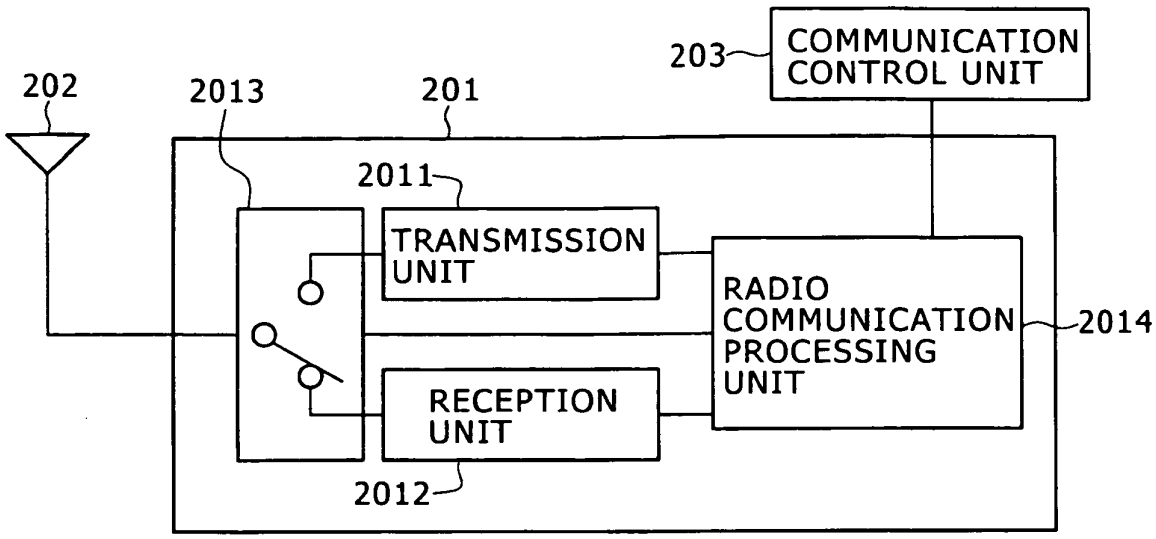

203
COMMUNICATION CONTROL UNIT
202
2013
201
2011
TRANSMISSION UNIT
RADIO COMMUNICATION PROCESSING UNIT
2014
RECEPTION UNIT
2012

FIG. 4

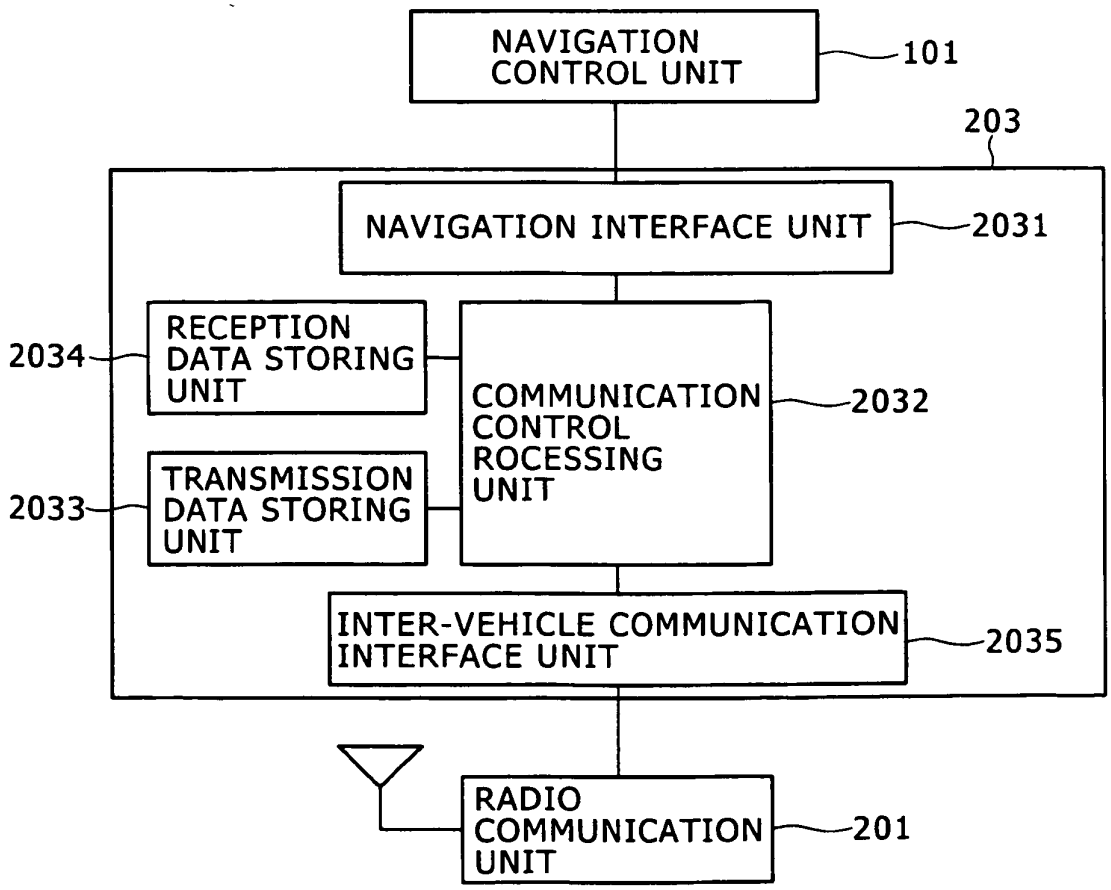

NAVIGATION CONTROL UNIT
101
203
NAVIGATION INTERFACE UNIT
2031
2034
RECEPTION DATA STORING UNIT
COMMUNICATION CONTROL ROCESSING UNIT
2032
2033
TRANSMISSION DATA STORING UNIT
INTER-VEHICLE COMMUNICATION INTERFACE UNIT
2035
RADIO COMMUNICATION UNIT
201

FIG.5A

VEHICLE DRIVE INFORMATION			
DATA ITEM	DATA AMOUNT	UNIT	CONTENT
VEHICLE ID	2 bytes	–	NUMBER SPECIFYING VEHICLE (1-65535)
KIND OF VEHICLE	1 byte	–	SET UP KIND OF SELF VEHICLE (1: NORMAL PERSON CAR, 2: TWO-WHEELED CAR, 3; LARGE-SIZE CAR, 4; OTHERS)
LATITUDE	2 bytes	DEGREE, MINUTE	
LONGITUDE	2 bytes	DEGREE, MINUTE	
ALTITUDE	1 byte	m	
VEHICULAR SPEED	1 byte	km/h	0-255km/h
ACCELERATION	1 byte		-127-+127 STEPS
DIRECTION	1 byte		16 DIRECTIONS
BRAKE	1 byte		ON:OFF
ACCELERATOR	1 byte		ON:OFF
TO-BE-WATCHED VEHICLE ID	2 bytes	–	VEHICLE ID APPROACHING DETECTED TO-BE-WATCHED VEHICLE

FIG.5B

VEHICLE DRIVE INFORMATION DATA FORMAT

VEHICLE ID 2 Bytes	KIND OF VEHICLE 2 Bytes	LATITUDE 2 Bytes	LONGITUDE 2 Bytes	ALTITUDE 2 Bytes	VEHICULAR SPEED 1 Byte	ACCELERATION 1 Byte	DIRECTION 1 Byte	BRAKE 1 Byte	ACCELERATOR 1 Byte	TO-BE-WATCHED VEHICLE ID 2 Bytes

FIG. 6

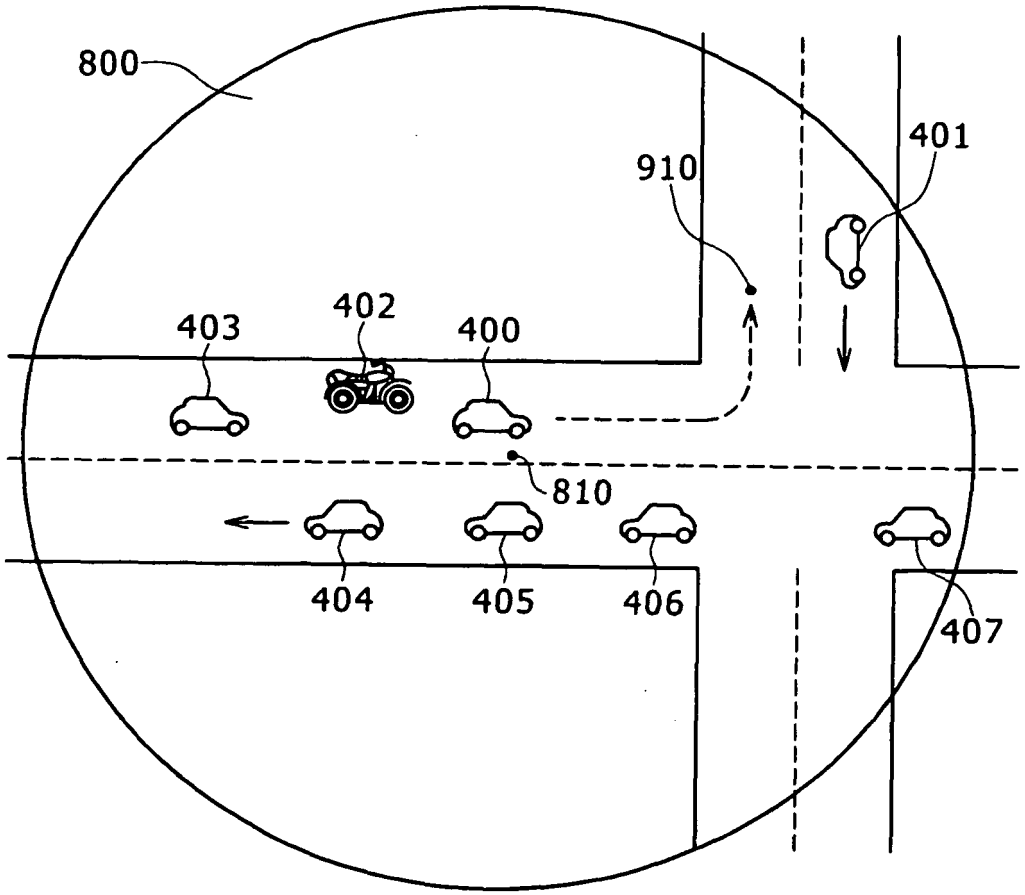


FIG. 7

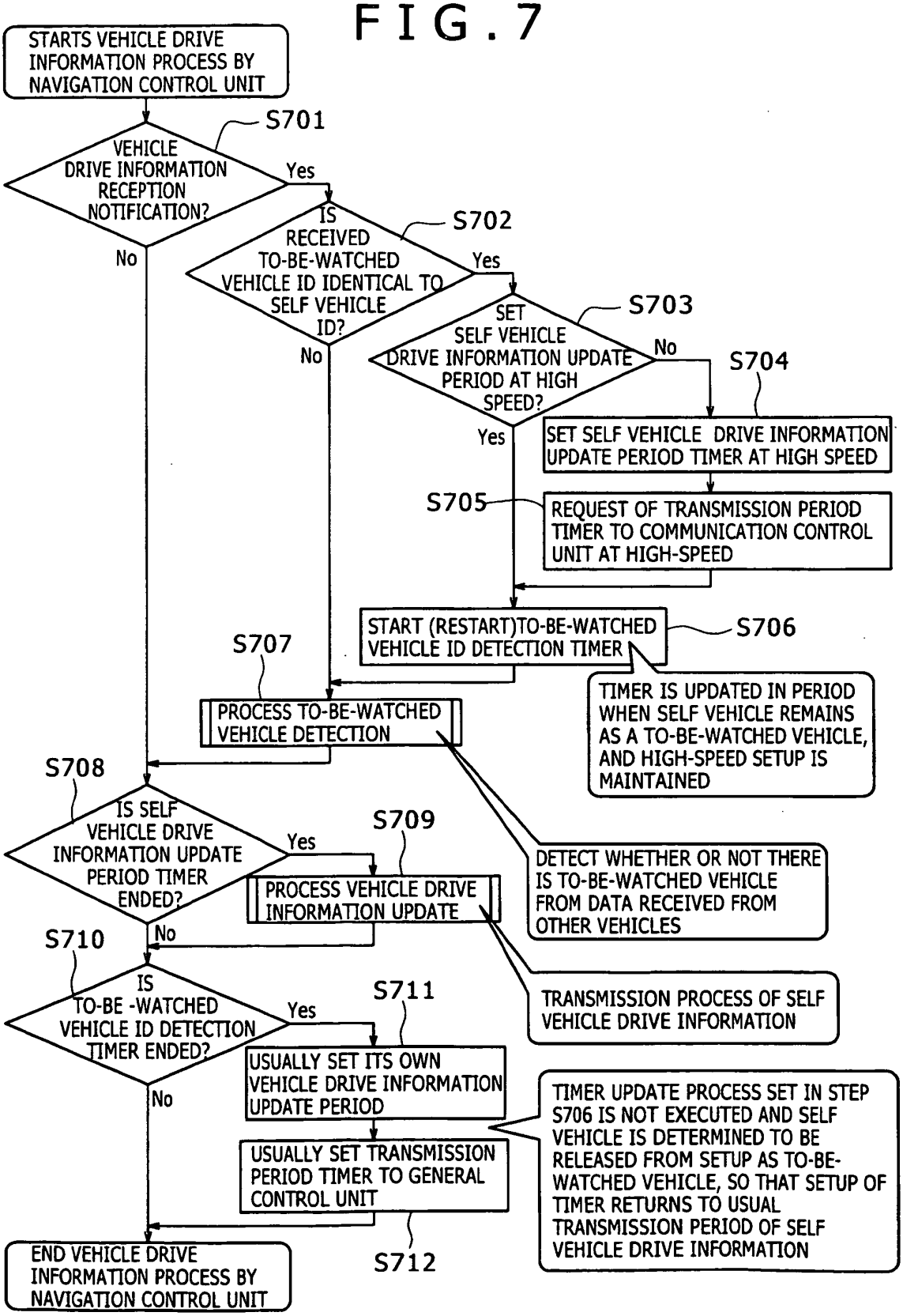

STARTS VEHICLE DRIVE INFORMATION PROCESS BY NAVIGATION CONTROL UNIT
S701
VEHICLE DRIVE INFORMATION RECEPTION NOTIFICATION?
Yes
No
S702
IS RECEIVED TO-BE-WATCHED VEHICLE ID IDENTICAL TO SELF VEHICLE ID?
Yes
No
S703
SET SELF VEHICLE DRIVE INFORMATION UPDATE PERIOD AT HIGH SPEED?
No
Yes
S704
SET SELF VEHICLE DRIVE INFORMATION UPDATE PERIOD TIMER AT HIGH SPEED
S705
REQUEST OF TRANSMISSION PERIOD TIMER TO COMMUNICATION CONTROL UNIT AT HIGH-SPEED
START (RESTART)TO-BE-WATCHED VEHICLE ID DETECTION TIMER
S706
TIMER IS UPDATED IN PERIOD WHEN SELF VEHICLE REMAINS AS A TO-BE-WATCHED VEHICLE, AND HIGH-SPEED SETUP IS MAINTAINED
S707
PROCESS TO-BE-WATCHED VEHICLE DETECTION
DETECT WHETHER OR NOT THERE IS TO-BE-WATCHED VEHICLE FROM DATA RECEIVED FROM OTHER VEHICLES
S708
IS SELF VEHICLE DRIVE INFORMATION UPDATE PERIOD TIMER ENDED?
Yes
S709
PROCESS VEHICLE DRIVE INFORMATION UPDATE
TRANSMISSION PROCESS OF SELF VEHICLE DRIVE INFORMATION
No
S710
IS TO-BE -WATCHED VEHICLE ID DETECTION TIMER ENDED?
Yes
S711
USUALLY SET ITS OWN VEHICLE DRIVE INFORMATION UPDATE PERIOD
TIMER UPDATE PROCESS SET IN STEP S706 IS NOT EXECUTED AND SELF VEHICLE IS DETERMINED TO BE RELEASED FROM SETUP AS TO-BE-WATCHED VEHICLE, SO THAT SETUP OF TIMER RETURNS TO USUAL TRANSMISSION PERIOD OF SELF VEHICLE DRIVE INFORMATION
No
USUALLY SET TRANSMISSION PERIOD TIMER TO GENERAL CONTROL UNIT
S712
END VEHICLE DRIVE INFORMATION PROCESS BY NAVIGATION CONTROL UNIT

FIG. 8

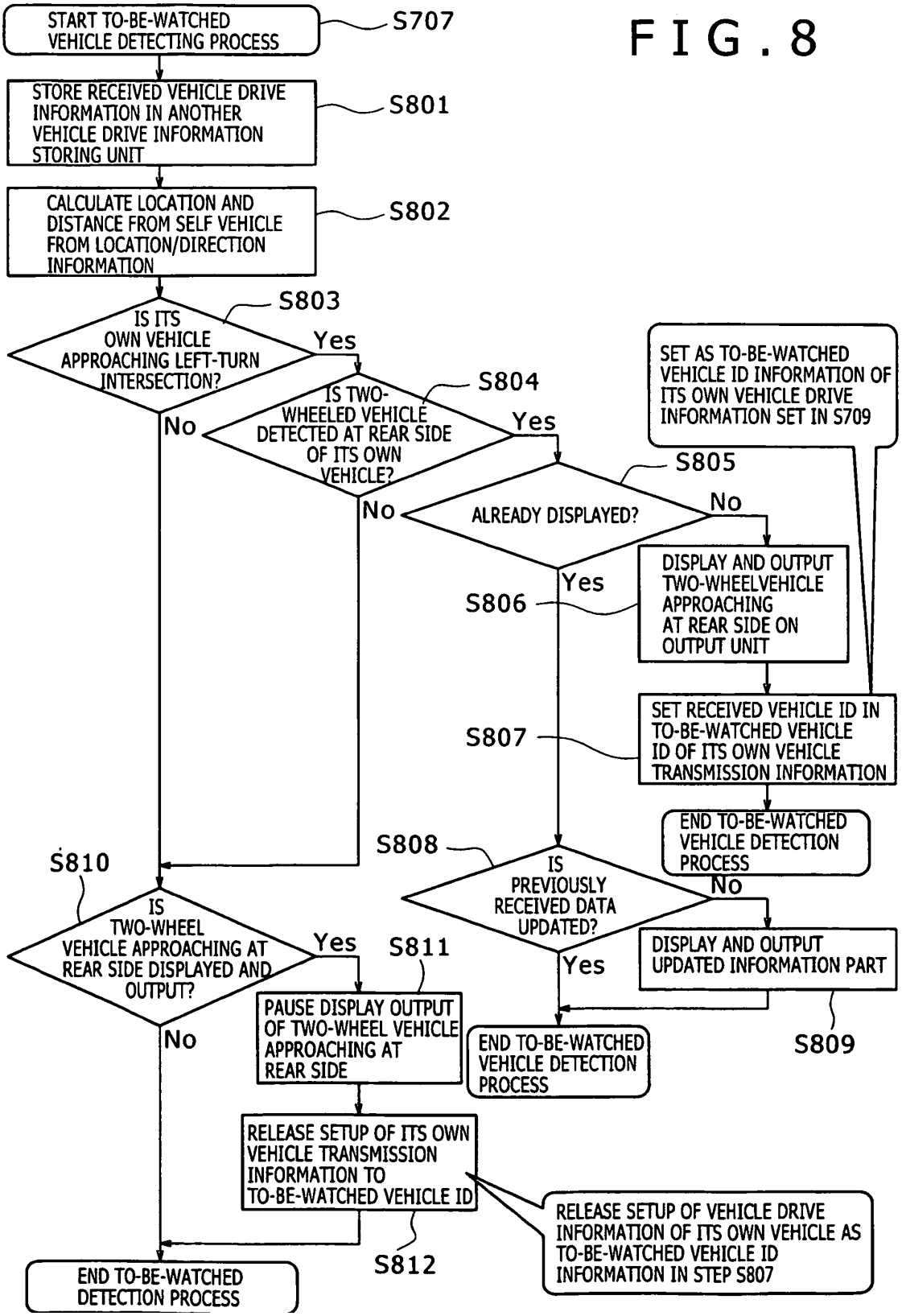

START TO-BE-WATCHED VEHICLE DETECTING PROCESS
S707
STORE RECEIVED VEHICLE DRIVE INFORMATION IN ANOTHER VEHICLE DRIVE INFORMATION STORING UNIT
S801
CALCULATE LOCATION AND DISTANCE FROM SELF VEHICLE FROM LOCATION/DIRECTION INFORMATION
S802
S803
IS ITS OWN VEHICLE APPROACHING LEFT-TURN INTERSECTION?
Yes
No
S804
IS TWO-WHEELED VEHICLE DETECTED AT REAR SIDE OF ITS OWN VEHICLE?
Yes
No
SET AS TO-BE-WATCHED VEHICLE ID INFORMATION OF ITS OWN VEHICLE DRIVE INFORMATION SET IN S709
S805
ALREADY DISPLAYED?
No
Yes
S806
DISPLAY AND OUTPUT TWO-WHEELVEHICLE APPROACHING AT REAR SIDE ON OUTPUT UNIT
S807
SET RECEIVED VEHICLE ID IN TO-BE-WATCHED VEHICLE ID OF ITS OWN VEHICLE TRANSMISSION INFORMATION
END TO-BE-WATCHED VEHICLE DETECTION PROCESS
S808
IS PREVIOUSLY RECEIVED DATA UPDATED?
No
Yes
DISPLAY AND OUTPUT UPDATED INFORMATION PART
S809
S810
IS TWO-WHEEL VEHICLE APPROACHING AT REAR SIDE DISPLAYED AND OUTPUT?
Yes
No
S811
PAUSE DISPLAY OUTPUT OF TWO-WHEEL VEHICLE APPROACHING AT REAR SIDE
END TO-BE-WATCHED VEHICLE DETECTION PROCESS
RELEASE SETUP OF ITS OWN VEHICLE TRANSMISSION INFORMATION TO TO-BE-WATCHED VEHICLE ID
S812
RELEASE SETUP OF VEHICLE DRIVE INFORMATION OF ITS OWN VEHICLE AS TO-BE-WATCHED VEHICLE ID INFORMATION IN STEP S807
END TO-BE-WATCHED DETECTION PROCESS

FIG. 9

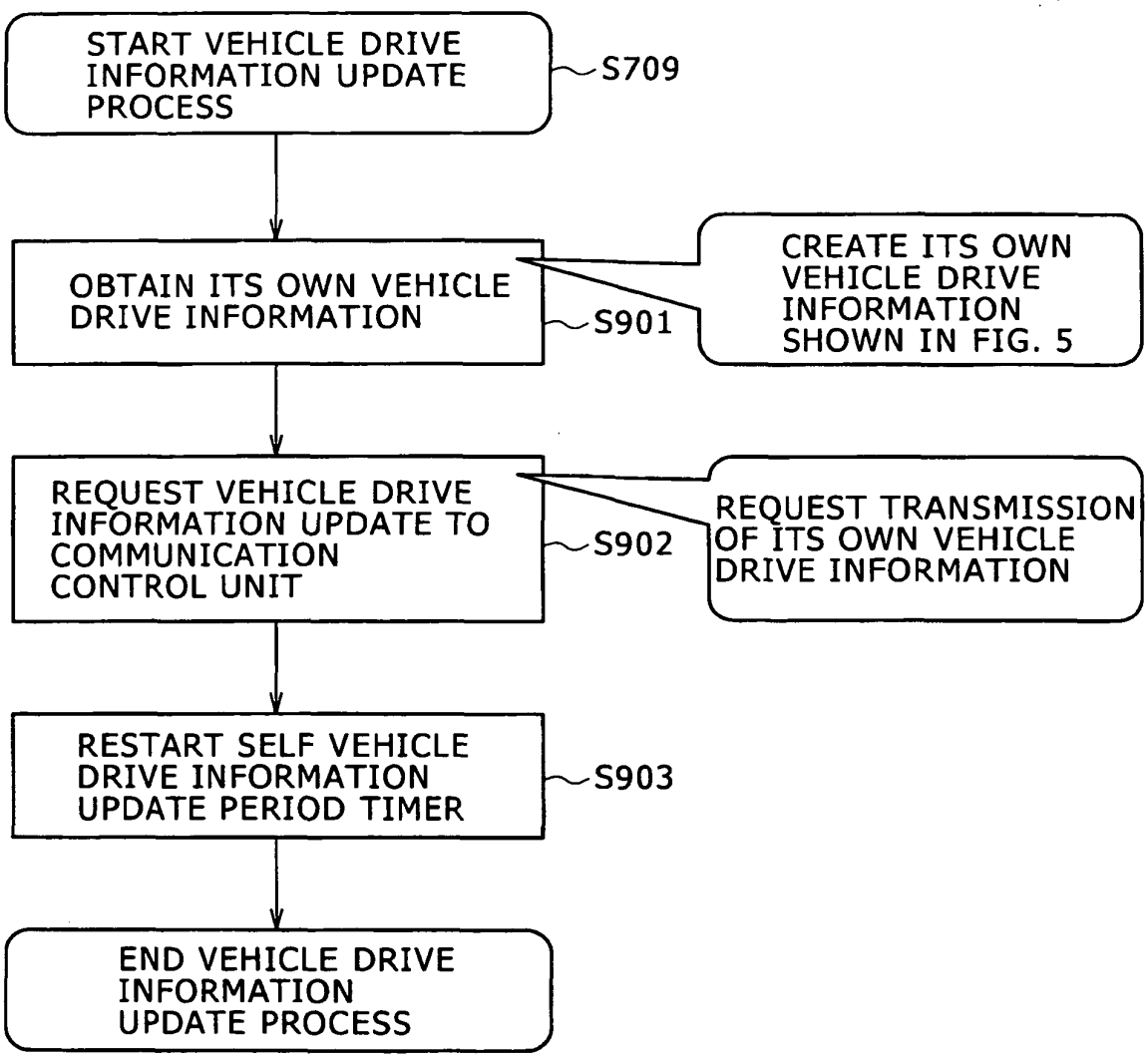

START VEHICLE DRIVE INFORMATION UPDATE PROCESS
S709
OBTAIN ITS OWN VEHICLE DRIVE INFORMATION
S901
CREATE ITS OWN VEHICLE DRIVE INFORMATION SHOWN IN FIG. 5
REQUEST VEHICLE DRIVE INFORMATION UPDATE TO COMMUNICATION CONTROL UNIT
S902
REQUEST TRANSMISSION OF ITS OWN VEHICLE DRIVE INFORMATION
RESTART SELF VEHICLE DRIVE INFORMATION UPDATE PERIOD TIMER
S903
END VEHICLE DRIVE INFORMATION UPDATE PROCESS

FIG. 10

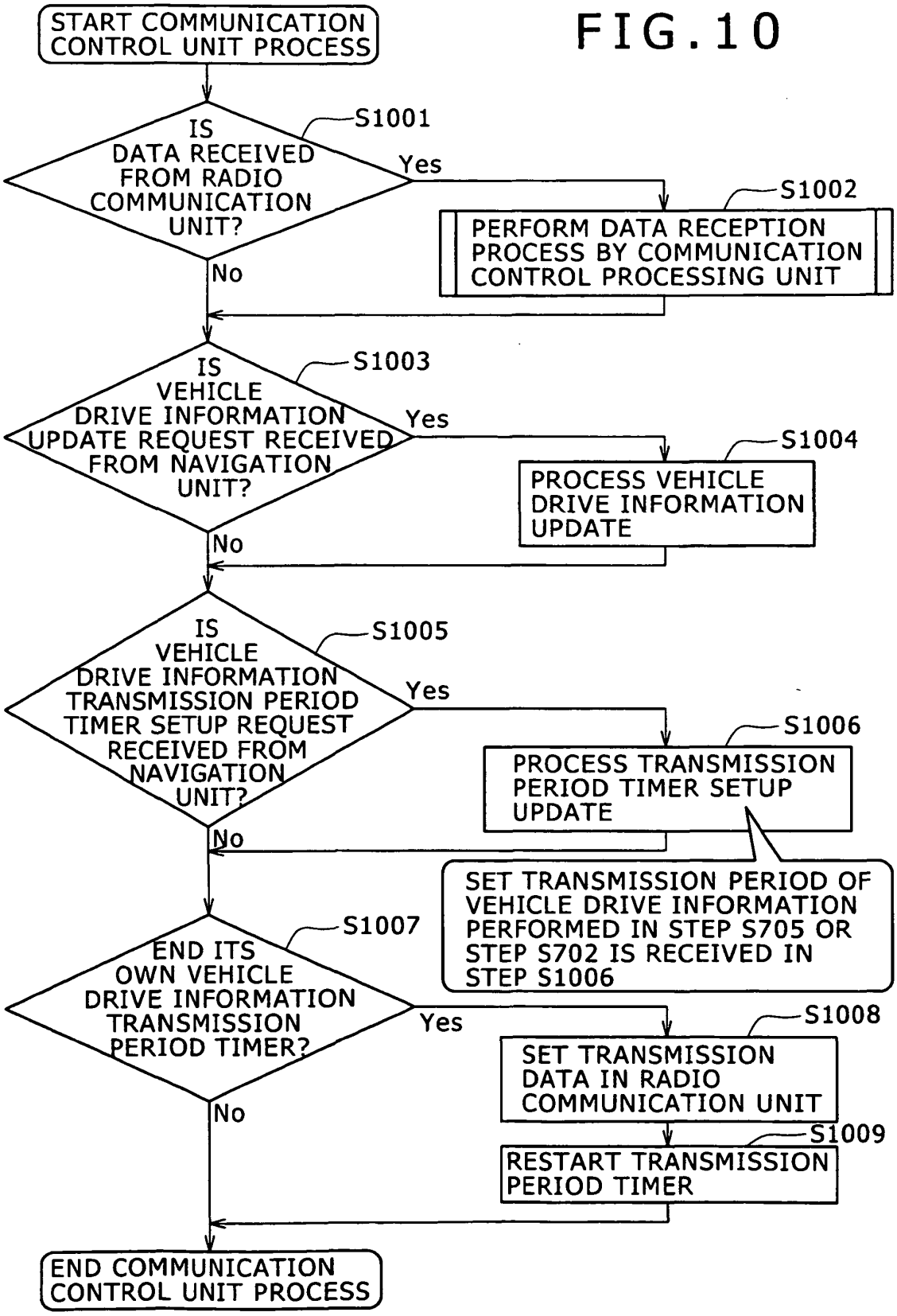

START COMMUNICATION CONTROL UNIT PROCESS
S1001
IS DATA RECEIVED FROM RADIO COMMUNICATION UNIT?
Yes
No
S1002
PERFORM DATA RECEPTION PROCESS BY COMMUNICATION CONTROL PROCESSING UNIT
S1003
IS VEHICLE DRIVE INFORMATION UPDATE REQUEST RECEIVED FROM NAVIGATION UNIT?
Yes
No
S1004
PROCESS VEHICLE DRIVE INFORMATION UPDATE
S1005
IS VEHICLE DRIVE INFORMATION TRANSMISSION PERIOD TIMER SETUP REQUEST RECEIVED FROM NAVIGATION UNIT?
Yes
No
S1006
PROCESS TRANSMISSION PERIOD TIMER SETUP UPDATE
SET TRANSMISSION PERIOD OF VEHICLE DRIVE INFORMATION PERFORMED IN STEP S705 OR STEP S702 IS RECEIVED IN STEP S1006
S1007
END ITS OWN VEHICLE DRIVE INFORMATION TRANSMISSION PERIOD TIMER?
Yes
No
S1008
SET TRANSMISSION DATA IN RADIO COMMUNICATION UNIT
S1009
RESTART TRANSMISSION PERIOD TIMER
END COMMUNICATION CONTROL UNIT PROCESS

FIG. 11

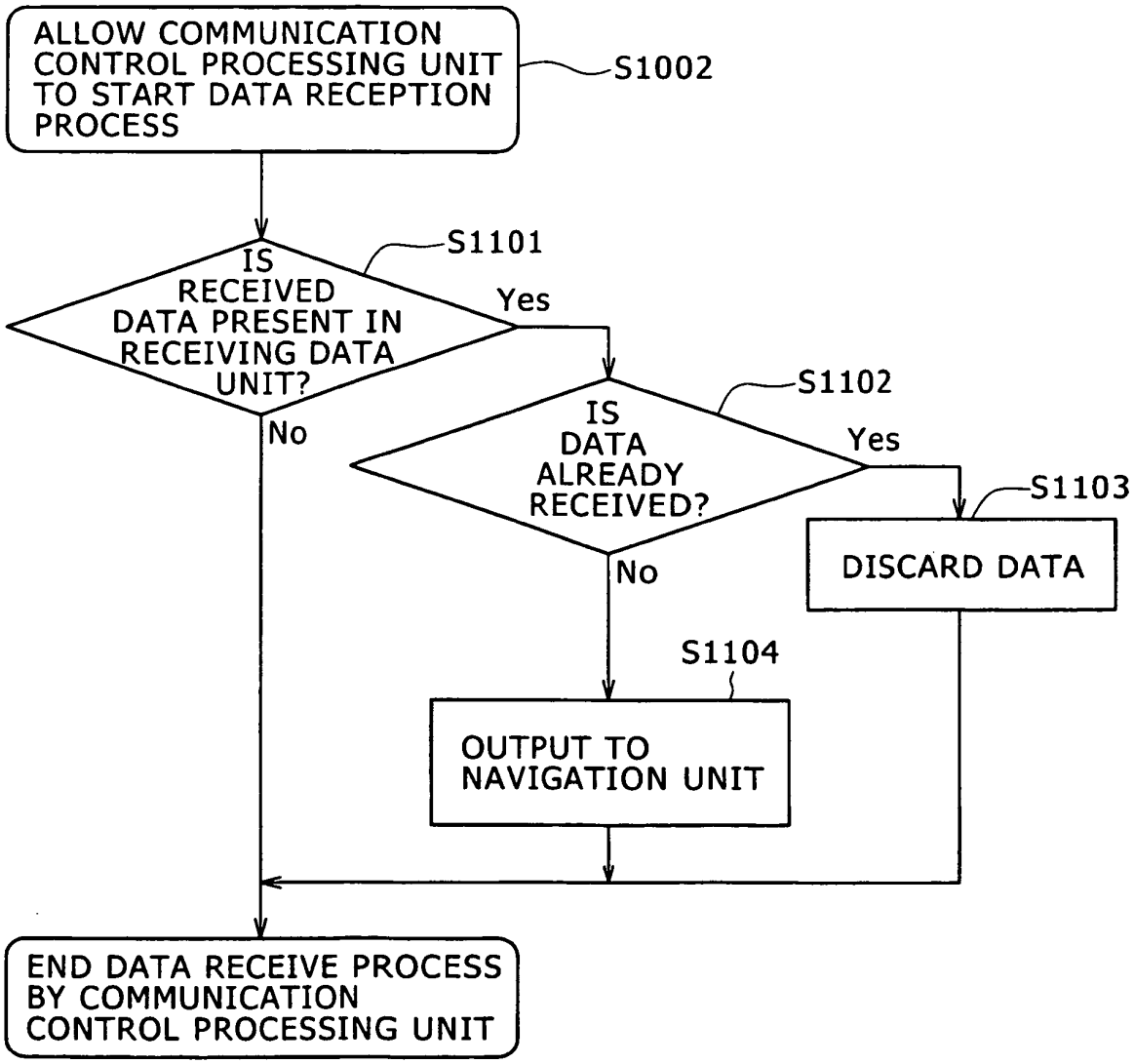

ALLOW COMMUNICATION CONTROL PROCESSING UNIT TO START DATA RECEPTION PROCESS
S1002
IS RECEIVED DATA PRESENT IN RECEIVING DATA UNIT?
S1101
Yes
No
IS DATA ALREADY RECEIVED?
S1102
Yes
No
DISCARD DATA
S1103
OUTPUT TO NAVIGATION UNIT
S1104
END DATA RECEIVE PROCESS BY COMMUNICATION CONTROL PROCESSING UNIT

FIG. 12

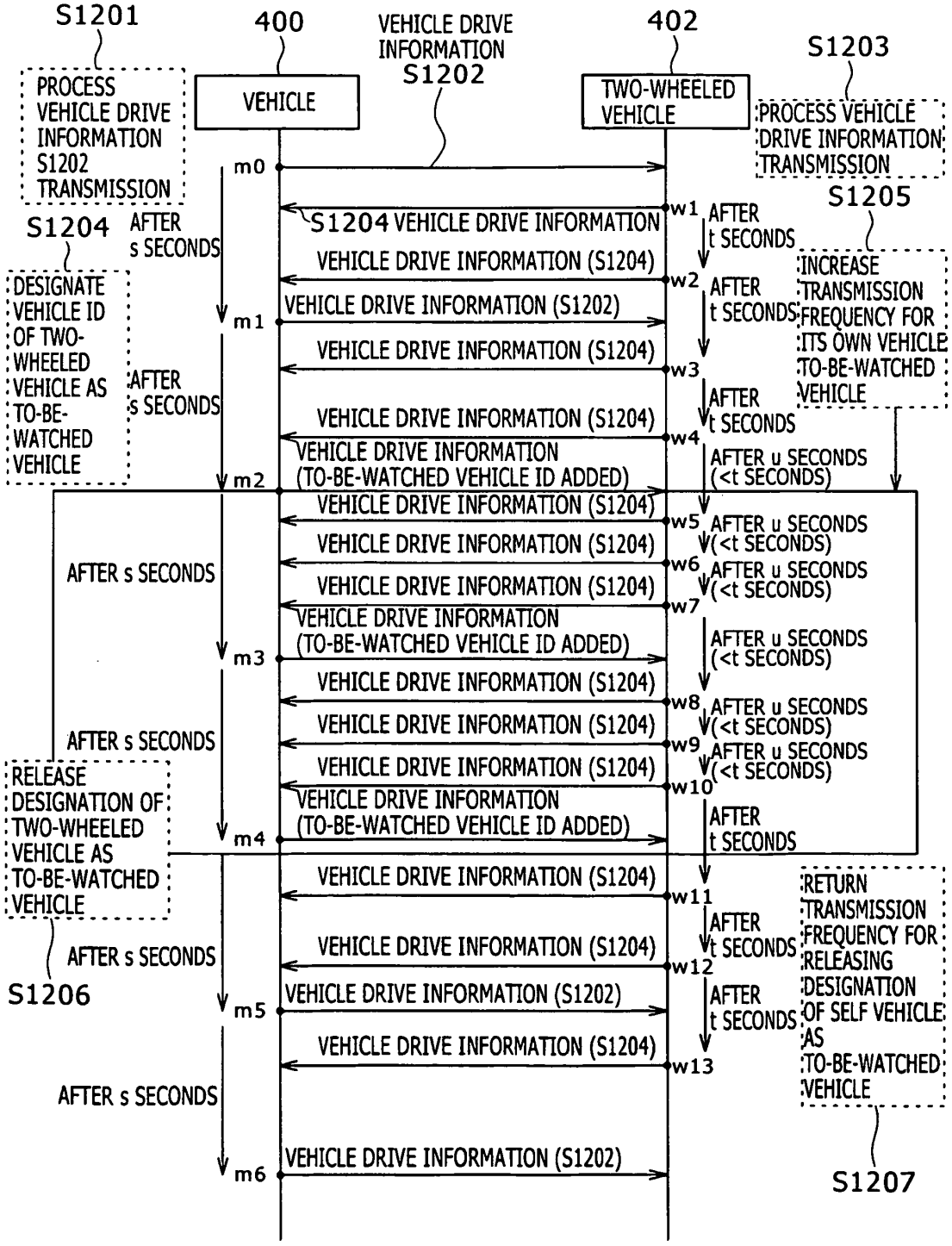

S1201
400
VEHICLE DRIVE INFORMATION S1202
402
S1203
PROCESS VEHICLE DRIVE INFORMATION S1202 TRANSMISSION
VEHICLE
TWO-WHEELED VEHICLE
PROCESS VEHICLE DRIVE INFORMATION TRANSMISSION
S1205
m0
S1204 VEHICLE DRIVE INFORMATION
w1
AFTER t SECONDS
S1204
AFTER s SECONDS
VEHICLE DRIVE INFORMATION (S1204)
w2
AFTER t SECONDS
INCREASE TRANSMISSION FREQUENCY FOR ITS OWN VEHICLE TO-BE-WATCHED VEHICLE
DESIGNATE VEHICLE ID OF TWO-WHEELED VEHICLE AS TO-BE-WATCHED VEHICLE
VEHICLE DRIVE INFORMATION (S1202)
m1
VEHICLE DRIVE INFORMATION (S1204)
w3
AFTER t SECONDS
AFTER s SECONDS
VEHICLE DRIVE INFORMATION (S1204)
w4
AFTER u SECONDS (<t SECONDS)
VEHICLE DRIVE INFORMATION (TO-BE-WATCHED VEHICLE ID ADDED)
m2
VEHICLE DRIVE INFORMATION (S1204)
w5
AFTER u SECONDS (<t SECONDS)
AFTER s SECONDS
VEHICLE DRIVE INFORMATION (S1204)
w6
AFTER u SECONDS (<t SECONDS)
VEHICLE DRIVE INFORMATION (S1204)
w7
VEHICLE DRIVE INFORMATION (TO-BE-WATCHED VEHICLE ID ADDED)
m3
AFTER u SECONDS (<t SECONDS)
VEHICLE DRIVE INFORMATION (S1204)
w8
AFTER u SECONDS (<t SECONDS)
AFTER s SECONDS
VEHICLE DRIVE INFORMATION (S1204)
w9
AFTER u SECONDS (<t SECONDS)
RELEASE DESIGNATION OF TWO-WHEELED VEHICLE AS TO-BE-WATCHED VEHICLE
VEHICLE DRIVE INFORMATION (S1204)
w10
VEHICLE DRIVE INFORMATION (TO-BE-WATCHED VEHICLE ID ADDED)
m4
AFTER t SECONDS
VEHICLE DRIVE INFORMATION (S1204)
w11
AFTER t SECONDS
RETURN TRANSMISSION FREQUENCY FOR RELEASING DESIGNATION OF SELF VEHICLE AS TO-BE-WATCHED VEHICLE
AFTER s SECONDS
VEHICLE DRIVE INFORMATION (S1204)
w12
S1206
VEHICLE DRIVE INFORMATION (S1202)
m5
AFTER t SECONDS
VEHICLE DRIVE INFORMATION (S1204)
w13
AFTER s SECONDS
VEHICLE DRIVE INFORMATION (S1202)
m6
S1207

FIG.13

(NAVI DISPLAY SCREEN OF ITS OWN VEHICLE)

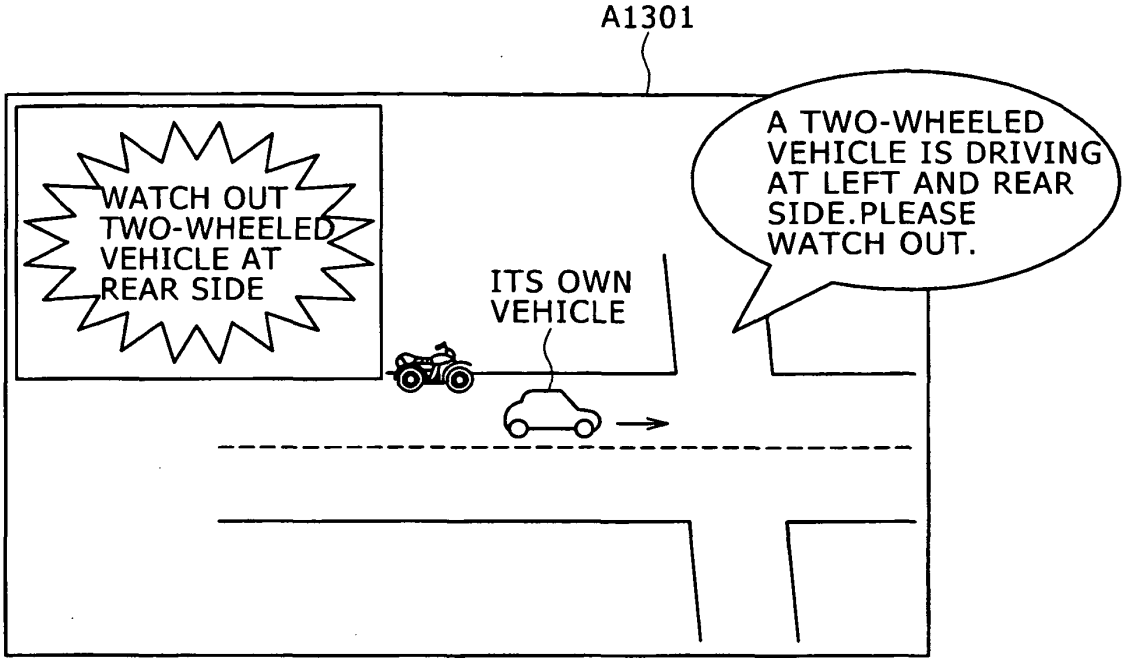


FIG.14

(NAVI DISPLAY SCREEN OF TO-BE-WATCHED VEHICLE)

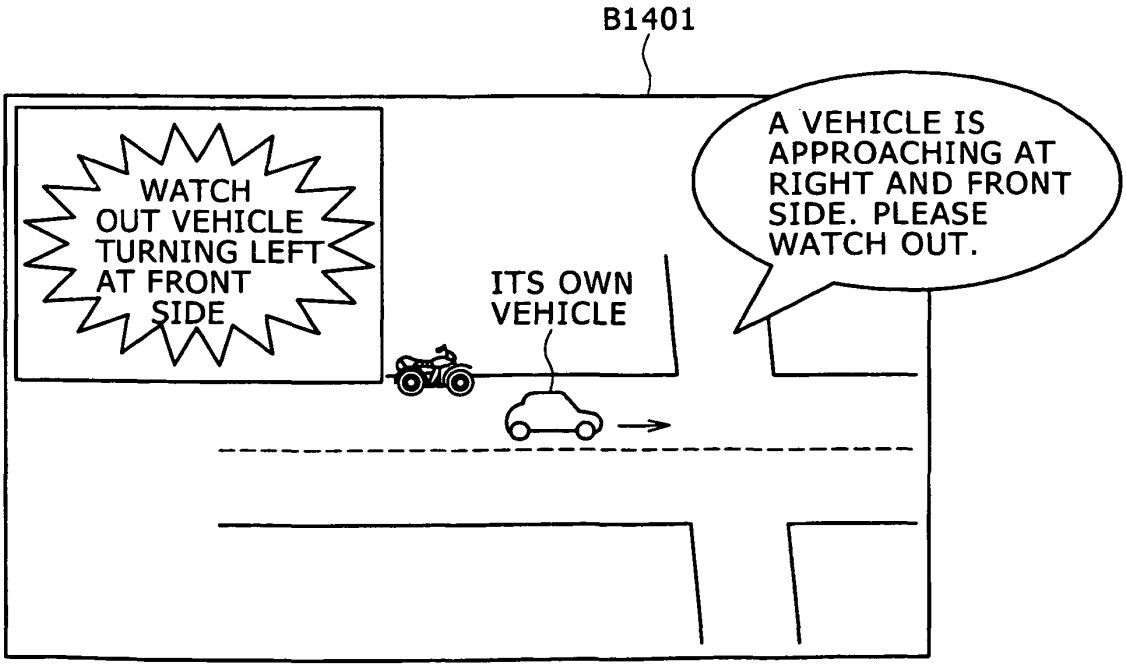


FIG. 15

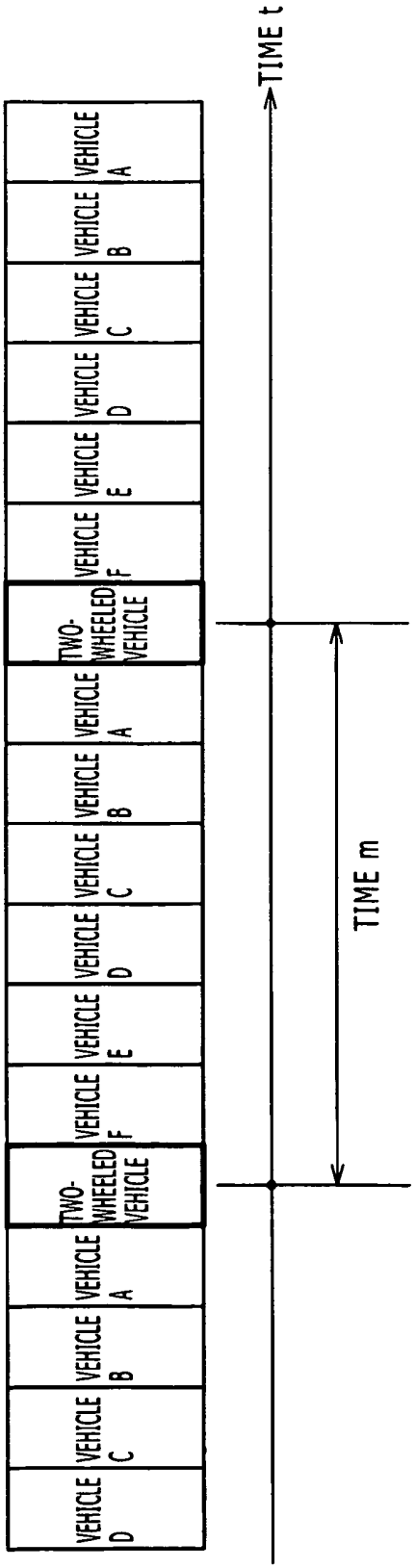

VEHICLE D
VEHICLE C
VEHICLE B
VEHICLE A
TWO-WHEELED VEHICLE
VEHICLE F
VEHICLE E
VEHICLE D
VEHICLE C
VEHICLE B
VEHICLE A
TWO-WHEELED VEHICLE
VEHICLE F
VEHICLE E
VEHICLE D
VEHICLE C
VEHICLE B
VEHICLE A
TIME m
TIME t

FIG. 16

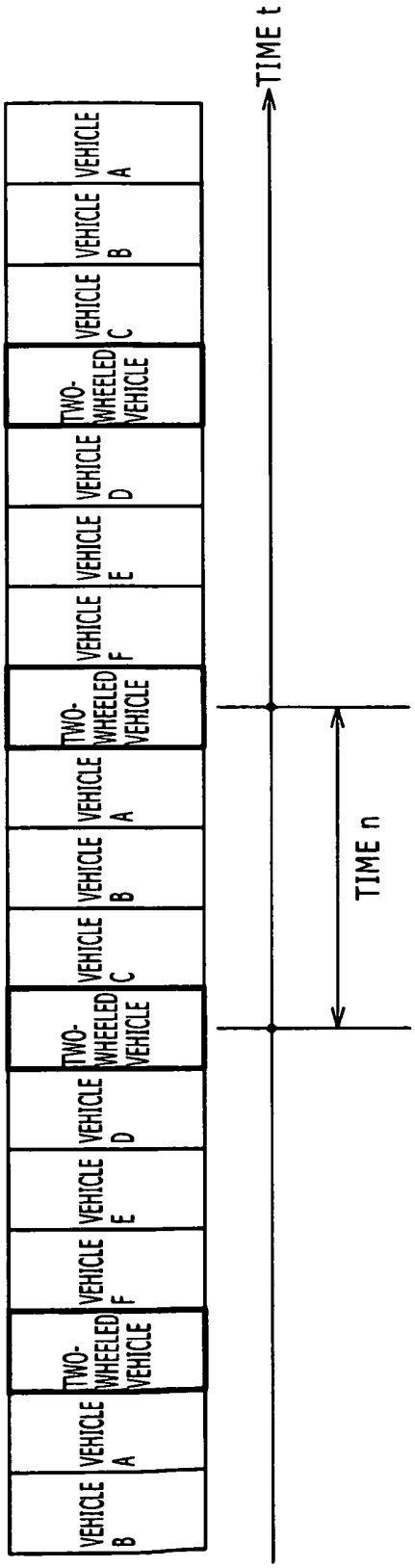

VEHICLE B
VEHICLE A
TWO-WHEELED VEHICLE
VEHICLE F
VEHICLE E
VEHICLE D
TWO-WHEELED VEHICLE
VEHICLE C
VEHICLE B
VEHICLE A
TWO-WHEELED VEHICLE
VEHICLE F
VEHICLE E
VEHICLE D
TWO-WHEELED VEHICLE
VEHICLE C
VEHICLE B
VEHICLE A
TIME n
TIME t

FIG.17

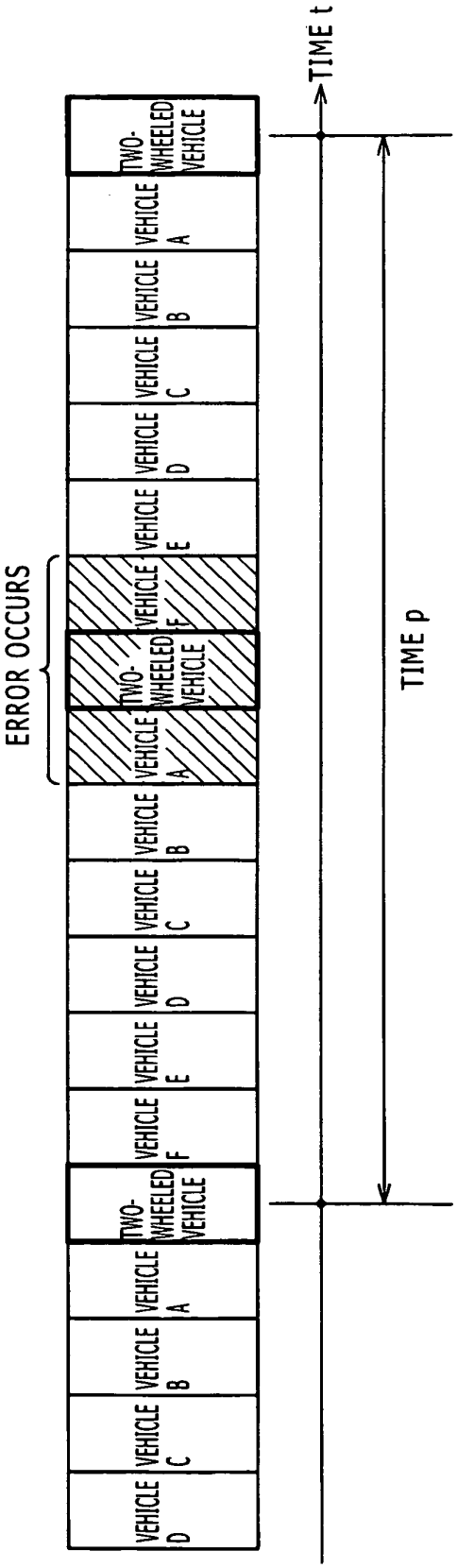

TIME t
TIME p
ERROR OCCURS
VEHICLE D
VEHICLE C
VEHICLE B
VEHICLE A
TWO-WHEELED VEHICLE
VEHICLE F
VEHICLE E
VEHICLE D
VEHICLE C
VEHICLE B
VEHICLE A
TWO-WHEELED VEHICLE
VEHICLE F
VEHICLE E

FIG.18

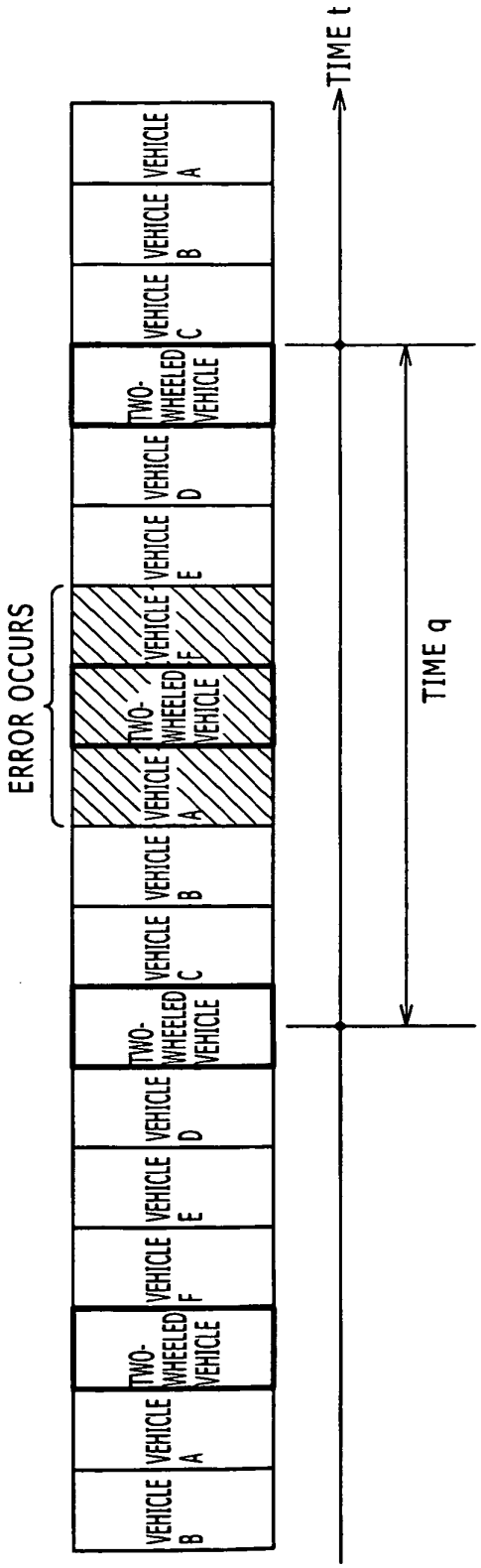

TIME t
TIME q
ERROR OCCURS
VEHICLE B
VEHICLE A
TWO-WHEELED VEHICLE
VEHICLE F
VEHICLE E
VEHICLE D
TWO-WHEELED VEHICLE
VEHICLE C
VEHICLE B
VEHICLE A
TWO-WHEELED VEHICLE
VEHICLE F
VEHICLE E
VEHICLE D
VEHICLE C

FIG. 19

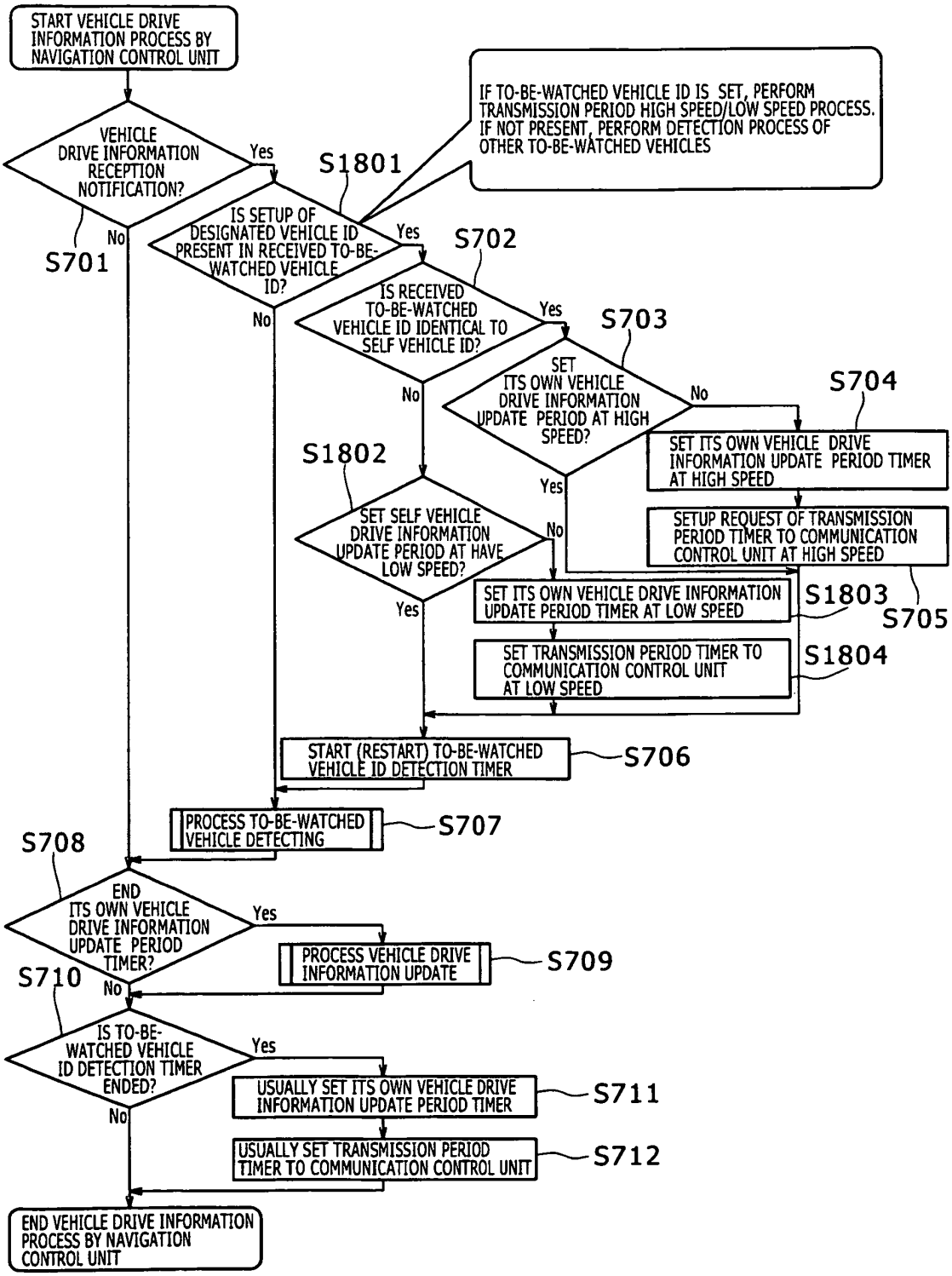

START VEHICLE DRIVE INFORMATION PROCESS BY NAVIGATION CONTROL UNIT
VEHICLE DRIVE INFORMATION RECEPTION NOTIFICATION?
Yes
No
S701
S1801
IF TO-BE-WATCHED VEHICLE ID IS SET, PERFORM TRANSMISSION PERIOD HIGH SPEED/LOW SPEED PROCESS. IF NOT PRESENT, PERFORM DETECTION PROCESS OF OTHER TO-BE-WATCHED VEHICLES
IS SETUP OF DESIGNATED VEHICLE ID PRESENT IN RECEIVED TO-BE-WATCHED VEHICLE ID?
Yes
No
S702
IS RECEIVED TO-BE-WATCHED VEHICLE ID IDENTICAL TO SELF VEHICLE ID?
Yes
No
S703
SET ITS OWN VEHICLE DRIVE INFORMATION UPDATE PERIOD AT HIGH SPEED?
No
Yes
S704
SET ITS OWN VEHICLE DRIVE INFORMATION UPDATE PERIOD TIMER AT HIGH SPEED
SETUP REQUEST OF TRANSMISSION PERIOD TIMER TO COMMUNICATION CONTROL UNIT AT HIGH SPEED
S705
S1802
SET SELF VEHICLE DRIVE INFORMATION UPDATE PERIOD AT HAVE LOW SPEED?
No
Yes
SET ITS OWN VEHICLE DRIVE INFORMATION UPDATE PERIOD TIMER AT LOW SPEED
S1803
SET TRANSMISSION PERIOD TIMER TO COMMUNICATION CONTROL UNIT AT LOW SPEED
S1804
START (RESTART) TO-BE-WATCHED VEHICLE ID DETECTION TIMER
S706
PROCESS TO-BE-WATCHED VEHICLE DETECTING
S707
S708
END ITS OWN VEHICLE DRIVE INFORMATION UPDATE PERIOD TIMER?
Yes
No
PROCESS VEHICLE DRIVE INFORMATION UPDATE
S709
S710
IS TO-BE-WATCHED VEHICLE ID DETECTION TIMER ENDED?
Yes
No
USUALLY SET ITS OWN VEHICLE DRIVE INFORMATION UPDATE PERIOD TIMER
S711
USUALLY SET TRANSMISSION PERIOD TIMER TO COMMUNICATION CONTROL UNIT
S712
END VEHICLE DRIVE INFORMATION PROCESS BY NAVIGATION CONTROL UNIT

FIG.20

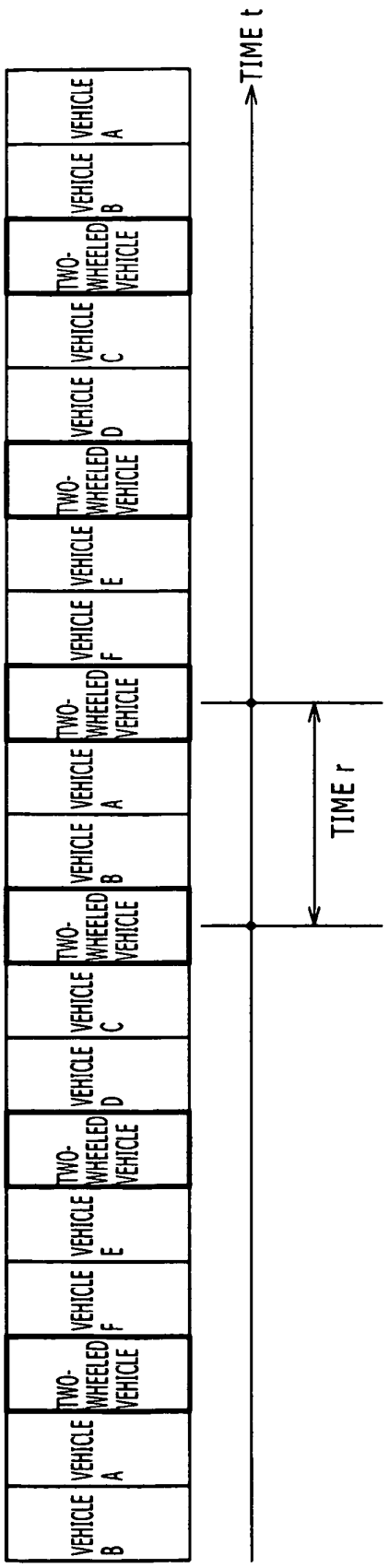

VEHICLE B
VEHICLE A
TWO-WHEELED VEHICLE
VEHICLE F
TWO-WHEELED VEHICLE
VEHICLE E
VEHICLE D
TWO-WHEELED VEHICLE
VEHICLE C
VEHICLE B
TWO-WHEELED VEHICLE
VEHICLE A
TWO-WHEELED VEHICLE
VEHICLE F
VEHICLE E
TWO-WHEELED VEHICLE
VEHICLE D
VEHICLE C
TWO-WHEELED VEHICLE
VEHICLE B
VEHICLE A
TIME t
TIME r

FIG.21

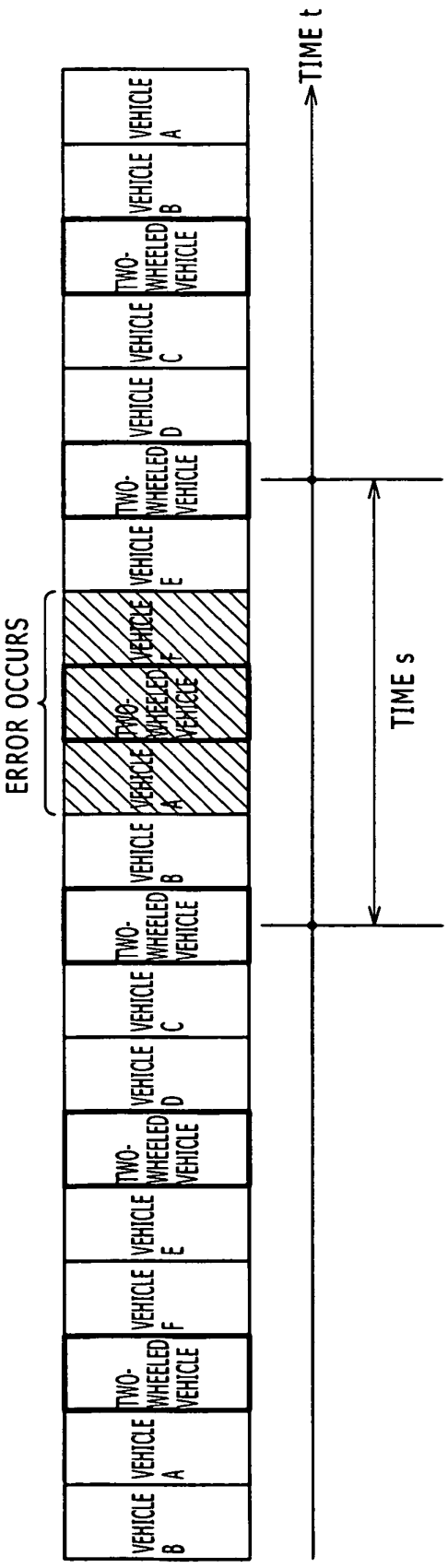

ERROR OCCURS
VEHICLE B
VEHICLE A
TWO-WHEELED VEHICLE
VEHICLE F
TWO-WHEELED VEHICLE
VEHICLE E
VEHICLE D
TWO-WHEELED VEHICLE
VEHICLE C
VEHICLE B
TWO-WHEELED VEHICLE
VEHICLE A
TWO-WHEELED VEHICLE
VEHICLE F
VEHICLE E
TWO-WHEELED VEHICLE
VEHICLE D
VEHICLE C
TWO-WHEELED VEHICLE
VEHICLE B
VEHICLE A
TIME t
TIME s

FIG.22

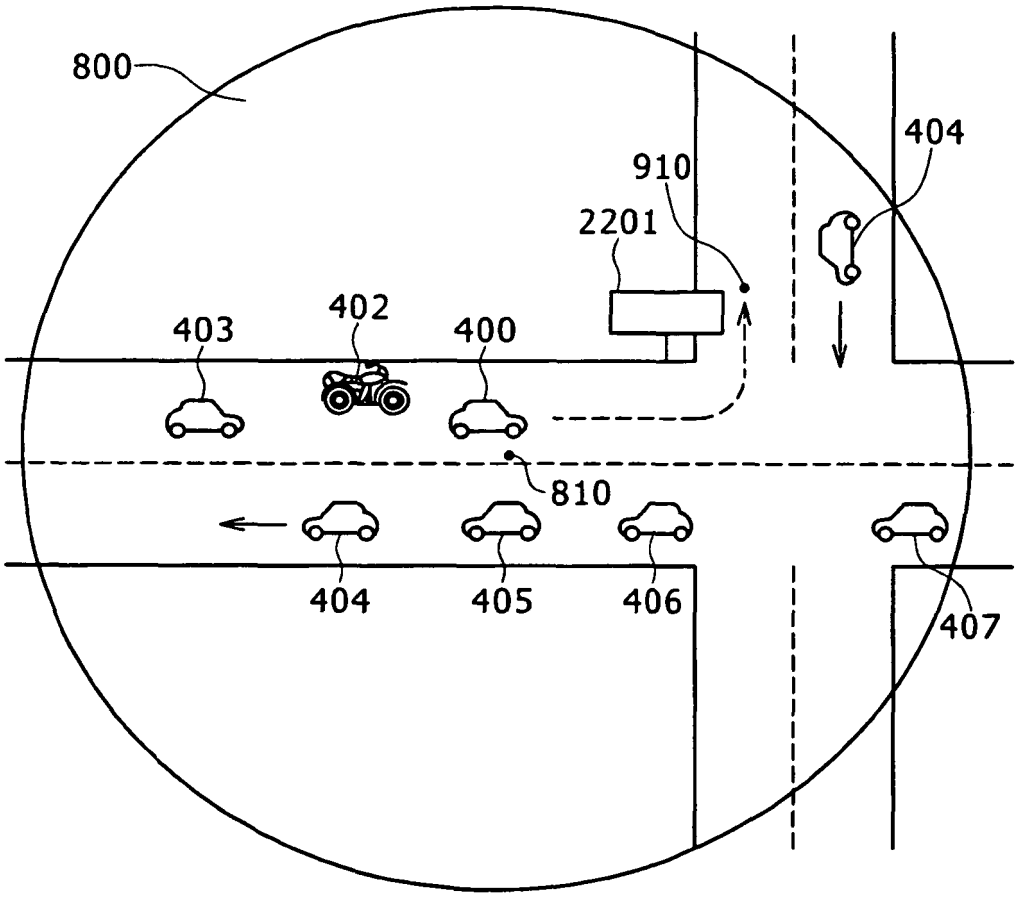


FIG.23

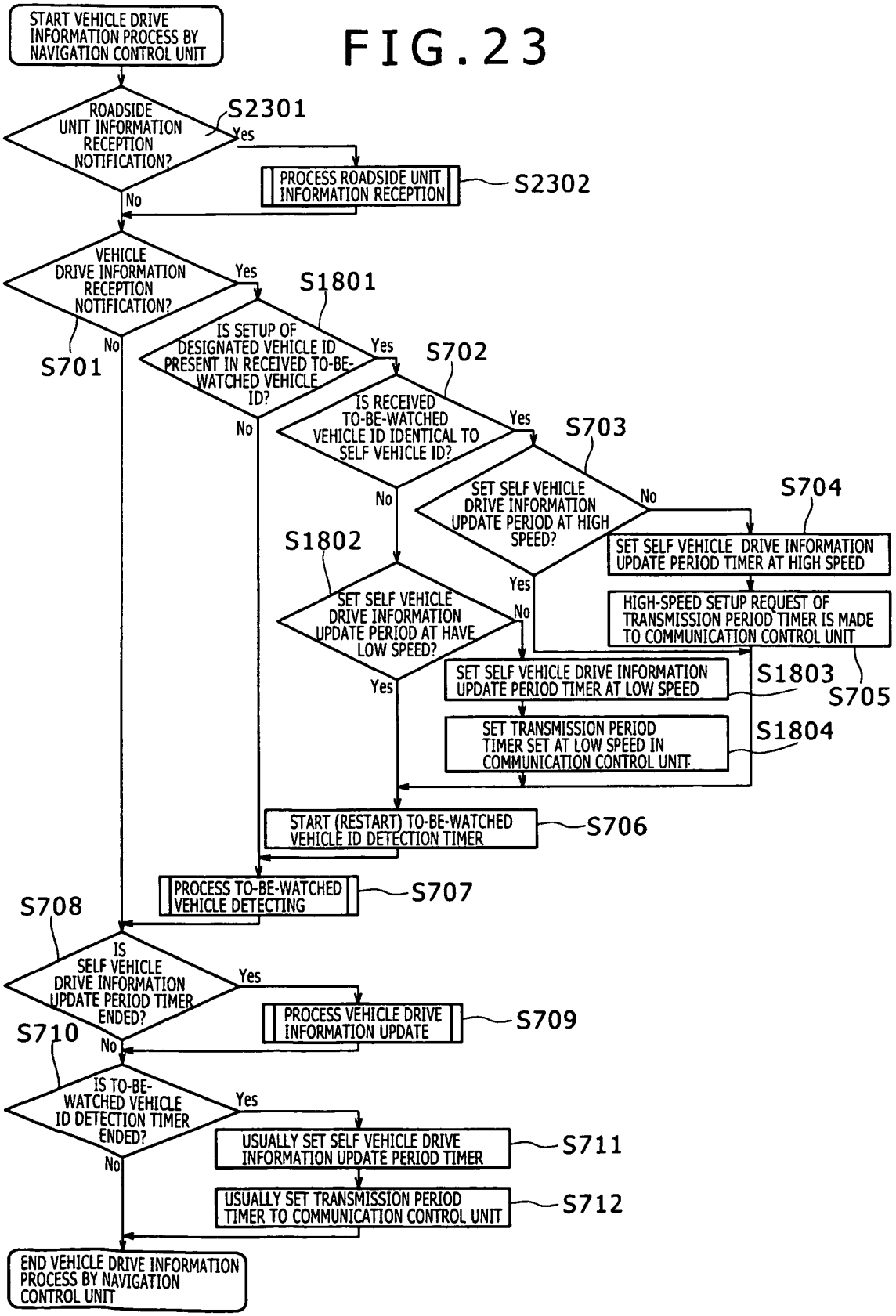

START VEHICLE DRIVE INFORMATION PROCESS BY NAVIGATION CONTROL UNIT
ROADSIDE UNIT INFORMATION RECEPTION NOTIFICATION?
S2301
Yes
No
PROCESS ROADSIDE UNIT INFORMATION RECEPTION
S2302
VEHICLE DRIVE INFORMATION RECEPTION NOTIFICATION?
Yes
No
S701
S1801
IS SETUP OF DESIGNATED VEHICLE ID PRESENT IN RECEIVED TO-BE-WATCHED VEHICLE ID?
Yes
No
S702
IS RECEIVED TO-BE-WATCHED VEHICLE ID IDENTICAL TO SELF VEHICLE ID?
Yes
No
S703
SET SELF VEHICLE DRIVE INFORMATION UPDATE PERIOD AT HIGH SPEED?
No
Yes
S704
SET SELF VEHICLE DRIVE INFORMATION UPDATE PERIOD TIMER AT HIGH SPEED
HIGH-SPEED SETUP REQUEST OF TRANSMISSION PERIOD TIMER IS MADE TO COMMUNICATION CONTROL UNIT
S1802
SET SELF VEHICLE DRIVE INFORMATION UPDATE PERIOD AT HAVE LOW SPEED?
Yes
No
SET SELF VEHICLE DRIVE INFORMATION UPDATE PERIOD TIMER AT LOW SPEED
S1803
S705
SET TRANSMISSION PERIOD TIMER SET AT LOW SPEED IN COMMUNICATION CONTROL UNIT
S1804
START (RESTART) TO-BE-WATCHED VEHICLE ID DETECTION TIMER
S706
PROCESS TO-BE-WATCHED VEHICLE DETECTING
S707
S708
IS SELF VEHICLE DRIVE INFORMATION UPDATE PERIOD TIMER ENDED?
Yes
No
PROCESS VEHICLE DRIVE INFORMATION UPDATE
S709
S710
IS TO-BE-WATCHED VEHICLE ID DETECTION TIMER ENDED?
Yes
No
USUALLY SET SELF VEHICLE DRIVE INFORMATION UPDATE PERIOD TIMER
S711
USUALLY SET TRANSMISSION PERIOD TIMER TO COMMUNICATION CONTROL UNIT
S712
END VEHICLE DRIVE INFORMATION PROCESS BY NAVIGATION CONTROL UNIT

FIG.24

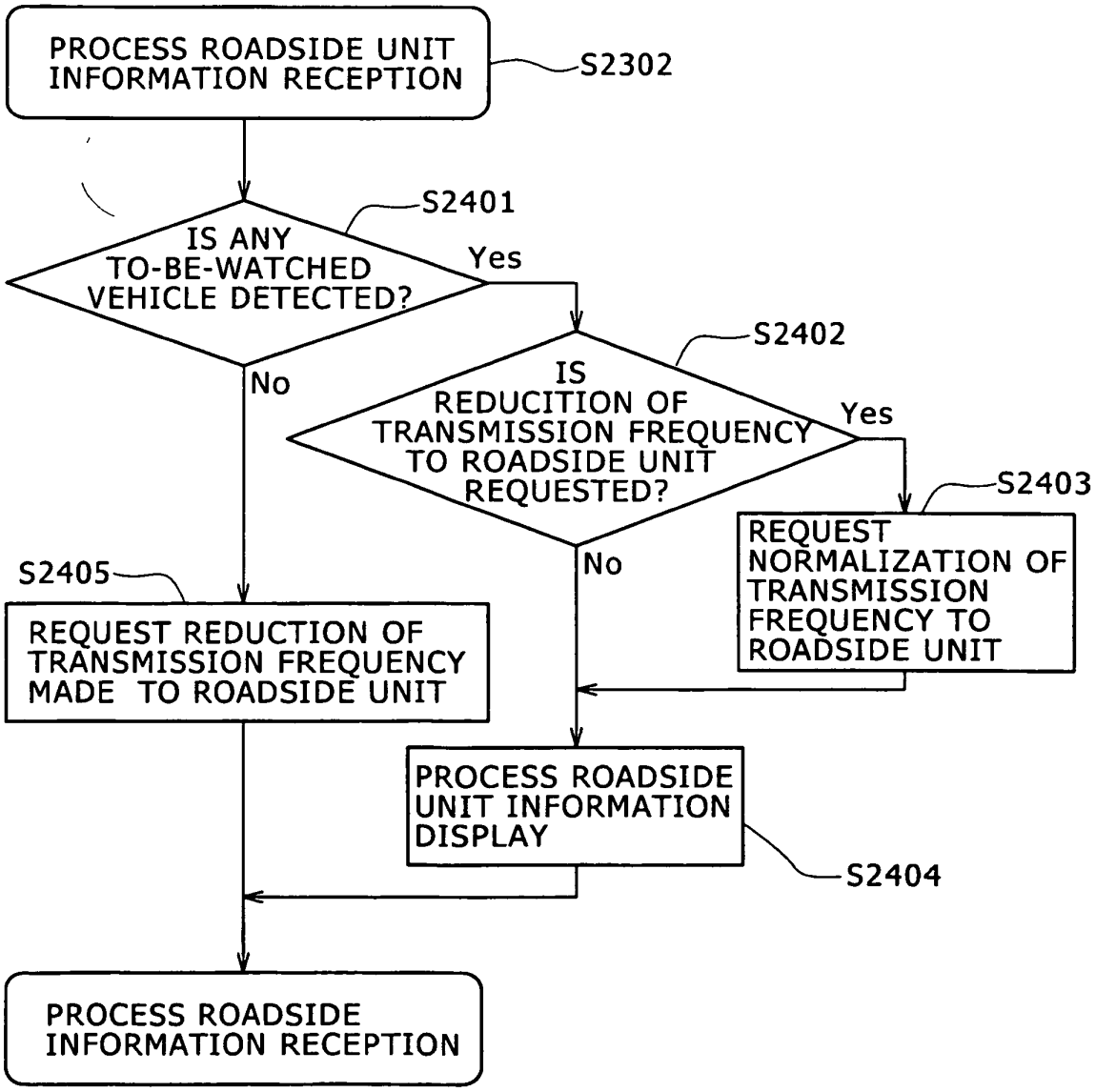

PROCESS ROADSIDE UNIT INFORMATION RECEPTION
S2302
S2401
IS ANY TO-BE-WATCHED VEHICLE DETECTED?
Yes
No
S2402
IS REDUCITION OF TRANSMISSION FREQUENCY TO ROADSIDE UNIT REQUESTED?
Yes
No
S2403
REQUEST NORMALIZATION OF TRANSMISSION FREQUENCY TO ROADSIDE UNIT
S2405
REQUEST REDUCTION OF TRANSMISSION FREQUENCY MADE TO ROADSIDE UNIT
PROCESS ROADSIDE UNIT INFORMATION DISPLAY
S2404
PROCESS ROADSIDE INFORMATION RECEPTION

FIG.25

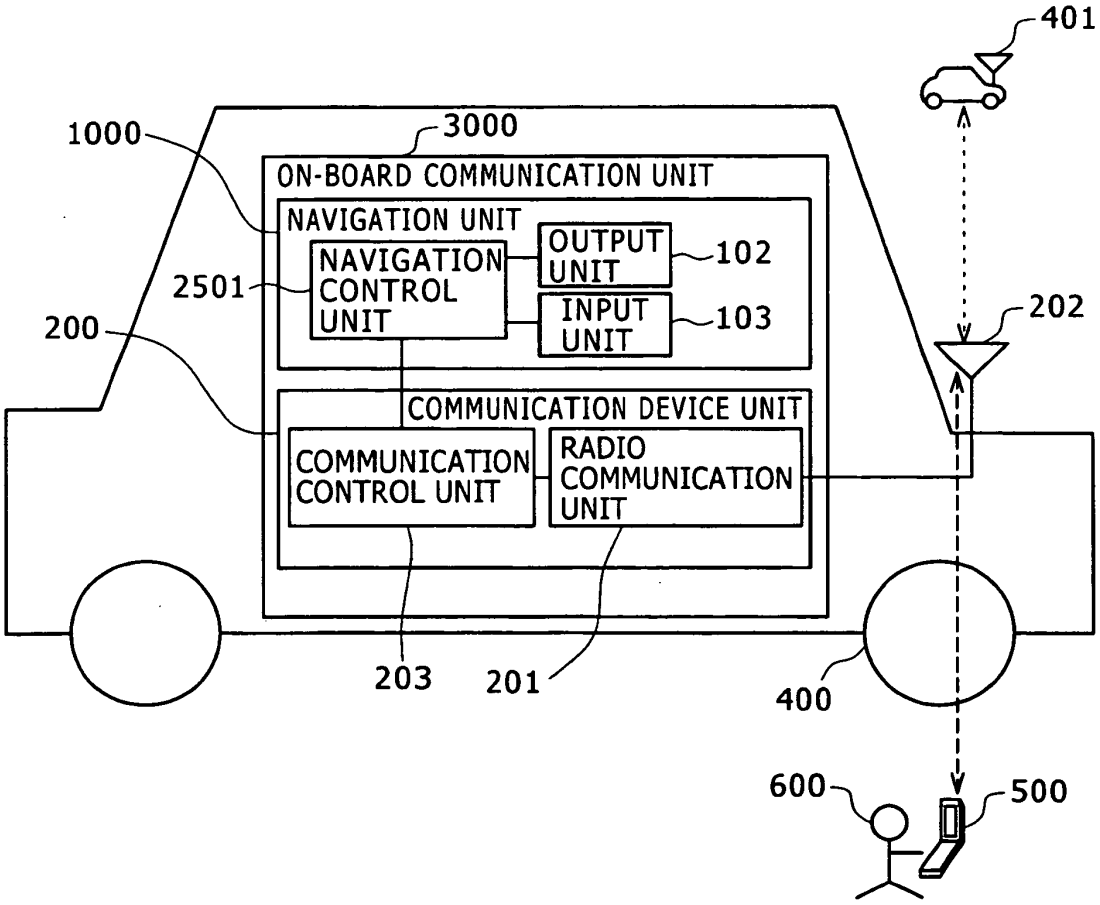

401
1000
3000
ON-BOARD COMMUNICATION UNIT
NAVIGATION UNIT
NAVIGATION CONTROL UNIT
OUTPUT UNIT
102
2501
INPUT UNIT
103
200
202
COMMUNICATION DEVICE UNIT
COMMUNICATION CONTROL UNIT
RADIO COMMUNICATION UNIT
203
201
400
600
500

FIG.26

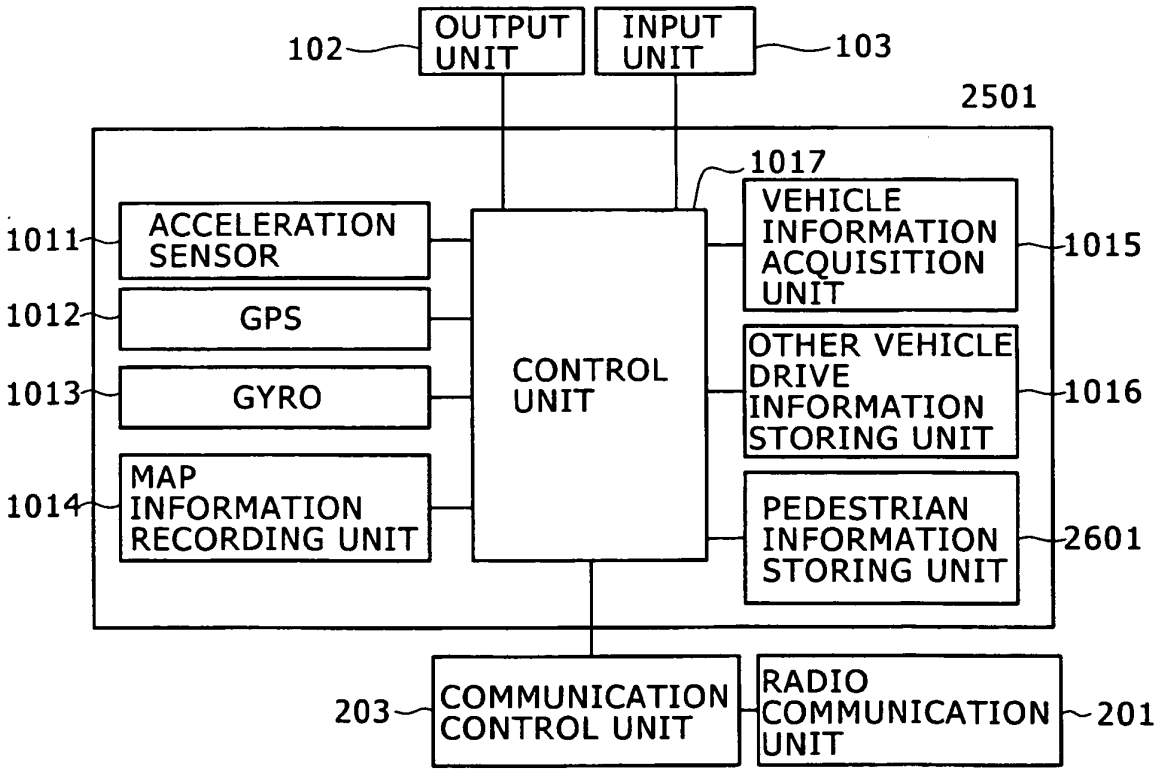

102
OUTPUT UNIT
INPUT UNIT
103
2501
1017
1011
ACCELERATION SENSOR
1012
GPS
1013
GYRO
1014
MAP INFORMATION RECORDING UNIT
CONTROL UNIT
VEHICLE INFORMATION ACQUISITION UNIT
1015
OTHER VEHICLE DRIVE INFORMATION STORING UNIT
1016
PEDESTRIAN INFORMATION STORING UNIT
2601
203
COMMUNICATION CONTROL UNIT
RADIO COMMUNICATION UNIT
201

FIG.27A

VEHICLE DRIVE INFORMATION			
DATA ITEM	DATA AMOUNT	UNIT	CONTENT
VEHICLE ID	2 bytes	–	NUMBER SPECIFYING VEHICLE (1-65535)
KIND OF VEHICLE	2 bytes	–	SET UP KIND OF SELF VEHICLE (1: NORMAL PERSON CAR, 2: TWO-WHEELED CAR, 3; LARGE-SIZE CAR, 4; OTHERS)
LATITUDE	2 bytes	DEGREE, MINUTE	
LONGITUDE	2 bytes	DEGREE, MINUTE	
ALTITUDE	1 byte	m	
VEHICULAR SPEED	1 byte	km/h	0-255km/h
ACCELERATION	1 byte		-127-+127 STEPS
DIRECTION	1 byte		16 DIRECTIONS
BRAKE	1 byte		ON:OFF
ACCELERATOR	1 byte		ON:OFF
TO-BE-WATCHED TERMINAL ID	2 bytes	–	TERMINAL ID APPROACHING DETECTED SELF VEHICLE

FIG.27B

VEHICLE DRIVE INFORMATION DATA FORMAT

VEHICLE ID 2 Bytes	KIND OF VEHICLE 2 Bytes	LATITUDE 2 Bytes	LONGITUDE 2 Bytes	ALTITUDE 2 Bytes	VEHICULAR SPEED 1 Byte	ACCELERATION 1 Byte	DIRECTION 1 Byte	BRAKE 1 Byte	ACCELERATOR 1 Byte	TO-BE-WATCHED VEHICLE ID 2 Bytes

FIG.28

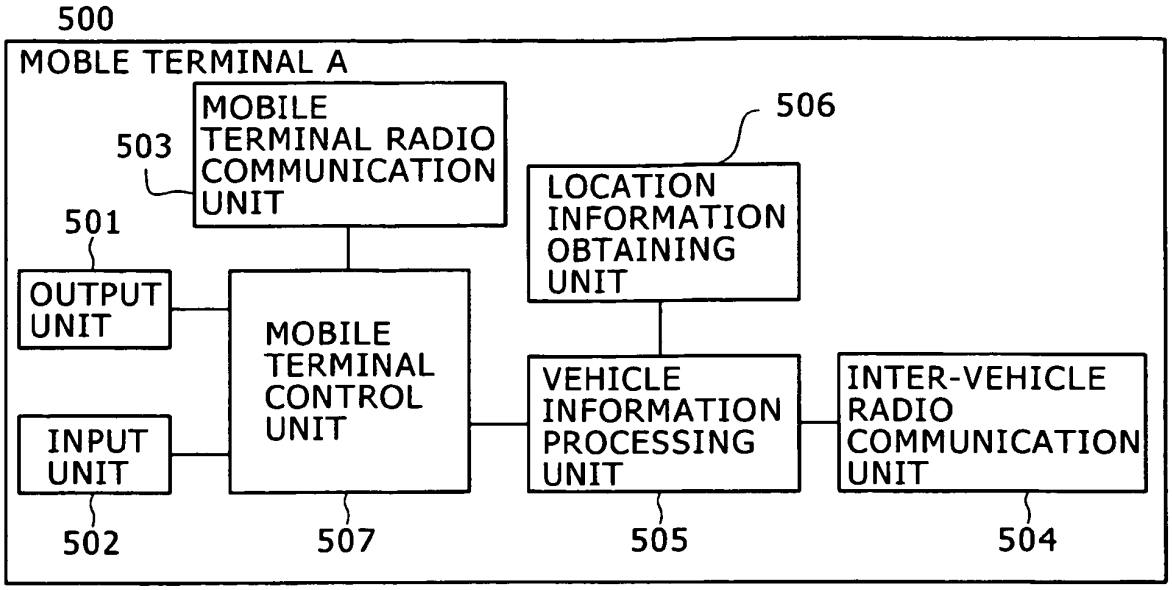


FIG.29A

PEDESTRIAN INFORMATION			
DATA ITEM	DATA AMOUNT	UNIT	CONTENT
PORTABLE ID	2 bytes	–	INTER-VEHICLE RADIO DEVICE NUMBER (1-65535) / 0: INVALID
LATITUDE	2 bytes	DEGREE, MINUTE'	
LONGITUDE	2 bytes	DEGREE, MINUTE'	
DIRECTION	1 byte		16 DIRECTIONS

FIG.29B

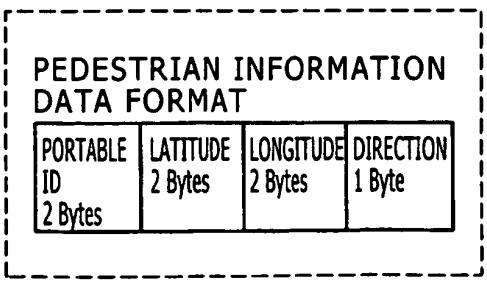


FIG.30

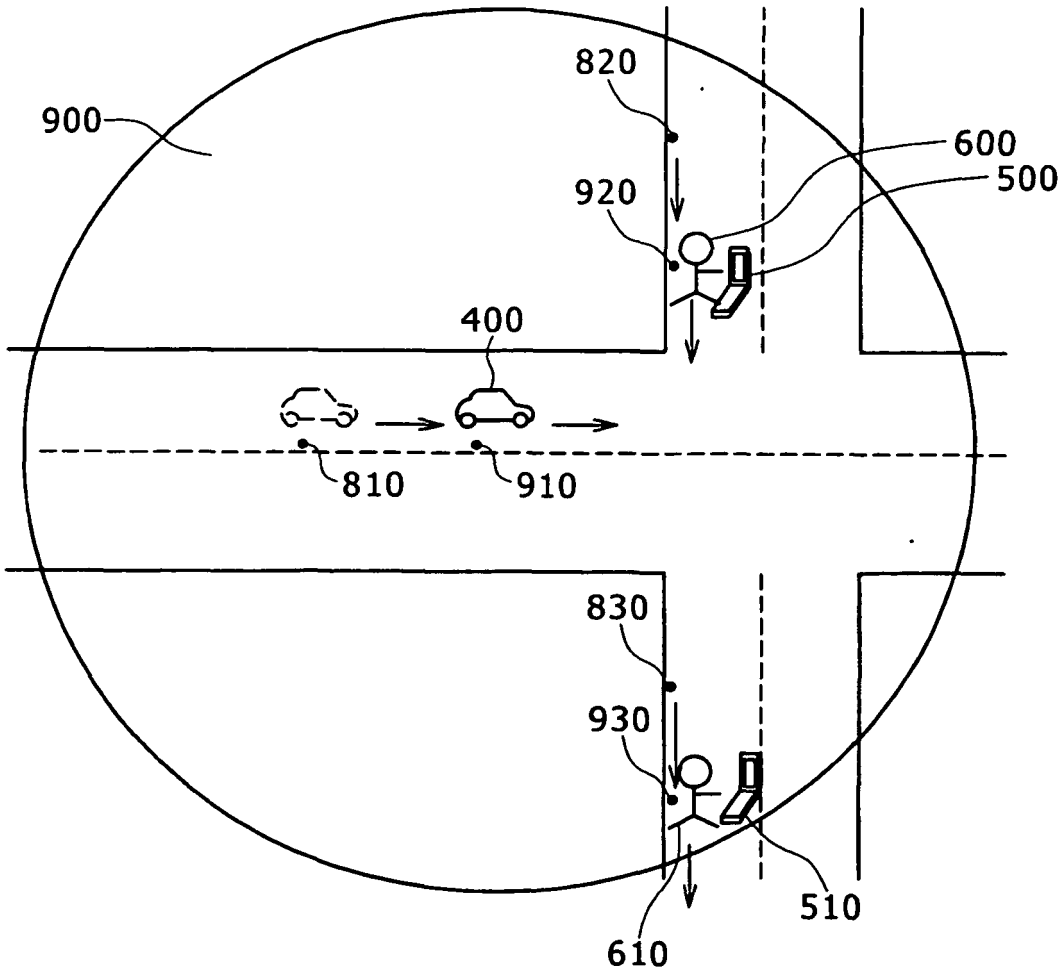


FIG.31

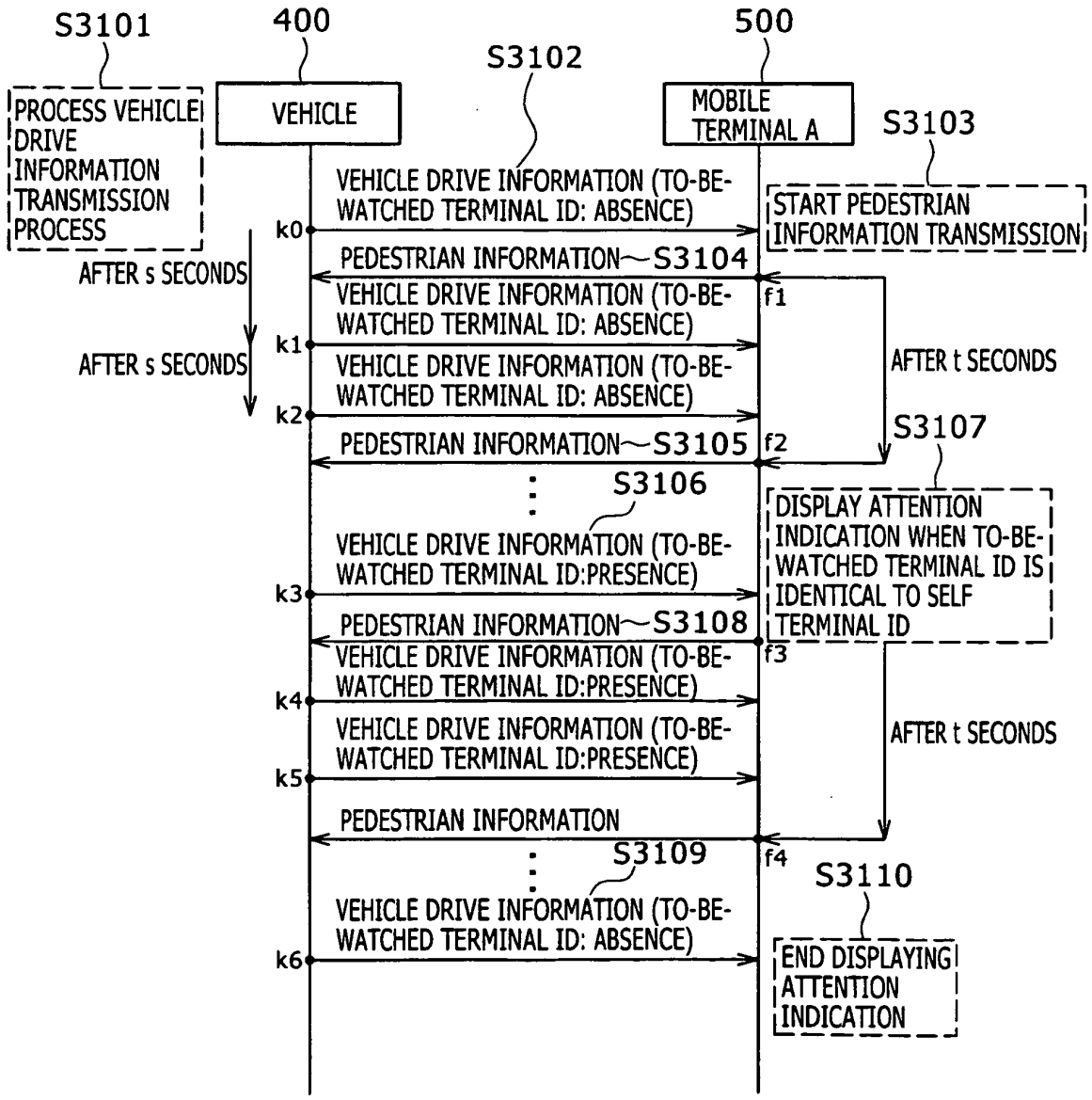

S3101
400
500
S3102
PROCESS VEHICLE DRIVE INFORMATION TRANSMISSION PROCESS
VEHICLE
MOBILE TERMINAL A
S3103
VEHICLE DRIVE INFORMATION (TO-BE-WATCHED TERMINAL ID: ABSENCE)
START PEDESTRIAN INFORMATION TRANSMISSION
k0
PEDESTRIAN INFORMATION~S3104
AFTER s SECONDS
VEHICLE DRIVE INFORMATION (TO-BE-WATCHED TERMINAL ID: ABSENCE)
f1
k1
AFTER s SECONDS
VEHICLE DRIVE INFORMATION (TO-BE-WATCHED TERMINAL ID: ABSENCE)
AFTER t SECONDS
k2
PEDESTRIAN INFORMATION~S3105
f2
S3107
S3106
DISPLAY ATTENTION INDICATION WHEN TO-BE-WATCHED TERMINAL ID IS IDENTICAL TO SELF TERMINAL ID
VEHICLE DRIVE INFORMATION (TO-BE-WATCHED TERMINAL ID:PRESENCE)
k3
PEDESTRIAN INFORMATION~S3108
f3
VEHICLE DRIVE INFORMATION (TO-BE-WATCHED TERMINAL ID:PRESENCE)
k4
VEHICLE DRIVE INFORMATION (TO-BE-WATCHED TERMINAL ID:PRESENCE)
AFTER t SECONDS
k5
PEDESTRIAN INFORMATION
f4
S3109
S3110
VEHICLE DRIVE INFORMATION (TO-BE-WATCHED TERMINAL ID: ABSENCE)
END DISPLAYING ATTENTION INDICATION
k6

FIG. 32

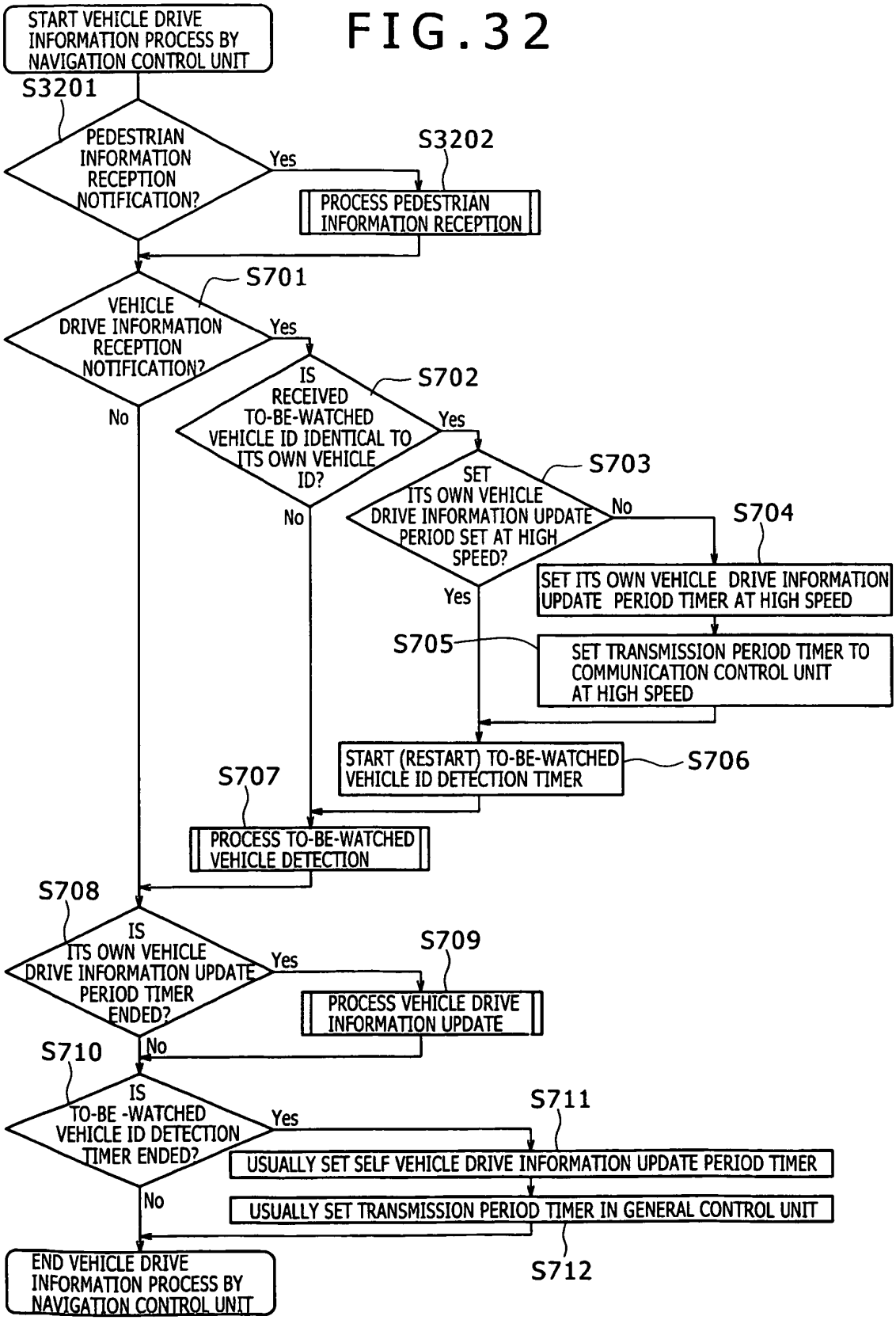

START VEHICLE DRIVE INFORMATION PROCESS BY NAVIGATION CONTROL UNIT
S3201
PEDESTRIAN INFORMATION RECEPTION NOTIFICATION?
Yes
S3202
PROCESS PEDESTRIAN INFORMATION RECEPTION
S701
VEHICLE DRIVE INFORMATION RECEPTION NOTIFICATION?
Yes
No
S702
IS RECEIVED TO-BE-WATCHED VEHICLE ID IDENTICAL TO ITS OWN VEHICLE ID?
Yes
No
S703
SET ITS OWN VEHICLE DRIVE INFORMATION UPDATE PERIOD SET AT HIGH SPEED?
No
S704
SET ITS OWN VEHICLE DRIVE INFORMATION UPDATE PERIOD TIMER AT HIGH SPEED
Yes
S705
SET TRANSMISSION PERIOD TIMER TO COMMUNICATION CONTROL UNIT AT HIGH SPEED
S706
START (RESTART) TO-BE-WATCHED VEHICLE ID DETECTION TIMER
S707
PROCESS TO-BE-WATCHED VEHICLE DETECTION
S708
IS ITS OWN VEHICLE DRIVE INFORMATION UPDATE PERIOD TIMER ENDED?
Yes
S709
PROCESS VEHICLE DRIVE INFORMATION UPDATE
No
S710
IS TO-BE -WATCHED VEHICLE ID DETECTION TIMER ENDED?
Yes
S711
USUALLY SET SELF VEHICLE DRIVE INFORMATION UPDATE PERIOD TIMER
No
USUALLY SET TRANSMISSION PERIOD TIMER IN GENERAL CONTROL UNIT
S712
END VEHICLE DRIVE INFORMATION PROCESS BY NAVIGATION CONTROL UNIT

FIG.33

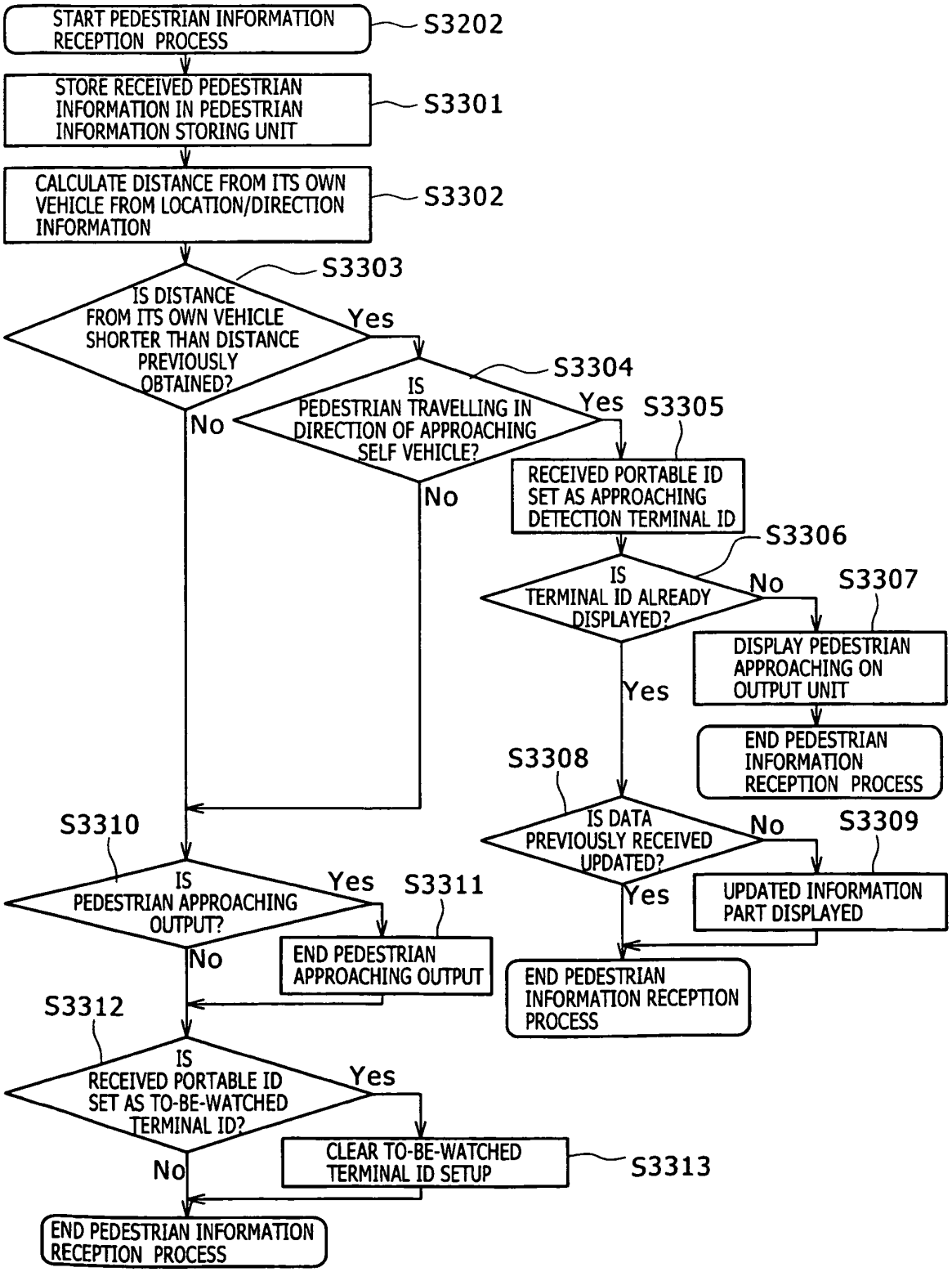
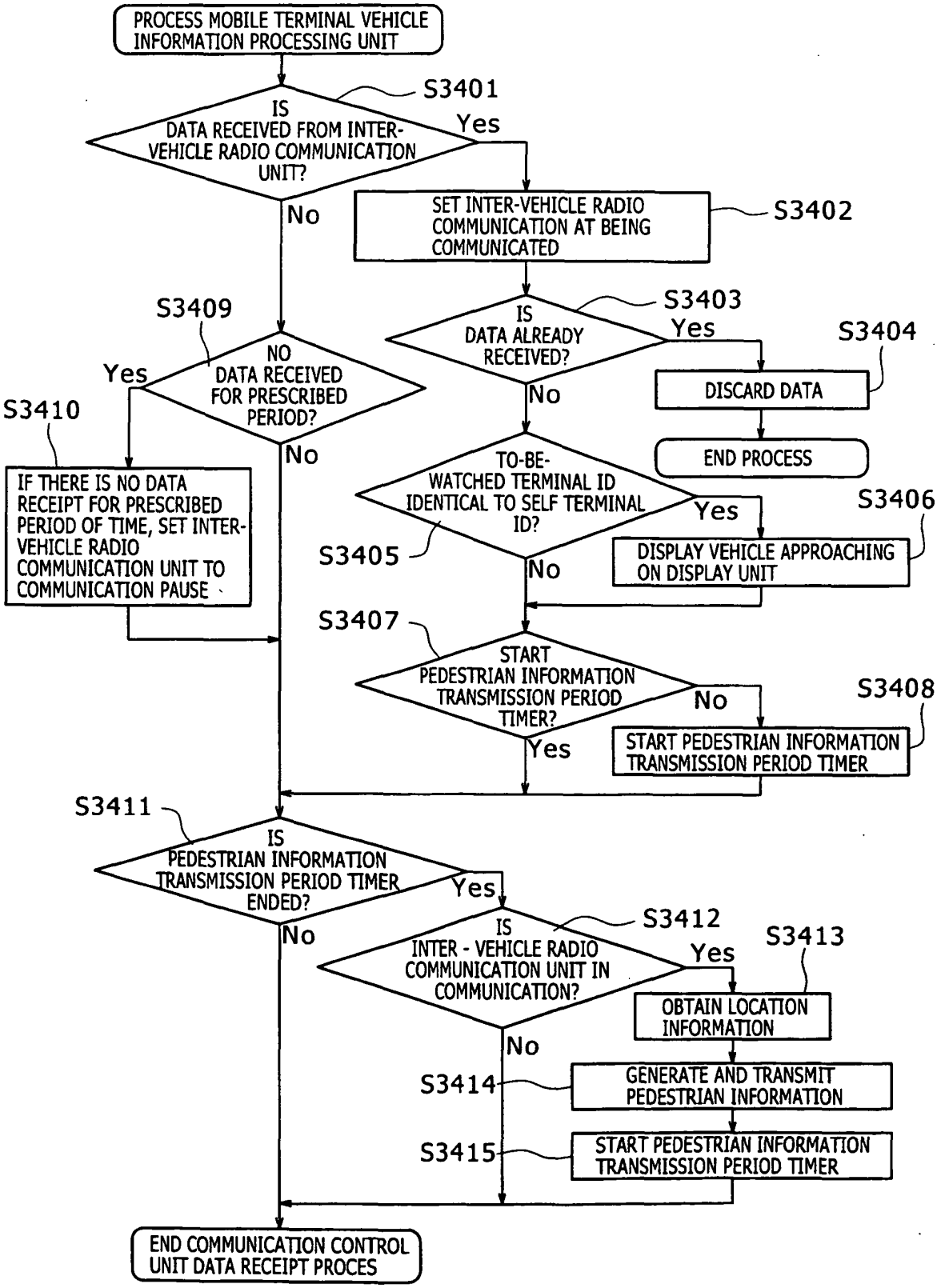

START PEDESTRIAN INFORMATION RECEPTION PROCESS
S3202
STORE RECEIVED PEDESTRIAN INFORMATION IN PEDESTRIAN INFORMATION STORING UNIT
S3301
CALCULATE DISTANCE FROM ITS OWN VEHICLE FROM LOCATION/DIRECTION INFORMATION
S3302
S3303
IS DISTANCE FROM ITS OWN VEHICLE SHORTER THAN DISTANCE PREVIOUSLY OBTAINED?
Yes
No
S3304
IS PEDESTRIAN TRAVELLING IN DIRECTION OF APPROACHING SELF VEHICLE?
Yes
No
S3305
RECEIVED PORTABLE ID SET AS APPROACHING DETECTION TERMINAL ID
S3306
IS TERMINAL ID ALREADY DISPLAYED?
No
Yes
S3307
DISPLAY PEDESTRIAN APPROACHING ON OUTPUT UNIT
END PEDESTRIAN INFORMATION RECEPTION PROCESS
S3308
IS DATA PREVIOUSLY RECEIVED UPDATED?
No
Yes
S3309
UPDATED INFORMATION PART DISPLAYED
END PEDESTRIAN INFORMATION RECEPTION PROCESS
S3310
IS PEDESTRIAN APPROACHING OUTPUT?
Yes
No
S3311
END PEDESTRIAN APPROACHING OUTPUT
S3312
IS RECEIVED PORTABLE ID SET AS TO-BE-WATCHED TERMINAL ID?
Yes
No
CLEAR TO-BE-WATCHED TERMINAL ID SETUP
S3313
END PEDESTRIAN INFORMATION RECEPTION PROCESS

FIG. 34


PROCESS MOBILE TERMINAL VEHICLE INFORMATION PROCESSING UNIT
S3401
IS DATA RECEIVED FROM INTER-VEHICLE RADIO COMMUNICATION UNIT?
Yes
No
SET INTER-VEHICLE RADIO COMMUNICATION AT BEING COMMUNICATED
S3402
S3403
IS DATA ALREADY RECEIVED?
Yes
S3404
DISCARD DATA
END PROCESS
No
S3409
NO DATA RECEIVED FOR PRESCRIBED PERIOD?
Yes
No
S3410
IF THERE IS NO DATA RECEIPT FOR PRESCRIBED PERIOD OF TIME, SET INTER-VEHICLE RADIO COMMUNICATION UNIT TO COMMUNICATION PAUSE
TO-BE-WATCHED TERMINAL ID IDENTICAL TO SELF TERMINAL ID?
Yes
S3406
DISPLAY VEHICLE APPROACHING ON DISPLAY UNIT
S3405
No
S3407
START PEDESTRIAN INFORMATION TRANSMISSION PERIOD TIMER?
No
S3408
START PEDESTRIAN INFORMATION TRANSMISSION PERIOD TIMER
Yes
S3411
IS PEDESTRIAN INFORMATION TRANSMISSION PERIOD TIMER ENDED?
Yes
No
S3412
IS INTER - VEHICLE RADIO COMMUNICATION UNIT IN COMMUNICATION?
Yes
S3413
OBTAIN LOCATION INFORMATION
No
S3414
GENERATE AND TRANSMIT PEDESTRIAN INFORMATION
S3415
START PEDESTRIAN INFORMATION TRANSMISSION PERIOD TIMER
END COMMUNICATION CONTROL UNIT DATA RECEIPT PROCES

REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- JP H111999195196 A **[0002]**
- JP 2004220143 A **[0002] [0004] [0006]**
- JP H111990195196 A **[0003]**
- JP H11199019519 A **[0005]**
- US 20050073438 A1 **[0007]**