

[DESCRIPTION]

[TITLE OF INVENTION]

ON-VEHICLE DEVICE, VEHICLE, DISCONNECTION DETECTION METHOD,
AND PROGRAM

5 [Technical Field]

[0001]

The present invention relates to an on-vehicle device, a vehicle, a disconnection detection method, and a program.

[Background Art]

10 [0002]

A technique for an on-vehicle device mounted in a vehicle to acquire probe information including information related to traveling such as the traveling position, speed, acceleration, or the like of the vehicle is known.

[0003]

15 The probe information acquired by the on-vehicle device is collected by a center server or the like and is used for various purposes.

For example, Patent Document 1 discloses a charging system that determines whether a vehicle has traveled in a charge area (an area or a road which is a charging target) on the basis of probe information collected by a center server and charges the
20 vehicle.

In addition, as another example, a driving evaluation system that detects the sudden start, sudden braking, excessive speed, or the like of a vehicle on the basis of probe information collected by the center server and evaluates whether a driver of the vehicle has performed safe driving or economic driving (environmentally friendly
25 driving) can be considered. Further, a system in which the center server performs

business management by aggregating the travel route, traveling distance, traveling time, fare, or the like of a taxi on the basis of probe information collected from an on-vehicle device mounted in the taxi can be considered.

[Citation List]

5 [Patent Literature]

[0004]

[Patent Document 1]

Japanese Unexamined Patent Application, First Publication No. 2010-198571

[Summary of Invention]

10 [Technical Problem]

[0005]

An on-vehicle device is activated when it receives an input of an activation signal of a vehicle (for example, a signal indicating ON of an ignition (IGCT) switch), and continues to execute a process of acquiring probe information and transmitting it to a center server. In addition, when an input of a stop signal of the vehicle (for example, a signal indicating OFF of the IGCT switch) is received, various processes including a process of acquiring and transmitting probe information are ended, and the vehicle enters an inactivated state.

[0006]

20 However, in a case where an input line for inputting the activation signal of a vehicle to the on-vehicle device is disconnected due to a failure or is not connected due to a wrongful action, the on-vehicle device will not be activated even if the vehicle outputs the activation signal. Then, for example, even in a case where a vehicle travels in a charge area, the center server cannot collect probe information from the on-vehicle device of the vehicle, and thus there is a possibility of not being able to charge the

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vehicle correctly. In addition, similarly, in a case where there is a period for which the on-vehicle device is not activated while the vehicle is traveling, there is a possibility of the center server not being able to correctly perform various processes such as driving evaluation based on probe information or business management of a taxi.

5 [Solution to Problem]

[0007]

In order to solve the above problem, the present invention adopts the following means.

According to a first aspect of the present invention, there is provided an
10 on-vehicle device (20) including: an activation determination unit (210) that is configured to determine whether an activation signal of a vehicle (10) is input through an input line (L1); a motion determination unit (211) that is configured to determine whether the vehicle is moving on the basis of a detection signal which is received from a detection sensor capable of detecting a motion of the vehicle (10); and a determination
15 unit (212) that is configured to determine that the input line (L1) is disconnected in a case where it is determined that the activation signal is not input and it is determined that the vehicle (10) is moving.

In this manner, the on-vehicle device can detect that a failure such as disconnection or poor contact occurs in the input line or the input line is not connected to
20 the on-vehicle device due to a wrongful action.

[0008]

According to a second aspect of the present invention, in the on-vehicle device (20) according to the first aspect, in a case where it is determined that the input line (L1) is disconnected, the determination unit (212) is configured to store information indicating
25 the disconnection of the input line (L1) in a storage unit (25).

In this manner, by storing the input line being disconnected, it is possible to prevent a user (such as a driver of a vehicle) from performing a wrongful action such as intentional disconnection of the input line.

[0009]

- 5 According to a third aspect of the present invention, the on-vehicle device (20) according to the first or second aspect further includes a notification processing unit (213) that, in a case where it is determined that the input line (L1) is disconnected, is configured to notify of information indicating the disconnection of the input line (L1) and identification information from which the vehicle (10) is able to be specified in
- 10 association with each other.

In this manner, by notifying that the input line is disconnected, the on-vehicle device can cause a user or the like to recognize the disconnection of the input line due to a failure, and can prevent the user from performing a wrongful action such as intentional disconnection of the input line.

15 [0010]

- According to a fourth aspect of the present invention, the on-vehicle device (20) according to any one of the first to third aspects further includes a satellite signal reception unit (23) that, as the detection sensor, is configured to specify a position of the vehicle (10) on the basis of a signal received from a satellite and output the specified
- 20 position as the detection signal, and the motion determination unit (211) is configured to compare the detection signals which are continuous in time series and determines whether the vehicle (10) is moving.

In this manner, the motion determination unit can determine whether the vehicle is moving on the basis of a signal received from a satellite.

25 [0011]

According to a fifth aspect of the present invention, the on-vehicle device (20) according to any one of the first to third aspects further includes a gyro sensor (27) that, as the detection sensor, is configured to measure an angular velocity of the vehicle (10) and output the measured angular velocity as the detection signal, and the motion determination unit (211) is configured to compare the detection signals which are continuous in time series and determines whether the vehicle (10) is moving.

In this manner, the motion determination unit can determine whether the vehicle is moving on the basis of the angular velocity measured by the gyro sensor.

[0012]

According to a sixth aspect of the present invention, the on-vehicle device (20) according to any one of the first to third aspects further includes an acceleration sensor (28) that, as the detection sensor, is configured to measure an acceleration of the vehicle (10) and output the measured acceleration as the detection signal, and the motion determination unit (211) is configured to compare the detection signals which are continuous in time series and determines whether the vehicle (10) is moving.

In this manner, the motion determination unit can determine whether the vehicle is moving on the basis of the acceleration measured by the acceleration sensor.

[0013]

According to a seventh aspect of the present invention, the on-vehicle device (20) according to any one of the first to third aspects further includes a broadband communication unit (24) that, as the detection sensor, is configured to perform broadband communication through a base station and output a base station ID from which the base station is able to be identified as the detection signal, and the motion determination unit (211) is configured to determine that the vehicle (10) is moving in a case where the base station ID changes on the basis of the detection signals which are continuous in time

series.

In this manner, the motion determination unit can determine whether the vehicle is moving on the basis of the base station ID acquired by the broadband communication unit.

5 [0014]

According to an eighth aspect of the present invention, the on-vehicle device (20) according to any one of the first to third aspects further includes a detection signal acquisition unit (29) that is configured to receive a detection signal which is output from the detection sensor (13) provided in the vehicle (10) and includes at least one of a
 10 traveling distance, an ignition state, a speed, an acceleration, an angular velocity, and a steering angle of the vehicle (10), and the motion determination unit (211) is configured to compare the detection signals which are continuous in time series and determines whether the vehicle (10) is moving.

In this manner, the motion determination unit can determine whether the vehicle
 15 is moving on the basis of the detection signal which is output from the detection sensor provided in advance in the vehicle.

[0015]

According to a ninth aspect of the present invention, there is provided a vehicle (10) including: an activation determination unit (210) that is configured to determine
 20 whether an activation signal of the vehicle (10) is input through an input line (L1); a motion determination unit (211) that is configured to determine whether the vehicle (10) is moving on the basis of a detection signal which is received from a detection sensor capable of detecting a motion of the vehicle (10); and a determination unit (212) that is configured to determine that the input line (L1) is disconnected in a case where it is
 25 determined that the activation signal is not input and it is determined that the vehicle (10)

is moving.

[0016]

According to a tenth aspect of the present invention, there is provided a disconnection detection method including: an activation determination step of
 5 determining whether an activation signal of a vehicle (10) is input through an input line (L1); a motion determination step of determining whether the vehicle (10) is moving on the basis of a detection signal which is received from a detection sensor capable of detecting a motion of the vehicle (10); and a determination step of determining that the input line (L1) is disconnected in a case where it is determined that the activation signal
 10 is not input and it is determined that the vehicle is moving.

[0017]

According to an eleventh aspect of the present invention, there is provided a program causing a computer of an on-vehicle device (20) mounted in a vehicle to function, a program causing the computer to execute: an activation determination step of
 15 determining whether an activation signal of a vehicle (10) is input through an input line (L1); a motion determination step of determining whether the vehicle (10) is moving on the basis of a detection signal which is received from a detection sensor capable of detecting a motion of the vehicle (10); and a determination step of determining that the input line (L1) is disconnected in a case where it is determined that the activation signal
 20 is not input and it is determined that the vehicle (10) is moving.

[Advantageous Effects of Invention]

[0018]

According to the on-vehicle device, the vehicle, the disconnection detection method, and the program described above, it is possible to detect the disconnection of the
 25 input line for inputting the activation signal of the vehicle.

[Brief Description of Drawings]

[0019]

Fig. 1 is a diagram showing an outline of a disconnection detection system according to a first embodiment of the present invention.

5 Fig. 2 is a diagram showing a functional configuration of the disconnection detection system according to the first embodiment of the present invention.

Fig. 3 is a first flowchart showing an example of processing of the disconnection detection system according to the first embodiment of the present invention.

Fig. 4 is a second flowchart showing an example of processing of the
10 disconnection detection system according to the first embodiment of the present invention.

Fig. 5 is a diagram showing an example of disconnection detection information according to the first embodiment of the present invention.

Fig. 6 is a diagram showing a functional configuration of a disconnection
15 detection system according to a second embodiment of the present invention.

Fig. 7 is a diagram showing a functional configuration of a disconnection detection system according to a third embodiment of the present invention.

Fig. 8 is a diagram showing a functional configuration of a disconnection detection system according to a fourth embodiment of the present invention.

20 Fig. 9 is a diagram showing a functional configuration of a disconnection detection system according to a fifth embodiment of the present invention.

Fig. 10 is a diagram showing an example of a hardware configuration of an on-vehicle device according to at least one embodiment of the present invention.

[Description of Embodiments]

25 [0020]

<First embodiment>

Hereinafter, a disconnection detection system 1 according to a first embodiment of the present invention will be described with reference to Figs. 1 to 5.

[0021]

5 (Overall configuration)

Fig. 1 is a diagram showing an outline of a disconnection detection system according to the first embodiment of the present invention.

As shown in Fig. 1, the disconnection detection system 1 includes a vehicle 10, an on-vehicle device 20 mounted in the vehicle 10, and a center server 30.

10 Meanwhile, in the example of Fig. 1, one vehicle 10 and one center server 30 are shown, but there is no limitation thereto. The disconnection detection system 1 may include a plurality of vehicles 10 and a plurality of center servers 30.

[0022]

The vehicle 10 includes an ignition (IGCT) switch 11 and a battery 12.

15 The IGCT switch 11 turns an ignition signal to “ON” when an ON operation is performed by a driver. In addition, the IGCT switch 11 turns the ignition signal to “OFF” when an OFF operation is performed by the driver. The ignition signal is input to the on-vehicle device 20 through an input line L1.

The battery 12 is connected to the on-vehicle device 20 through a power supply
20 line L2 to supply power for the on-vehicle device 20 to operate.

[0023]

The on-vehicle device 20 performs activation or stop (sleep) on the basis of the ignition signal which is input from the IGCT switch 11 through the input line L1.

In the present embodiment, when the ignition signal is “ON,” the on-vehicle
25 device 20 determines that an activation signal has been input and performs activation.

On the other hand, when the ignition signal is “OFF,” the on-vehicle device 20 determines that the activation signal is not input and stops (sleeps).

In addition, the on-vehicle device 20 acquires probe information including information related to traveling of the vehicle 10 during activation and transmits it to the center server 30. The probe information includes, for example, identification information from which the vehicle 10 can be specified, the traveling position (latitude, longitude), speed, traveling direction, acceleration, and angular velocity of the vehicle 10, or the like. The identification information from which the vehicle 10 can be specified is, for example, license plate information (such as a classification number or a vehicle number) of the vehicle 10, an on-vehicle device ID of the on-vehicle device 20 mounted in the vehicle 10, or the like.

[0024]

The center server 30 collects the probe information from the on-vehicle device 20 through a broadband communication network NW, and executes various processes based on the probe information.

In the present embodiment, for example, the center server 30 is assumed to execute a process of charging the vehicle 10 which has traveled in a charge area on the basis of the probe information. Specifically, the center server 30 determines whether the vehicle 10 has traveled in a charge area on the basis of the traveling position of the vehicle 10 included in the probe information and map information from which a region or a road which is set as the charge area can be specified. The center server 30 charges a predetermined usage fee to the vehicle 10 having traveled in the charge area.

[0025]

(Functional configuration)

Fig. 2 is a diagram showing a functional configuration of the disconnection

detection system according to the first embodiment of the present invention.

As shown in Fig. 2, the on-vehicle device 20 includes a disconnection detection unit 21, a power supply control unit 22, a satellite signal reception unit 23, a broadband communication unit 24, a storage unit 25, and a CPU 26.

5 [0026]

The disconnection detection unit 21 detects the presence or absence of disconnection of the input line L1 to which the activation signal (ignition signal = ON) is input from the IGCT switch 11 of the vehicle 10.

The disconnection detection unit 21 includes an activation determination unit
10 210, a motion determination unit 211, a determination unit 212, and a notification processing unit 213.

[0027]

The activation determination unit 210 determines whether the activation signal of the vehicle 10 is input to the on-vehicle device 20.

15 [0028]

The motion determination unit 211 determines whether the vehicle 10 is moving on the basis of a detection signal which is received from a detection sensor capable of detecting the motion of the vehicle 10.

[0029]

20 The determination unit 212 determines that the input line L1 is disconnected in a case where the activation determination unit 210 determines that the activation signal is not input and the motion determination unit 211 determines that the vehicle 10 is moving. In addition, in a case where it is determined that the input line L1 is disconnected, the determination unit 212 stores information (a disconnection log) indicating the
25 disconnection of the input line L1 in the storage unit 25. The disconnection log

includes, for example, the date and time when the disconnection is detected, the content of detection (information indicating “disconnection of the input line L1”), or the like.

[0030]

In a case where it is determined that the input line L1 is disconnected, the notification processing unit 213 notifies the center server 30 of “disconnection detection information D1 (Fig. 5)” in which the information (a disconnection log) indicating the disconnection of the input line L1 and the identification information from which the vehicle 10 can be specified are associated with each other.

[0031]

10 The power supply control unit 22 controls the power supply ON and power supply OFF of the on-vehicle device 20 on the basis of the ignition signal which is input from the IGCT switch 11 of the vehicle 10.

Specifically, when the activation signal (ignition signal = ON) is input, the power supply control unit 22 starts supplying power to the CPU 26 from the battery 12 of the vehicle 10 to turn the power supply of the on-vehicle device 20 ON.

In addition, in a case where the activation signal is no longer input from the IGCT switch 11 of the vehicle 10 (ignition signal = OFF), the power supply control unit 22 stops supplying power to the CPU 26 to turn the power supply of the on-vehicle device 20 OFF.

20 The power supply control unit 22 always supplies minimum necessary power from the battery 12 to components required for detecting the presence or absence of disconnection of the input line L1. In the present embodiment, when the power supply of the on-vehicle device 20 is turned OFF, the power supply control unit 22 is assumed to supply minimum necessary power, for example, to the disconnection detection unit 21, a detection sensor (the satellite signal reception unit 23), and the broadband

25

communication unit 24, and not to supply power to other components.

[0032]

The satellite signal reception unit 23 receives a satellite signal from which positional information (latitude, longitude) of the vehicle 10 can be detected from a satellite constituting a global navigation satellite system (GNSS). The satellite signal may include a signal from which the current date and time can be detected.

In addition, in the present embodiment, the satellite signal reception unit 23 functions as a detection sensor capable of detecting the motion of the vehicle 10. The satellite signal reception unit 23 outputs the positional information of the vehicle 10 specified on the basis of the satellite signal as a detection signal to the disconnection detection unit 21.

[0033]

The broadband communication unit 24 uses a base station of a data communication terminal (such as a cellular phone) to communicate with the center server 30 through the broadband communication network NW that connects various devices which are present in remote locations.

[0034]

The storage unit 25 is a non-volatile storage device, and stores probe information, a disconnection log of the input line L1, or the like. In addition, the storage unit 25 stores various programs or the like to be executed by the CPU 26 in advance.

[0035]

The CPU 26 is a central processing unit that takes charge of the overall operation of the on-vehicle device 20. The CPU 26 is activated when power is supplied through the power supply control unit 22, and executes various functions in accordance

with a program stored in the storage unit 25.

Meanwhile, in the present embodiment, the CPU 26 is assumed to execute a process of acquiring probe information and transmitting it to the center server 30 in accordance with a program stored in advance.

5 [0036]

(Process flow)

Fig. 3 is a first flowchart showing an example of processing of the disconnection detection system according to the first embodiment of the present invention.

Fig. 4 is a second flowchart showing an example of processing of the
10 disconnection detection system according to the first embodiment of the present invention.

Hereinafter, an example of a process in which the disconnection detection unit 21 of the on-vehicle device 20 detects the presence or absence of disconnection of the input line L1 will be described with reference to Figs. 3 to 4.

15 First, the determination unit 212 initializes a disconnection detection flag of the input line L1 (FLAG=0) before monitoring the presence or absence of disconnection of the input line L1 (step S10). For example, the determination unit 212 initializes the disconnection detection flag when the power supply of the on-vehicle device 20 is turned OFF.

20 [0037]

Next, the determination unit 212 starts a monitoring loop for monitoring the presence or absence of disconnection of the input line L1 (step S11). In this monitoring loop, the activation determination unit 210 constantly monitors the presence or absence of input of the activation signal from the IGCT switch 11. The determination unit 212
25 repeatedly executes the following steps S12 to S14 while the activation determination

unit 210 determines that the activation signal is not input and the disconnection detection flag is in an initial state (FLAG=0).

[0038]

The motion determination unit 211 acquires a detection signal from the detection
5 sensor at predetermined intervals (for example, ten minutes) (step S12).

In the present embodiment, the motion determination unit 211 acquires
positional information of the vehicle 10 as a detection signal from the satellite signal
reception unit 23.

[0039]

10 Next, the motion determination unit 211 determines whether the vehicle 10 is
moving on the basis of the positional information which is continuous in time series (step
S13).

Specifically, the motion determination unit 211 compares latest positional
information acquired in step S12 with previously acquired positional information. In a
15 case where the position of the vehicle 10 changes by a predetermined distance (for
example, 10 m) or more, the motion determination unit 211 determines that the vehicle
10 is moving (step S13: YES). On the other hand, in a case where the position of the
vehicle 10 does not change by a predetermined distance or more, the motion
determination unit 211 determines that the vehicle 10 is not moving (step S13: NO).

20 [0040]

Next, in a case where the motion determination unit 211 determines that the
vehicle 10 is moving (step S13: YES), the determination unit 212 determines that the
input line L1 is disconnected and sets the disconnection detection flag to be ON
(FLAG=1) (step S14).

25 [0041]

In addition, in a case where the motion determination unit 211 determines that the vehicle 10 is not moving (step S13: NO), the determination unit 212 stands by without performing the process.

[0042]

5 Next, the determination unit 212 checks the end condition of the monitoring loop (step S15). In a case where the activation signal is input or a case where the disconnection detection flag is set to be ON (FLAG=1), the determination unit 212 exits the monitoring loop, and proceeds to the processing of Fig. 4. On the other hand, in a case where the activation signal is not input and the disconnection detection flag remains
10 OFF (FLAG=0), the determination unit 212 returns to step S12, and repeatedly executes the above-described steps.

[0043]

 Next, in a case where the disconnection of the input line L1 is detected (FLAG=1) after exiting the monitoring loop (step S16: YES), the determination unit 212
15 stores a disconnection log indicating the disconnection of the input line L1 in the storage unit 25 (step S17).

[0044]

 In addition, in a case where the disconnection of the input line L1 is detected (FLAG=1) (step S16: YES), the notification processing unit 213 notifies the center server
20 30 of the “disconnection detection information D1 (Fig. 5)” in which information (a disconnection log) indicating the disconnection of the input line L1 and identification information from which the vehicle 10 can be specified are associated with each other (step S18).

 Fig. 5 is a diagram showing an example of disconnection detection information
25 according to the first embodiment of the present invention.

As shown in Fig. 5, the disconnection detection information D1 includes “identification information,” “date and time of detection” when the disconnection of the input line L1 is detected, and “content of detection.” The identification information may be any information insofar as it enables the vehicle 10 to be specified, and is, for example, license plate information (such as a classification number or a vehicle number) of the vehicle 10, an on-vehicle device ID of the on-vehicle device 20 mounted in the vehicle 10, or the like. In addition, the “content of detection” is information indicating “disconnection of the input line L1,” and may be text information, or may be an error code specified in advance between the center server 30 and the vehicle.

10 [0045]

In addition, returning to the description of Fig. 4, in a case where the disconnection of the input line L1 is not detected (FLAG=0) (step S16: NO), the activation signal is input from the IGCT switch 11, and thus the power supply of the on-vehicle device 20 is turned ON by the power supply control unit 22 (step S19).

15 [0046]

The on-vehicle device 20 repeatedly executes the processing shown in Figs. 3 and 4 every time the power supply is turned OFF, and monitors the presence or absence of disconnection of the input line L1.

Meanwhile, in the example of Fig. 4, the notification processing unit 213
20 notifies the center server 30 of the disconnection detection information D1 every time the disconnection of the input line L1 is detected, but there is no limitation thereto. In another embodiment, the notification processing unit 213 may notify the center server 30 of the disconnection detection information D1 in a case where a disconnection log is stored in the storage unit 25 at a timing when a predetermined time (for example, one
25 day) has elapsed or at a timing when the power supply of the on-vehicle device 20 is

turned ON. In this case, in a case where a plurality of disconnection logs are stored in the storage unit 25, the notification processing unit 213 may create the disconnection detection information D1 including the plurality of disconnection logs and notify the center server 30 of the created information.

5 [0047]

The center server 30 stores the disconnection detection information D1 of which it is notified by each of the vehicles 10.

For example, an administrator of a charging system may specify the vehicle 10 of which the input line L1 is disconnected due to a failure or a wrongful action by referring to the disconnection detection information D1 stored in the center server 30, and give a warning or a penalty to a user of the vehicle 10.

In addition, the center server 30 may confirm the disconnection detection information D1 periodically (for example, every month), and automatically execute a process of giving a warning or a penalty to the vehicle 10 of which the input line L1 is disconnected. In this manner, the center server 30 keeps users' wrongful actions or the like under control.

[0048]

(Operational effect)

As described above, the on-vehicle device 20 according to the present embodiment includes the activation determination unit 210 that determines whether the activation signal of the vehicle 10 is input through the input line L1, the motion determination unit 211 that determines whether the vehicle 10 is moving on the basis of the positional information (the detection signal) which is received from the satellite signal reception unit 23 (the detection sensor) capable of detecting the motion of the vehicle 10, and the determination unit 212 that determines that the input line L1 is

disconnected in a case where it is determined that the activation signal is not input and it is determined that the vehicle 10 is moving.

In this manner, the on-vehicle device 20 can detect that a failure such as disconnection or poor contact occurs in the input line L1 or the input line L1 is not
5 connected to the on-vehicle device 20 due to a wrongful action.

[0049]

In addition, in a case where it is determined that the input line L1 is disconnected, the determination unit 212 stores a disconnection log which is information indicating the disconnection of the input line L1 in the storage unit 25.

10 In this manner, by storing the input line L1 being disconnected, it is possible to prevent a user (such as a driver of a vehicle) from performing a wrongful action such as intentional disconnection of the input line L1.

[0050]

In addition, in a case where it is determined that the input line L1 is
15 disconnected, the on-vehicle device 20 further includes the notification processing unit 213 that notifies of the disconnection detection information D1 in which a disconnection log that is information indicating the disconnection of the input line L1 and identification information from which the vehicle 10 can be specified are associated with each other.

In this manner, by notifying that the input line L1 is disconnected, the on-vehicle
20 device 20 can cause a user or the like to recognize the disconnection of the input line L1 due to a failure, and can prevent the user from performing a wrongful action such as intentional disconnection of the input line L1.

In addition, the notification processing unit 213 of the on-vehicle device 20 may refer to a disconnection log stored in the storage unit 25 and notify of the disconnection
25 detection information D1 at a predetermined timing. Thereby, an administrator of a

charging system or the like can recognize whether the input line L1 has been disconnected in the on-vehicle device 20 in the past.

[0051]

In addition, the on-vehicle device 20 further includes the satellite signal
5 reception unit 23 that, as the detection sensor, specifies the position of the vehicle 10 on the basis of a signal received from a satellite and outputs the specified position as the positional information (the detection signal), and the motion determination unit 211 compares the positional information which is continuous in time series, and determines whether the vehicle 10 is moving.

10 In this manner, the motion determination unit 211 can determine whether the vehicle 10 is moving on the basis of a signal received from a satellite.

In addition, in a case where the position of the vehicle 10 changes by a predetermined distance or more, the motion determination unit 211 may determine that the vehicle 10 is moving. Thereby, the motion determination unit 211 can prevent the
15 vehicle 10 from being erroneously determined to be moving due to a sensor error.

[0052]

<Second embodiment>

Next, a disconnection detection system 1 according to a second embodiment of the present invention will be described with reference to Fig. 6.

20 Common components with respect to those in the first embodiment are denoted by the same reference numerals and signs, and thus the detailed description thereof will not be given.

[0053]

Fig. 6 is a diagram showing a functional configuration of a disconnection
25 detection system according to the second embodiment of the present invention.

As shown in Fig. 6, the on-vehicle device 20 according to the present embodiment further includes a gyro sensor 27.

[0054]

The gyro sensor 27 measures the angular velocity of the vehicle 10. In addition,
5 in the present embodiment, the gyro sensor 27 functions as a detection sensor capable of detecting the motion of the vehicle 10 (a change in its inclination in a traveling direction or the like). The gyro sensor 27 outputs the measured angular velocity as a detection signal to the disconnection detection unit 21.

[0055]

10 The motion determination unit 211 of the disconnection detection unit 21 according to the present embodiment acquires the angular velocity as a detection signal from the gyro sensor 27 which is a detection sensor in the monitoring loop (Fig. 3) of the input line L1 (step S12 of Fig. 3).

The motion determination unit 211 compares the latest angular velocity acquired
15 from the gyro sensor 27 with a previously acquired angular velocity, and determines that the inclination of the vehicle 10 has changed, that is, the vehicle 10 is moving, in a case where the angular velocity has changed by a predetermined threshold or more (step S13: YES). On the other hand, the motion determination unit 211 determines that the inclination of the vehicle 10 has not changed in a case where the angular velocity has not
20 changed by a predetermined threshold or more (step S13: NO).

[0056]

As described above, the on-vehicle device 20 according to the present embodiment further includes the gyro sensor 27 that, as the detection sensor, measures the angular velocity of the vehicle 10 and outputs the measured angular velocity as the
25 detection signal, and the motion determination unit 211 compares angular velocities

indicated by the detection signals which are continuous in time series and determines whether the vehicle 10 is moving.

In this manner, the motion determination unit 211 can determine whether the vehicle 10 is moving on the basis of the angular velocity measured by the gyro sensor 27.

5 In addition, the motion determination unit 211 may determine that the vehicle 10 is moving in a case where the inclination of the vehicle 10 has changed by a predetermined threshold or more. Thereby, the motion determination unit 211 can prevent the vehicle 10 from being erroneously determined to be moving due to a sensor error.

10 [0057]

<Third embodiment>

Next, a disconnection detection system 1 according to a third embodiment of the present invention will be described with reference to Fig. 7.

Common components with respect to those in each of the above-described
15 embodiments are denoted by the same reference numerals and signs, and thus the detailed description thereof will not be given.

[0058]

Fig. 7 is a diagram showing a functional configuration of a disconnection detection system according to the third embodiment of the present invention.

20 As shown in Fig. 7, the on-vehicle device 20 according to the present embodiment further includes an acceleration sensor 28.

[0059]

The acceleration sensor 28 measures the acceleration of the vehicle 10. In addition, in the present embodiment, the acceleration sensor 28 functions as a detection
25 sensor capable of detecting the motion of the vehicle 10 (a change in motion). The

acceleration sensor 28 outputs the measured acceleration as a detection signal to the disconnection detection unit 21.

[0060]

The motion determination unit 211 of the disconnection detection unit 21 according to the present embodiment acquires an acceleration as a detection signal from the acceleration sensor 28 which is a detection sensor in the monitoring loop (Fig. 3) of the input line L1 (step S12 of Fig. 3).

The motion determination unit 211 compares the latest acceleration acquired from the acceleration sensor 28 with a previously acquired acceleration, and determines that the vehicle 10 is moving in a case where the acceleration has changed by a predetermined threshold or more (step S13: YES). On the other hand, the motion determination unit 211 determines that the vehicle 10 is not moving in a case where the acceleration has not changed by a predetermined threshold or more (step S13: NO).

[0061]

As described above, the on-vehicle device 20 according to the present embodiment further includes the acceleration sensor 28 that, as the detection sensor, measures the acceleration of the vehicle 10 and outputs the measured acceleration as the detection signal, and the motion determination unit 211 compares accelerations indicated by the detection signals which are continuous in time series and determines whether the vehicle 10 is moving.

In this manner, the motion determination unit 211 can determine whether the vehicle 10 is moving on the basis of the acceleration measured by the acceleration sensor 28.

In addition, the motion determination unit 211 may determine that the vehicle 10 is moving in a case where the acceleration of the vehicle 10 has changed by a

predetermined threshold or more. Thereby, the motion determination unit 211 can prevent the vehicle 10 from being erroneously determined to be moving due to a sensor error.

[0062]

5 <Fourth embodiment>

Next, a disconnection detection system 1 according to a fourth embodiment of the present invention will be described with reference to Fig. 8.

Common components with respect to those in each of the above-described embodiments are denoted by the same reference numerals and signs, and thus the
10 detailed description thereof will not be given.

[0063]

Fig. 8 is a diagram showing a functional configuration of a disconnection detection system according to the fourth embodiment of the present invention.

As shown in Fig. 8, the on-vehicle device 20 according to the present
15 embodiment uses the broadband communication unit 24 as a detection sensor.

The broadband communication unit 24 is connected to the center server 30 which is present in a remote location by communicating with any one of a plurality of base stations in accordance with the position of the vehicle 10. Each of the plurality of base stations is given a base station ID from which the base station can be uniquely
20 identified. The broadband communication unit 24 according to the present embodiment acquires a base station ID of the base station when communicating with the base station.

[0064]

The motion determination unit 211 of the disconnection detection unit 21 according to the present embodiment acquires the base station ID as a detection signal
25 from the broadband communication unit 24 which is a detection sensor in the monitoring

loop (Fig. 3) of the input line L1 (step S12 of Fig. 3).

The motion determination unit 211 compares the latest base station ID acquired from the broadband communication unit 24 with a previously acquired base station ID, and determines that the vehicle 10 is moving in a case where the base station ID has

5 changed (step S13: YES). On the other hand, the motion determination unit 211 determines that the vehicle 10 is not moving in a case where the base station ID has not changed (step S13: NO).

[0065]

As described above, the on-vehicle device 20 according to the present

10 embodiment includes the broadband communication unit 24 that, as the detection sensor, performs broadband communication through the base station and outputs a base station ID from which the base station can be identified as the detection signal, and the motion determination unit 211 determines the vehicle 10 is moving in a case where the base station ID has changed on the basis of the detection signals which are continuous in time

15 series.

In this manner, the motion determination unit 211 can determine whether the vehicle 10 is moving on the basis of the base station ID acquired by the broadband communication unit 24.

[0066]

20 <Fifth embodiment>

Next, a disconnection detection system 1 according to a fifth embodiment of the present invention will be described with reference to Fig. 9.

Common components with respect to those in each of the above-described embodiments are denoted by the same reference numerals and signs, and thus the

25 detailed description thereof will not be given.

[0067]

Fig. 9 is a diagram showing a functional configuration of a disconnection detection system according to the fifth embodiment of the present invention.

As shown in Fig. 9, the vehicle 10 according to the present embodiment includes
5 a vehicle sensor 13 as a detection sensor. The vehicle sensor 13 is, for example, at least one of a speed sensor, an acceleration sensor, a gyro sensor, or a rudder angle sensor that measures the traveling distance, ignition state, speed, acceleration, angular velocity, or steering angle of the vehicle 10 and outputs it as a detection signal. Meanwhile, the traveling distance means a cumulative total traveling distance after the production of the
10 vehicle 10 is completed. The ignition state means a state such as an engine ON (ignition ON), an accessory ON, or an engine OFF included in a signal indicating a vehicle state which is output from the vehicle 10.

In addition, the on-vehicle device 20 according to the present embodiment includes a detection signal acquisition unit 29 that acquires a detection signal which is
15 output from the vehicle sensor 13. Meanwhile, the detection signal acquisition unit 29 may acquire only one of the traveling distance, ignition state, speed, acceleration, angular velocity, and steering angle of the vehicle 10 from the vehicle sensor 13, or may acquire a plurality of them.

[0068]

20 The motion determination unit 211 of the disconnection detection unit 21 according to the present embodiment acquires a detection signal from the vehicle sensor 13 which is a detection sensor through the detection signal acquisition unit 29 in the monitoring loop (Fig. 3) of the input line L1 (step S12 of Fig. 3).

The motion determination unit 211 compares the latest acquired detection signal
25 with a previously acquired detection signal, and determines that the vehicle 10 is moving

in a case where the amount of change in the detection signal is a predetermined threshold or more (step S13: YES). On the other hand, the motion determination unit 211 determines that the vehicle 10 is not moving in a case where the amount of change in the detection signal is not a predetermined threshold or more (step S13: NO).

5 Meanwhile, the threshold is determined in advance in accordance with the type of detection signal which is acquired from the vehicle sensor 13. For example, the motion determination unit 211 determines that the vehicle 10 is moving in a case where the speed of the vehicle 10 is acquired as a detection signal and a case where the state of a predetermined speed (10 km/h) or higher continues for a certain period of time (for
10 example, for one minute) or longer. That is, the threshold may include both a threshold of the amount of change for determining that the vehicle 10 is moving and a threshold of the duration thereof. Thereby, the motion determination unit 211 can ignore a change in a detection signal in a short period of time which is caused by a sensor error, signal noise, or the like.

15 In addition, the motion determination unit 211 may determine whether the vehicle 10 is moving on the basis of any one of the detection signals acquired by the detection signal acquisition unit 29, or may make the determination in a combination of two or more detection signals.

[0069]

20 As described above, the on-vehicle device 20 according to the present embodiment further includes the detection signal acquisition unit 29 that receives a detection signal which is output from the detection sensor 13 provided in the vehicle 10 and includes at least one of the speed, acceleration, angular velocity, and steering angle of the vehicle 10, and the motion determination unit 211 compares the detection signals
25 which are continuous in time series and determines whether the vehicle 10 is moving.

In this manner, the motion determination unit 211 can determine whether the vehicle 10 is moving on the basis of the detection signal which is output from the vehicle sensor 13 provided in advance in the vehicle 10.

In addition, the motion determination unit 211 may determine that the vehicle 10 is moving in a case where the amount of change in the detection signal is a predetermined threshold or more or a case where a state in which the amount of change in the detection signal is a predetermined threshold or more continues for a certain period of time or longer. Thereby, the motion determination unit 211 can prevent the vehicle 10 from being erroneously determined to be moving due to a sensor error.

10 [0070]

(Hardware configuration)

Fig. 10 is a diagram showing an example of a hardware configuration of an on-vehicle device according to at least one embodiment of the present invention.

As shown in Fig. 10, a computer 900 includes a CPU 901, a main storage device 15 902, an auxiliary storage device 903, and an interface 904.

The above-described on-vehicle device 20 is mounted in the computer 900. The operation of each processing unit described above is stored in the auxiliary storage device 903 in the form of a program. The CPU 901 (the disconnection detection unit 21, the CPU 26) reads out a program from the auxiliary storage device 903, develops the program on the main storage device 902, and executes the above process in accordance with the program. In addition, the CPU 901 secures a storage area used for various processes by the disconnection detection unit 21 and the CPU 26 in the main storage device 902 in accordance with the program.

[0071]

25 An example of the auxiliary storage device 903 includes a hard disk drive

(HDD), a solid state drive (SSD), a magnetic disc, a magnetooptic disc, a compact disc read only memory (CD-ROM), a digital versatile disc read only memory (DVD-ROM), a semiconductor memory, or the like. The auxiliary storage device 903 may be internal media connected directly to the bus of the computer 900, or may be external media
5 connected to the computer 900 through the interface 904 or a communication line. In addition, in a case where this program is delivered to the computer 900 through a communication line, the computer 900 having received the delivery may develop the program into the main storage device 902, and execute the above process. In at least one embodiment, the auxiliary storage device 903 is a non-transitory tangible storage
10 medium.
[0072]

In addition, the program may be a program which is used for realizing a portion of the aforementioned functions.

Further, the program may be a so-called difference file (a difference program)
15 for realizing the aforementioned functions by a combination with another program stored in advance in the auxiliary storage device 903.
[0073]

Hereinbefore, although the embodiments of the present invention have been described in detail, the present invention is not limited to these embodiments insofar as
20 they do not deviate from the technical idea of the invention, and some design changes and the like are also possible.

For example, although an aspect in which, in a case where the disconnection of the input line L1 is detected, the on-vehicle device 20 stores a disconnection log in the storage unit 25 and notifies the center server 30 of the disconnection detection
25 information D1 has been described in each of the above-described embodiments, the

present invention is not limited thereto. In another embodiment, the power supply control unit 22 of the on-vehicle device 20 may turn the power supply of the on-vehicle device 20 ON in a case where it is detected that the vehicle 10 is moving in spite of the activation signal not being input. In this manner, when the vehicle 10 is moving even in
5 a case where the input line L1 is disconnected, it is possible to correctly acquire and transmit probe information by activating the on-vehicle device 20.

In addition, in still another embodiment, in a case where the disconnection of the input line L1 is detected, the on-vehicle device 20 may output a command for restricting some functions of the on-vehicle device 20 or the vehicle 10 (such as, for example,
10 restricting an ignition ON operation until the connection of the input line L1 is confirmed). Thereby, the on-vehicle device 20 can urge a user to correctly connect the input line L1 in order to operate the vehicle 10 normally.

[0074]

In addition, although an aspect in which the notification processing unit 213
15 notifies the center server 30 of the disconnection detection information D1 has been described in each of the above-described embodiments, the present invention is not limited thereto. The notification processing unit 213 may notify (such as notify based on a text message or a voice) a user (such as a driver of the vehicle 10) of the disconnection detection information D1 using a display unit and a speaker (not shown) of
20 the on-vehicle device 20.

Thereby, the notification processing unit 213 can urge a user to repair or correctly connect the input line L1.

[0075]

In addition, although an aspect in which the on-vehicle device 20 includes each
25 functional unit (the disconnection detection unit 21, the power supply control unit 22, the

detection sensor (the satellite signal reception unit 23, the gyro sensor 27, the acceleration sensor 28, or the broadband communication unit 24), the storage unit 25, or the CPU 26) has been described in each of the above-described embodiments, the present invention is not limited thereto. In another embodiment, the vehicle 10 may include these functional units.

[0076]

In addition, although an aspect in which the center server 30 executes a charging process on the basis of the probe information has been described in each of the above-described embodiments, the present invention is not limited thereto. In another embodiment, the center server 30 may execute a driving evaluation process of detecting the sudden start, sudden braking, abrupt steering, excessive speed, or the like of the vehicle 10 on the basis of the speed, acceleration, angular velocity, or the like of the vehicle 10 included in the probe information and evaluating whether a driver of the vehicle has performed safe driving or economic driving.

Further, in another embodiment, the center server 30 may execute a business management process by aggregating the travel route, traveling distance, traveling time, charge, or the like of a taxi on the basis of probe information collected from the on-vehicle device 20 mounted in the taxi.

[0077]

In addition, in the aforementioned fifth embodiment, an aspect in which the motion determination unit 211 determines that the vehicle 10 is moving in a case where a state in which the amount of change in the detection signal of the vehicle 10 is a threshold or more continues for a certain period of time (for example, for one minute) or longer has been described. The aspect may be applied to the motion determination unit 211 according to the first to fourth embodiments. Thereby, the motion determination

unit 211 can ignore a change in the detection signal in a short period of time which is caused by a sensor error, signal noise, or the like. Thereby, the motion determination unit 211 can suppress a deterioration in the degree of accuracy of determining whether the vehicle 10 is moving.

5 [Industrial Applicability]

[0078]

According to the on-vehicle device, the vehicle, the disconnection detection method, and the program described above, it is possible to detect the disconnection of the input line for inputting the activation signal of the vehicle.

10 [Reference Signs List]

[0079]

- 1 Disconnection detection system
- 10 Vehicle
- 11 Ignition (IGCT) switch
- 15 12 Battery
- 13 Vehicle sensor (detection sensor)
- 20 On-vehicle device
- 21 Disconnection detection unit
- 210 Activation determination unit
- 20 211 Motion determination unit
- 212 Determination unit
- 213 Notification processing unit
- 22 Power supply control unit
- 23 Satellite signal reception unit (detection sensor)
- 25 24 Broadband communication unit (detection sensor)

- 25 Storage unit
- 26 CPU
- 27 Gyro sensor (detection sensor)
- 28 Acceleration sensor (detection sensor)
- 5 29 Detection signal acquisition unit
- 30 Center server

[CLAIMS]

[Claim 1]

An on-vehicle device comprising:

- an activation determination unit that is configured to determine whether an
- 5 activation signal of the vehicle is input through an input line;
- a motion determination unit that is configured to determine whether the vehicle is moving on the basis of a detection signal which is received from a detection sensor capable of detecting a motion of the vehicle; and
- a determination unit that is configured to determine that the input line is
- 10 disconnected in a case where it is determined that the activation signal is not input and it is determined that the vehicle is moving.

[Claim 2]

- The on-vehicle device according to claim 1, wherein, in a case where it is determined that the input line is disconnected, the determination unit is configured to
- 15 store information indicating the disconnection of the input line in a storage unit.

[Claim 3]

- The on-vehicle device according to claim 1 or 2, further comprising a notification processing unit that, in a case where it is determined that the input line is disconnected, is configured to notify of information indicating the disconnection of the
- 20 input line and identification information from which the vehicle is able to be specified in association with each other.

[Claim 4]

- The on-vehicle device according to any one of claims 1 to 3, further comprising a satellite signal reception unit that, as the detection sensor, is configured to specify a
- 25 position of the vehicle on the basis of a signal received from a satellite and output the

specified position as the detection signal,

wherein the motion determination unit is configured to compare the detection signals which are continuous in time series and determines whether the vehicle is moving.

5 [Claim 5]

The on-vehicle device according to any one of claims 1 to 3, further comprising a gyro sensor that, as the detection sensor, is configured to measure an angular velocity of the vehicle and output the measured angular velocity as the detection signal,

10 wherein the motion determination unit is configured to compare the detection signals which are continuous in time series and determines whether the vehicle is moving.

[Claim 6]

The on-vehicle device according to any one of claims 1 to 3, further comprising an acceleration sensor that, as the detection sensor, is configured to measure an
15 acceleration of the vehicle and output the measured acceleration as the detection signal,

wherein the motion determination unit is configured to compare the detection signals which are continuous in time series and determines whether the vehicle is moving.

[Claim 7]

20 The on-vehicle device according to any one of claims 1 to 3, further comprising a broadband communication unit that, as the detection sensor, is configured to perform broadband communication through a base station and output a base station ID from which the base station is able to be identified as the detection signal,

25 wherein the motion determination unit is configured to compare the detection signals which are continuous in time series and determines whether the vehicle is

moving.

[Claim 8]

The on-vehicle device according to any one of claims 1 to 3, further comprising a detection signal acquisition unit that is configured to receive a detection signal which is
5 output from the detection sensor provided in the vehicle and includes at least one of a speed, an acceleration, an angular velocity, and a steering angle of the vehicle,

wherein the motion determination unit is configured to compare the detection signals which are continuous in time series and determines whether the vehicle is moving.

10 [Claim 9]

A vehicle comprising:

an activation determination unit that is configured to determine whether an activation signal of the vehicle is input through an input line;

a motion determination unit that is configured to determine whether the vehicle
15 is moving on the basis of a detection signal which is received from a detection sensor capable of detecting a motion of the vehicle; and

a determination unit that is configured to determine that the input line is disconnected in a case where it is determined that the activation signal is not input and it is determined that the vehicle is moving.

20 [Claim 10]

A disconnection detection method comprising:

an activation determination step of determining whether an activation signal of a vehicle is input through an input line;

a motion determination step of determining whether the vehicle is moving on the
25 basis of a detection signal which is received from a detection sensor capable of detecting

a motion of the vehicle; and

a determination step of determining that the input line is disconnected in a case where it is determined that the activation signal is not input and it is determined that the vehicle is moving.

5 [Claim 11]

A program causing a computer of an on-vehicle device mounted in a vehicle to function, the program causing the computer to execute:

an activation determination step of determining whether an activation signal of a vehicle is input through an input line;

10 a motion determination step of determining whether the vehicle is moving on the basis of a detection signal which is received from a detection sensor capable of detecting a motion of the vehicle; and

a determination step of determining that the input line is disconnected in a case where it is determined that the activation signal is not input and it is determined that the

15 vehicle is moving.