

DESCRIPTION

Title of Invention

VEHICLE-MOUNTED DEVICE, INFORMATION PROCESSING SYSTEM,
CONTROL METHOD, AND PROGRAM

[Technical Field]

[0001]

The present disclosure relates to a vehicle-mounted device, an information processing system, a control method, and a program.

[Background Art]

[0002]

On a toll road such as a highway, a charging process is performed when a vehicle passes by.

Patent Document 1 discloses a technology related to a system that performs a charging process on a vehicle detected by a camera, as a related technology.

[Citation List]

[Patent Document]

[0003]

[Patent Document 1] Japanese Unexamined Patent Application Publication No. 2003-030703

[Summary of Invention]

[Technical Subject]

[0004]

In some cases, charging is performed after detecting a position of a vehicle using a satellite such as a global navigation satellite system (GNSS) such as a global positioning system (GPS), and determining whether the vehicle has run on a toll road by using positioning information. In such a case, there is a possibility that the accuracy of detecting the position of the vehicle using a GNSS satellite is decrease depending on a situation, such as radio waves from the satellite to the vehicle reflecting buildings or the like, and as a result, the vehicle may be erroneously charged even though the vehicle has not actually passed through the toll road.

Therefore, there is a demand for a technology capable of reducing erroneous charging, in charging on a toll road by using vehicle positioning information obtained by the GNSS satellite.

[0005]

The present disclosure has been made to solve the above subjects, and an object of the present disclosure is to provide a vehicle-mounted device, an information processing system, a control method, and a program capable of reducing erroneous charging, in charging on a toll road by using vehicle positioning information obtained by a GNSS satellite.

[Subject to be solved]

[0006]

In order to solve the above subjects, a vehicle-mounted device according to the present disclosure includes: an instruction unit that performs a charging process based on position information indicating a position of a vehicle obtained by a GNSS satellite; a recording unit that records ambient environment information at at least one time close to a charging time at which charging is performed in the charging process; a determination unit that determines a presence or absence of circumstances in which the charging process needs to be reviewed; and a transmission unit that transmits specific information of a charging point at which the charging is performed, and the ambient environment information to an outside when the determination unit determines that the circumstances are present.

[0007]

An information processing system according to the present disclosure is an information processing system including the vehicle-mounted device and an information processing apparatus, in which the information processing system includes: a performing unit that performs the charging process; and a changing unit that reviews the charging process based on the specific information and the

ambient environment information.

[0008]

A control method of a vehicle-mounted device according to the present disclosure includes: performing a charging process based on position information indicating a position of a vehicle obtained by a GNSS satellite; recording ambient environment information at at least one time close to a charging time at which charging is performed in the charging process; determining a presence or absence of circumstances in which the charging process needs to be reviewed; and transmitting specific information of a charging point at which the charging is performed, and the ambient environment information when it is determined that the circumstances are present.

[0009]

A control method of an information processing system according to the present disclosure is a control method of an information processing system that includes a vehicle-mounted device and an information processing apparatus, the control method includes: performing a charging process based on position information indicating a position of a vehicle obtained by a GNSS satellite; recording ambient environment information at at least one time close to a charging time at which charging is performed in the charging process; determining a presence or absence of

circumstances in which the charging process needs to be reviewed; transmitting specific information of a charging point at which the charging is performed, and the ambient environment information when it is determined that the circumstances are present; performing the charging process; and reviewing the charging process based on the specific information and the ambient environment information.

[0010]

A program according to the present disclosure for causing a computer of a vehicle-mounted device to execute a process includes: performing a charging process based on position information indicating a position of a vehicle obtained by a GNSS satellite; recording ambient environment information at at least one time close to a charging time at which charging is performed in the charging process; determining a presence or absence of circumstances in which the charging process needs to be reviewed; and transmitting specific information of a charging point at which the charging is performed, and the ambient environment information when it is determined that the circumstances are present.

[Advantageous Effects of Invention]

[0011]

According to a vehicle-mounted device, an

information processing system, a control method, and a program of the present disclosure, it is possible to reduce erroneous charging, in charging on a toll road by using vehicle positioning information obtained by a GNSS satellite.

[Brief Description of Drawings]

[0012]

Fig. 1 is a diagram showing an example of a configuration of an information processing system according to one embodiment of the present disclosure.

Fig. 2 is a diagram showing an example of a configuration of a vehicle-mounted device according to the embodiment of the present disclosure.

Fig. 3 is a diagram showing an example of a configuration of an acquisition device according to the embodiment of the present disclosure.

Fig. 4 is a diagram showing an example of a configuration of a center system according to the embodiment of the present disclosure.

Fig. 5 is a diagram showing an example of a processing flow of an information processing system according to the embodiment of the present disclosure.

Fig. 6 is a first diagram showing an example of a notification in the embodiment of the present disclosure.

Fig. 7 is a second diagram showing an example of a

notification in the embodiment of the present disclosure.

Fig. 8 is a schematic block diagram showing a configuration of a computer according to at least the embodiment.

[Description of Embodiments]

[0013]

<Embodiment>

Hereinafter, an embodiment will be described in detail with reference to the drawings.

An information processing system according to one embodiment of the present disclosure will be described.

(Configuration of Information Processing System)

Fig. 1 is a diagram showing a configuration of an information processing system 1 according to the embodiment of the present disclosure. As shown in Fig. 1, the information processing system 1 includes a global navigation satellite system (GNSS) satellite 10, a vehicle 30, and a center system 40 (an example of an information processing apparatus). The information processing system 1 is a system in which the vehicle 30 transmits specific information of a charging point, and ambient environment information to the center system 40 when circumstances, in which a charging process that is performed with respect to the vehicle 30 needs to be reviewed, are present. The specific information related to the charging point is

information used for specifying a position where the charging is performed. For example, the charging point is any predetermined region, and the specific information is a unique identifier indicating the predetermined region. The ambient environment information is information indicating environment around the vehicle 30 including at least information indicating environment related to at one time close to a charging time around the vehicle 30 in which the charging is performed. That is, the ambient environment information is information indicating environment related to at least the charging time around the vehicle 30 in which the charging is performed, a predetermined time before the charging time, a predetermined time after the charging time, the charging point where the vehicle 30 that is specified based on the specific information is charged, a predetermined distance behind the charging point, and a predetermined distance ahead of the charging point. For example, the ambient environment information is information including images captured from the vehicle 30 at time corresponding to the charging time around the vehicle 30 in which the charging is performed, at time before the time corresponding to the charging time, and at time after the time corresponding to the charging time. Further, for example, the ambient environment information is information including images

captured from the vehicle 30 at a position of the charging point where the vehicle 30 that is specified based on the specific information is charged, a position of the predetermined distance behind the charging point, and a position of the predetermined distance ahead of the charging point.

[0014]

Examples of the GNSS satellite 10 include an artificial satellite used in a global positioning system (GPS) or the like. The GNSS satellite 10 includes, for example, four or more geostationary communication satellites.

[0015]

The vehicle 30 is a vehicle that runs on a toll road (for example, a highway). The vehicle 30 includes a vehicle-mounted device 30a. The vehicle-mounted device 30a may be referred to as an on board unit (OBU). As shown in Fig. 2, the vehicle-mounted device 30a includes an acquisition device 20, a communication unit 301, a positioning unit 302, a modification unit 303 (an example of a calculation unit), an instruction unit 304, a notification unit 305, and a cancelation unit 306 (an example of a determination unit, an example of a transmission unit, and an example of a reception unit).

[0016]

As shown in Fig. 3, the acquisition device 20 includes an acquisition unit 201 (an example of a recording unit), a storage unit 202, and a communication unit 203. The acquisition unit 201 acquires the ambient environment information. The ambient environment information is information indicating environment around the vehicle 30 including at least information indicating environment related to the charging time around the vehicle 30 in which the charging is performed. When the charging time is handled as time, time handled by the vehicle-mounted device 30a and time handled by the acquisition device 20 must match. Therefore, the time handled by the vehicle-mounted device 30a and the time handled by the acquisition device 20 are made to be coincide with each other by using a common timer between the vehicle-mounted device 30a and the acquisition device 20, by converting to, when each of the vehicle-mounted device 30a and the acquisition device 20 has a timer but each indicates a different time, a common time using a conversion table or a calculation unit and handling the time as the same time, by correcting the time using a radio wave timepiece, or the like, for example. In this case, the acquisition unit 201 captures an image around the vehicle 30. When the acquisition unit 201 captures the image around the vehicle 30, the acquisition unit 201

may be an imaging unit dedicated to the information processing system 1. The acquisition unit 201 associates the acquired ambient environment information with the charging time and the time close to the charging time and records the association result in the storage unit 202. For example, the acquisition unit 201 records the ambient environment information, which is related to the time close to the charging time at which charging is performed by the charging process, in the storage unit 202 in association with time information.

[0017]

In a calculation of the global navigation satellite system (GNSS), a position (x, y, z) of the vehicle 30 and time t are estimated by using distance information between the vehicle 30 and at least four GNSS satellites 10. An error of the estimated time t is negligibly small compared to a moving speed of the vehicle 30. Therefore, the OBU positioning measured by the GNSS may use the time t calculated by the GNSS or time of an internal timer associated therewith as a time stamp of the charging time.

[0018]

The storage unit 202 stores various types of information necessary for a process performed by the acquisition device 20. For example, the storage unit 202 stores the ambient environment information acquired by the

acquisition unit 201. The storage unit 202 is accessible from the outside.

[0019]

The communication unit 203 communicates with the outside of the acquisition device 20. For example, the communication unit 203 transmits the ambient environment information recorded in the storage unit 202 to the vehicle-mounted device 30a, which will be described later.

When the acquisition unit 201 captures the image around the vehicle 30, the acquisition device 20 may be a general (for example, commercially available) drive recorder. From the viewpoint of security, when the acquisition device 20 is a drive recorder, it is desirable that the information processing system 1 has a function of authenticating the drive recorder or the drive recorder is recognized as a certified device by a company that provides the information processing system 1. Examples of an authentication method of whether or not the device is a certified device include a method of using an encryption key for mutual authentication by giving the encryption keys to a vehicle-mounted device 30a side and a drive recorder side, respectively, and by exchanging information obtained by encrypting or decrypting random numbers, or the like.

[0020]

The communication unit 301 communicates with the outside of the vehicle-mounted device 30a. For example, the communication unit 301 receives radio waves from the GNSS satellite 10.

[0021]

The positioning unit 302 performs positioning on the vehicle 30 based on the radio waves received by the communication unit 301. The positioning method, which is performed by the positioning unit 302, may be a method, for example, using known technology, such as calculating a position of the vehicle 30 based on radio waves received from three of the four GNSS satellites 10 and correcting the position with radio waves received from another GNSS satellite 10.

[0022]

The modification unit 303 calculates a degree of certainty, which indicates certainty in which the vehicle 30 has passed the charging point, based on at least one of a running history of the vehicle 30, a positional relationship of each passage, that is, a distance between two roads, at least a part of which run parallel to each other on the passage indicated by the running history, and accuracy of the position of the vehicle 30 obtained by the GNSS satellite 10. The degree of certainty indicates a possibility, in which the vehicle 30 on each passage

within a range of a positioning error is running, with a value from 0 (0%) to 1 (100%). For example, when a passage A and a passage B are included within the range of the positioning error and there is only a possibility of the passage A from the running history, the modification unit 303 calculates the degree of certainty of the passage A as 1. Further, when there is a possibility of the passage A and the passage B from the running history, the modification unit 303 calculates a degree of certainty of the passage A as "a" and calculates a degree of certainty of the passage B as $(1 - a)$ based on a positional relationship between the passage A and the passage B, for example, a magnitude relationship between a distance from the vehicle 30 to the passage A and a distance from the vehicle 30 to the passage B.

[0023]

The modification unit 303 specifies a position of the vehicle 30 on a map based on a positioning result of the positioning unit 302 and a positioning error. When the positioning error, which uses radio waves of the GNSS satellite 10 being used, is known, the positioning error may be an error using the known error. Further, when the positioning error, which uses radio waves of the GNSS satellite 10 being used, is not known, the positioning error may be an error using the error estimated from the

positioning result. For example, when the positioning error is "r" (that is, there is a possibility of an error of radius "r" from the vehicle 30) and a plurality of passages on the map are included within the error, the modification unit 303 modifies, assuming that the vehicle 30 is running on the passage that is closest to the vehicle 30, the position of the vehicle 30 to the closest passage. This modification by the modification unit 303 may be performed by using, for example, a known map matching technology performed in a car navigation system or the like.

[0024]

Further, based on the degree of certainty, the modification unit 303 determines whether or not the vehicle 30 is present in a predetermined region (an example of the charging point), which is determined in advance on the map, where instruction for the charging process is provided (that is, the charging process is performed). Note that, when the modification unit 303 uses a map matching technology, based on a map matching result instead of the degree of certainty or based on the map matching result in addition to the degree of certainty, the modification unit 303 may determine whether or not the vehicle 30 is present in the predetermined region (an example of the charging point), which is determined in

advance on the map, where instruction for the charging process is provided (that is, the charging process is performed).

The instruction unit 304 causes the information processing apparatus 40 to perform the charging process based on the position information indicating the position of the vehicle 30 obtained by the GNSS satellite 10. Specifically, the instruction unit 304 transmits an instruction signal for performing the charging process to the center system 40 via the communication unit 301. For example, the instruction unit 304 determines that the vehicle 30 is present in the predetermined region when the degree of certainty, in which the vehicle 30 is running in the predetermined region, is equal to or higher than a predetermined value (an example of a threshold value) and transmits the instruction signal to the center system 40. The instruction signal includes information indicating an identifier associated with the vehicle 30 in advance and an identifier indicating the predetermined region.

[0025]

The notification unit 305 provides a notification that charging has been performed. Specifically, the notification unit 305 provides a notification of a content of the charging process indicated by the notification signal. The notification signal includes information

indicating the content of the charging process. The notification unit 305 is not limited to displaying information and may provide a notification that the charging process has been performed, for example, through sound (including voice) or vibration.

[0026]

The cancelation unit 306 receives that the charging is erroneous charging. For example, the cancelation unit 306 receives a signal, which is transmitted from an input device (such as a touch panel) operated by a user at the time when the user (for example, a charging target person, a driver, or the like) selects a charging process that is considered to be erroneous charging. The cancelation unit 306 determines a presence or absence of circumstances in which the charging process needs to be reviewed. Examples of the circumstances in which the charging process needs to be reviewed include a situation where it is determined that the charging is erroneous charging, a situation where the degree of certainty is equal to or lower than the predetermined value (an example of a threshold value), or the like. Specifically, the cancelation unit 306 determines whether or not there is a signal transmitted from the input device operated by the user at the time when the user (for example, a charging target person, a driver, or the like) selects the charging process that is

considered to be erroneous charging. For example, the user checks the content of the charging process, which is provided by the notification unit 305, and determines whether or not there is erroneous charging. When it is determined that there is erroneous charging, the user performs an operation, on the input device, of selecting the charging process considered to be the erroneous charging. That is, when the user performs the operation, on the input device, of selecting the charging process considered to be erroneous charging (that is, when the cancelation unit 306 receives that the charging is the erroneous charging), the cancelation unit 306 determines that the above-described circumstances are present. Further, when the user does not perform the operation, on the input device, of selecting the charging process considered to be erroneous charging, the cancelation unit 306 determines that the above-described circumstances are not present.

[0027]

Further, when it is determined that the circumstances, in which the charging process needs to be reviewed, are present, the cancelation unit 306 transmits the specific information, which is related to the charging point where the charging is performed, and the ambient environment information to the outside. Specifically, the

cancelation unit 306 determines whether or not to transmit a cancelation signal to the center system 40 via the communication unit 301 based on the determination result of whether or not there is a signal transmitted from the input device at the time when the user selects the charging process considered to be erroneous charging. The cancelation signal includes at least instruction information for requesting the center system 40 to cancel the charging and ambient environment information acquired by the acquisition device 20 at the time close to the charging process time. The instruction information includes information that can specify the charging process of requesting cancelation. For example, an identification number may be assigned to each of the information for providing a notification that the charging has been performed, and the instruction information may include the identification number.

[0028]

As shown in Fig. 4, the center system 40 includes a communication unit 401, a processing unit 402 (an example of a performing unit), a storage unit 403, and a correction unit 404 (an example of a changing unit). The communication unit 401 communicates with the outside of the center system 40. The processing unit 402 performs the charging process. The storage unit 403 stores various

types of information necessary for a process performed by the center system 40. The correction unit 404 determines whether or not the ambient environment information, which is included in the cancelation signal, indicates erroneous charging. When it is determined that the ambient environment information, which is included in the cancelation signal, indicates erroneous charging, the correction unit 404 reviews the charging process, that is, performs a process of canceling the charging indicated by the information that can specify the charging process included in the instruction information in the cancelation signal based on the specific information and the ambient environment information.

[0029]

(Process performed by Information Processing System 1)

Next, the charging that is performed by the information processing system 1 and a process of canceling the charging will be described with reference to Fig. 5. It is assumed that the acquisition device 20 constantly acquires an image captured from the vehicle 30 while the vehicle 30 is running and records the acquired image in the storage unit 202 in association with the acquired time.

[0030]

The communication unit 301 receives radio waves from

the GNSS satellite 10. The positioning unit 302 performs positioning on the vehicle 30 based on the radio waves received by the communication unit 301 (step S1).

[0031]

The modification unit 303 specifies the position of the vehicle 30 on the map based on the positioning result of the positioning unit 302 and the positioning error (step S2).

[0032]

Further, based on the degree of certainty, the modification unit 303 determines whether or not the vehicle 30 is present in a predetermined region (an example of the charging point), which is determined in advance on the map, where instruction for the charging process is provided (that is, the charging process is performed) (step S3). Further, when only one passage on the map is included within the range of the positioning error, the modification unit 303 specifies the degree of certainty as 1 for the passage. Further, when a plurality of passages are included within the range of the positioning error, the modification unit 303 calculates the degree of certainty for each passage. Specifically, the running history of the vehicle 30 (that is, the passage where the vehicle 30 has run), the positional relationship of each passage (that is, a relative distance

of each passage or the like), and the positioning error are each digitized, and the modification unit 303 calculates the degree of certainty for each passage based on the digitized running history, positional relationship of each passage, and positioning error. For example, when a passage A and a passage B are included within the range of the positioning error and there is only a possibility of the passage A from the running history, the modification unit 303 calculates the degree of certainty of the passage A as 1. Further, when there is a possibility of the passage A and the passage B from the running history, the modification unit 303 calculates a degree of certainty of the passage A as "a" and calculates a degree of certainty of the passage B as $(1 - a)$ based on a positional relationship between the passage A and the passage B, for example, a magnitude relationship between a distance from the vehicle 30 to the passage A and a distance from the vehicle 30 to the passage B.

[0033]

When the modification unit 303 determines that the vehicle 30 is not present in the predetermined region, which is determined in advance on the map, where instruction for the charging process is provided (NO in step S3), the modification unit 303 returns the process to the process of step S3. Further, when the modification

unit 303 determines that the vehicle 30 is present in the predetermined region, which is determined in advance on the map, where instruction for the charging process is provided (YES in step S3), the instruction unit 304 transmits an instruction signal for performing the charging process to the center system 40 via the communication unit 301 (step S4). The positioning of the vehicle 30 in steps S1 and S2 and the process of specifying the position on the map are performed in parallel in the processes after step S3. Further, the process of determining whether or not the vehicle 30 is present in the predetermined region in step S3 is also performed in parallel in the processes after step S4.

[0034]

When the communication unit 401 receives the instruction signal from the vehicle-mounted device 30a, the processing unit 402 performs the charging process (step S5). For example, the processing unit 402 specifies a target of the charging process from an identifier associated with the vehicle 30 in advance included in the instruction signal. Specifically, for example, the processing unit 402 stores the position where it is determined that the vehicle 30 has entered the toll road and specifies a charged amount from the stored position to a position indicated by the identifier indicating the

predetermined region included in the instruction signal. The processing unit 402 specifies the identifier, which is associated with the vehicle 30 in advance, in the storage unit 403 and bills a charging destination (for example, credit card numbers, bank account numbers, or the like), which is associated with the specified identifier, for the measured charged amount.

[0035]

The processing unit 402 transmits a notification signal, which indicates that the charging process has been performed, to the vehicle-mounted device 30a via the communication unit 401 (step S6). Examples of information indicating the content of charging process include information indicating the predetermined region where the charge has been performed (for example, the position where the charging has been performed, a running section of a charging target, or the like), information indicating time when the charging process has been performed, information indicating the charged amount, information indicating one column of a history of the charging process, or the like. The process of step S5 is performed in parallel after the process of step S6 so that the process can be performed in response to the instruction signal.

[0036]

When the communication unit 301 receives the

notification signal from the center system 40, the notification unit 305 provides a notification of the content of the charging process indicated by the notification signal (step S7). For example, when the notification unit 305 is a display unit, the notification unit 305 provides a notification of information indicating the content of the charging process, as shown in Figs. 6 and 7. The notification unit 305 is not limited to displaying information and may provide a notification that the charging process has been performed, for example, through sound (including voice) or vibration.

[0037]

The user (for example, a charging target person, a driver, or the like) checks the content of the charging process, which is provided by the notification unit 305, and determines whether or not there is erroneous charging. For example, the notification unit 305 is a display unit having a function of a touch panel as an input device, and the user determines whether or not there is erroneous charging in a charging list displayed on the notification unit 305, for example shown in Fig. 7. When the user selects the charging process determined to be erroneous charging in the charging list displayed on notification unit 305, the cancelation unit 306 determines whether or not there is a signal transmitted from the input device

operated by the user at the time of selection by the user. Based on the determination result, the cancelation unit 306 determines whether or not to transmit the cancelation signal to the center system 40 via the communication unit 301 (step S8).

[0038]

When the determination result is a determination result indicating that there is no signal transmitted from the input device, the cancelation unit 306 determines not to transmit the cancelation signal to the center system 40. Further, when the determination result is a determination result indicating that there is a signal transmitted from the input device, the cancelation unit 306 determines to transmit the cancelation signal to the center system 40.

[0039]

When the cancelation unit 306 determines not to transmit the cancelation signal to the center system 40 (NO in step S8), the cancelation unit 306 returns the process to the process of step S8. Further, when the cancelation unit 306 determines to transmit the cancelation signal to the center system 40 (YES in step S8), the cancelation unit 306 transmits the cancelation signal to the center system 40 via the communication unit 301 (step S9). The process of step S8 is performed in parallel after the process of step S9.

[0040]

When the communication unit 401 receives the cancelation signal, the correction unit 404 determines whether or not the ambient environment information, which is included in the cancelation signal, indicates erroneous charging (step S10). For example, each predetermined region is provided with a unique object in advance, and reference information, which indicates a feature of each predetermined region indicating the object, is stored in the storage unit 403 in advance. A plurality of unique objects may be provided with respect to the predetermined region, and signs, buildings, terrain, or the like may be used as the unique objects. When the ambient environment information is image information, the reference information is prepared as image information indicating the object. Further, when the ambient environment information is three-dimensional solid information obtained by a rider or the like, the reference information is prepared as three-dimensional solid information indicating the object. The correction unit 404 compares the ambient environment information of the predetermined region where the charging has been performed with the reference information of the predetermined region stored in the storage unit 403 and determines that, when it is determined that reference information is included in the

ambient environment information, the ambient environment information does not indicate erroneous charging. Further, the correction unit 404 compares the ambient environment information of the predetermined region where the charging has been performed with the reference information of the predetermined region stored in the storage unit 403 and determines that, when it is determined that reference information is not included in the ambient environment information, the ambient environment information indicates erroneous charging. Note that, the entire information (a periphery image of a road on which the vehicle 30 may pass through, three-dimensional information thereof, or the like), which may be acquired from the vehicle 30 within the predetermined region where the charging is performed, may be used as the reference information, and the correction unit 404 may check whether or not the ambient environment information, which is acquired from the vehicle 30, is included in the reference information. In this case, "reference information is included in ambient environment information" and "reference information is not included in ambient environment information" in a series of processes may be replaced with "ambient environment information is included in reference information" and "ambient environment information is not included in reference information" by exchanging the ambient

environment information and the reference information to perform the processes.

[0041]

When the correction unit 404 determines that the ambient environment information, which is included in the cancelation signal, indicates erroneous charging (YES in step S10), the correction unit 404 performs a process of canceling the charging in the predetermined region corresponding to the ambient environment information (step S11). Further, when it is determined that the ambient environment information, which is included in the cancelation signal, does not indicate erroneous charging (NO in step S10), the process of canceling the charging is not performed. The process of step S10 is performed in parallel even after the process of step S11 is performed so that the process can be performed in response to the cancelation signal.

[0042]

(Effects of Action)

The information processing system 1 according to the embodiment of the present disclosure has been described above. In the information processing system 1, the vehicle-mounted device 30a includes: the instruction unit 304 that performs the charging process based on the position information indicating the position of the

vehicle 30 obtained by the GNSS satellite 10; the acquisition unit 201 (an example of the recording unit) that records the ambient environment information at at least one time close to the charging time at which charging is performed in the charging process; the cancelation unit 306 (an example of the determination unit) that determines a presence or absence of circumstances in which the charging process needs to be reviewed; and the cancelation unit 306 (an example of the transmission unit) that transmits the specific information, which is related to the charging point at which the charging is performed, and the ambient environment information to the outside when the cancelation unit 306 determines that the circumstances are present.

[0043]

As a result, the vehicle-mounted device 30a of the information processing system 1 according to the embodiment of the present disclosure can reduce erroneous charging in the toll road charging using the vehicle positioning information obtained by the GNSS satellite.

[0044]

In the embodiment of the present disclosure, the cancelation signal is described as being transmitted from the vehicle 30 to the center system 40 based on the determination and operation of the user. Therefore, in

the embodiment of the present disclosure, it is possible to transmit the cancelation signal to the center system 40 expecting a determination error on the center system 40 side even though the vehicle has run on the toll road. In order to reduce such fraud, in the information processing system 1 according to another embodiment, for example, when the cancelation signal that does not indicate erroneous charging is transmitted to the center system 40 a certain number of times, a cancelation signal from the vehicle 30, to which the cancelation signal that does not indicate erroneous charging has been transmitted, may not be received for a certain period of time. Further, in the information processing system 1 according to another embodiment, for example, a deposit may be made to be paid when the cancelation signal is transmitted, the deposit may be returned only when the cancelation signal indicates erroneous charging, and the deposit may be confiscated in other cases. Further, in the information processing system 1 according to another embodiment, for example, when the cancelation signal that does not indicate erroneous charging is transmitted to the center system 40, a user (for example, a driver, a charging target person, or the like), who is associated with the vehicle 30 in which the cancelation signal is transmitted, may be downgraded.

[0045]

(Effects of Action)

In this way, in the information processing system 1 according to another embodiment, it is possible to reduce the reception of unnecessary cancelation signals. As a result, the information processing system 1 can quickly perform the cancelation process.

[0046]

In the embodiment of the present disclosure, the correction unit 404 has been described as determining whether or not the ambient environment information, which is included in the cancelation signal, indicates erroneous charging. However, in another embodiment, a determination result obtained by a person may be used instead of the determination result obtained by the correction unit 404 according to the embodiment of the present disclosure. For example, when the ambient environment information is an image, a person looks at the image and determines whether or not a region is the predetermined region where charging has been performed. The person records the determination result in the storage unit 403. The correction unit 404 acquires the determination result by reading the determination result recorded in the storage unit 403. The correction unit 404 may use the acquired determination result as the determination result in the

process of step S10 in the embodiment of the present disclosure to perform the process.

[0047]

(Effects of Action)

In this way, in the information processing system 1 according to another embodiment, determination made by a person can be reduced. As a result, the information processing system 1 can quickly perform the cancelation process.

[0048]

In another embodiment, the correction unit 404 may transmit a cancelation completion signal to the vehicle 30 when the cancelation process is completed. Further, the notification unit 305 may provide a notification that the cancelation process of erroneous charging has been performed in response to the cancelation completion signal.

[0049]

(Effects of Action)

In this way, in the information processing system 1 according to another embodiment, it is possible for the user to know that the cancelation process has been performed.

[0050]

The process described in the embodiment of the present disclosure is a process on the premise that the

process of providing instruction for the charging process from the vehicle 30 to the center system 40 is correct, based on the degree of certainty in steps S3 to S4. Therefore, whether or not to transmit the cancelation signal in step S8 has been described as being determined by the user. However, even when the degree of certainty in a case where it is determined that the vehicle 30 is present in the predetermined region is the degree of certainty in which instruction for charging is provided, it may be found that the vehicle 30 was not actually present in the predetermined region after the vehicle 30 passed through the predetermined region and the charging process was completed. For example, it is assumed that a passage A, which is a toll road, and a passage B, which is a general road, run parallel, the vehicle 30 is present in the predetermined region in the passage A, and the charging process is performed after it is determined that the degree of certainty is equal to or higher than a predetermined value. After the vehicle 30 passed through the predetermined region, when the passage A does not have a right-turn curve, but the passage B has a right-turn curve, and the positioning of the vehicle 30 indicates a right-turn curve, it turned out to be the vehicle 30 was running on the general road instead of the toll road. That is, the determination that the vehicle 30 was present

in the predetermined region is incorrect, and the charging is an erroneous charging. In another embodiment, for example, the cancelation unit 306 may determine erroneous charging after the charging as described above, and transmit the cancelation signal to the center system 40 as in step S8.

[0051]

(Effects of Action)

In this way, in the information processing system 1 according to another embodiment, the charging can be determined more accurately.

[0052]

In the process according to the embodiment of the present disclosure, the order of the process may be exchanged within a range in which an appropriate process is performed.

[0053]

Each of the storage unit or the storage device (including a register and a latch) in the embodiment of the present disclosure may be provided anywhere within a range in which appropriate information is transmitted and received. Further, a plurality of the storage units or the storage devices may be present in places within a range in which appropriate information is transmitted and received, and may distribute and store data.

[0054]

Although the embodiment of the present disclosure has been described, the information processing system 1, the vehicle-mounted device 30a, the acquisition device 20, the center system 40, and other control devices may have a computer system inside. The procedures of the above-mentioned processes are stored in a computer-readable recording medium in a form of a program, and the above-mentioned processes are performed by the computer reading and executing this program. A specific example of the computer is shown below.

Fig. 8 is a schematic block diagram showing a configuration of a computer according to at least one embodiment.

As shown in Fig. 8, a computer 5 includes a CPU 6, a main memory 7, a storage 8, and an interface 9.

For example, each of the above-described information processing system 1, the vehicle-mounted device 30a, the acquisition device 20, the center system 40, and other control devices is mounted on the computer 5. An operation of each processing unit described above is stored in the storage 8 in the form of a program. The CPU 6 reads the program from the storage 8, loads the program into the main memory 7, and executes the above process according to the program. Further, the CPU 6 secures a

storage area corresponding to each of the above-mentioned storage units in the main memory 7 according to the program.

[0055]

Examples of the storage 8 include a hard disk drive (HDD), a solid state drive (SSD), a magnetic disk, an optical magnetic disk, a compact disc read only memory (CD-ROM), a digital versatile disc read only memory (DVD-ROM), a semiconductor memory, and the like. The storage 8 may be an internal medium directly connected to a bus in the computer 5 or may be an external medium connected to the computer 5 via an interface 9 or via a communication line. Further, when this program is distributed to the computer 5 by using the communication line, the computer 5, in which the program is distributed, may load the program in the main memory 7 and execute the above process. In at least one embodiment, the storage 8 is a non-temporary tangible storage medium.

[0056]

Further, the above program may implement some of the above-mentioned functions. Further, the program may be a file, a so-called difference file (difference program), that can implement the above-mentioned functions in combination with a program already recorded in a computer system.

[0057]

Although some embodiments of the present disclosure have been described, these embodiments are examples and do not limit the scope of the disclosure. These embodiments may be subject to various additions, various omissions, various replacements, and various changes without departing from the gist of the disclosure.

[0058]

<Additional Notes>

The vehicle-mounted device 30a and the information processing system 1 described in each embodiment of the present disclosure are understood as follows, for example.

[0059]

(1) A vehicle-mounted device (30a) according to a first aspect includes: an instruction unit (304) that performs a charging process based on position information indicating a position of a vehicle (30) obtained by a GNSS satellite (10); a recording unit (201) that records ambient environment information at at least one time close to a charging time at which charging is performed in the charging process; a determination unit (306) that determines a presence or absence of circumstances in which the charging process needs to be reviewed; and a transmission unit (306) that transmits specific information of a charging point at which the charging is

performed, and the ambient environment information to an outside when the determination unit (306) determines that the circumstances are present.

[0060]

As a result, the vehicle-mounted device (30a) can reduce erroneous charging in the toll road charging using the vehicle (30) positioning information obtained by the GNSS satellite (10).

[0061]

(2) The vehicle-mounted device (30a) according to a second aspect is the vehicle-mounted device (30a) of (1), in which the ambient environment information at at least one time close to the charging time may be ambient environment information at the charging time, a predetermined time before the charging time, a predetermined time after the charging time, the charging point, a predetermined distance behind the charging point, or a predetermined distance ahead of the charging point.

[0062]

As a result, a user of the vehicle-mounted device (30a) can show evidence of erroneous charging.

[0063]

(3) The vehicle-mounted device (30a) according to a third aspect is the vehicle-mounted device (30a) of (1) or (2), in which the recording unit (201) may record the

ambient environment information in association with time.

[0064]

As a result, a user of the vehicle-mounted device (30a) can show evidence of erroneous charging.

[0065]

(4) The vehicle-mounted device (30a) according to a fourth aspect is the vehicle-mounted device (30a) of any one of (1) to (3), in which the ambient environment information may be information including an image captured from the vehicle (30).

[0066]

As a result, a user of the vehicle-mounted device (30a) can show evidence of erroneous charging.

[0067]

(5) The vehicle-mounted device (30a) according to a fifth aspect is the vehicle-mounted device (30a) of any one of (1) to (4), the vehicle-mounted device (30a) may include a calculation unit (303) that calculates a degree of certainty, which indicates certainty in which the vehicle (30) has passed the charging point, based on at least one of a running history of the vehicle (30), a distance between two roads, at least a part of which run parallel to each other on a passage indicated by the running history, and accuracy of the position of the vehicle (30) obtained by the GNSS satellite (10), in which

the determination unit (306) may determine that the circumstances, in which the charging process needs to be reviewed, are present when the degree of certainty is equal to or lower than a threshold value, and the transmission unit (306) may transmit the specific information and the ambient environment information to the outside when the determination unit determines that the circumstances, in which the charging process needs to be reviewed, are present.

[0068]

As a result, the vehicle-mounted device (30a) can reduce erroneous charging in the toll road charging using the vehicle (30) positioning information obtained by the GNSS satellite (10).

[0069]

(6) The vehicle-mounted device (30a) according to a sixth aspect is the vehicle-mounted device (30a) of any one of (1) to (5), the vehicle-mounted device (30a) may include a notification unit (305) that provides a notification that the charging has been performed.

[0070]

As a result, the user of the vehicle-mounted device (30a) can know that the charging has been performed.

[0071]

(7) The vehicle-mounted device (30a) according to a

seventh aspect is the vehicle-mounted device (30a) of any one of (1) to (6), the vehicle-mounted device (30a) may include a reception unit (306) that receives a fact that the charging is erroneous charging, in which the determination unit (306) determines that the circumstances are present when the reception unit (306) receives the fact that the charging is the erroneous charging.

[0072]

As a result, the vehicle-mounted device (30a) can reduce erroneous charging in the toll road charging using the vehicle (30) positioning information obtained by the GNSS satellite (10).

[0073]

(8) An information processing system (1) according to an eighth aspect is the information processing system (1) including the vehicle-mounted device (30a) according to any one of (1) to (7) and an information processing apparatus (40), the information processing system (1) includes: a performing unit (402) that performs the charging process; and a changing unit (404) that reviews the charging process based on the specific information and the ambient environment information.

[0074]

As a result, the information processing system (1) can reduce erroneous charging in the toll road charging

using the vehicle (30) positioning information obtained by the GNSS satellite (10).

[0075]

(9) A control method of a vehicle-mounted device (30a) according to a ninth aspect includes: performing a charging process based on position information indicating a position of a vehicle (30) obtained by a GNSS satellite (10); recording ambient environment information at at least one time close to a charging time at which charging is performed in the charging process; determining a presence or absence of circumstances in which the charging process needs to be reviewed; and transmitting specific information of a charging point at which the charging is performed, and the ambient environment information when it is determined that the circumstances are present.

[0076]

As a result, the control method of the vehicle-mounted device (30a) can reduce erroneous charging in the toll road charging using the vehicle (30) positioning information obtained by the GNSS satellite (10).

[0077]

(10) A control method of an information processing system (1) according to a tenth aspect is a control method of an information processing system (1) that includes a vehicle-mounted device (30a) and an information processing

apparatus (40), the control method includes: performing a charging process based on position information indicating a position of a vehicle (30) obtained by a GNSS satellite (10); recording ambient environment information at at least one time close to a charging time at which charging is performed in the charging process; determining a presence or absence of circumstances in which the charging process needs to be reviewed; transmitting specific information of a charging point at which the charging is performed, and the ambient environment information when it is determined that the circumstances are present; performing the charging process; and reviewing the charging process based on the specific information and the ambient environment information.

[0078]

As a result, the control method of the information processing system (1) can reduce erroneous charging in the toll road charging using the vehicle (30) positioning information obtained by the GNSS satellite (10).

[0079]

(11) A program according to an eleventh aspect for causing a computer (5) of a vehicle-mounted device (30a) to execute a process includes: performing a charging process based on position information indicating a position of a vehicle (30) obtained by a GNSS satellite

(10); recording ambient environment information at at least one time close to a charging time at which charging is performed in the charging process; determining a presence or absence of circumstances in which the charging process needs to be reviewed; and transmitting specific information of a charging point at which the charging is performed, and the ambient environment information when it is determined that the circumstances are present.

[0080]

As a result, the program can reduce erroneous charging in the toll road charging using the vehicle (30) positioning information obtained by the GNSS satellite (10).

[Industrial Applicability]

[0081]

According to a vehicle-mounted device, an information processing system, a control method, and a program of the present disclosure, it is possible to reduce erroneous charging, in charging on a toll road by using vehicle positioning information obtained by a GNSS satellite.

[Reference Signs List]

[0082]

- 1 Information processing system
- 5 Computer

6: CPU
7: Main memory
8: Storage
9: Interface
10: GNSS satellite
20: Acquisition device
30: Vehicle
30a: Vehicle-mounted device
40: Center system
201: Acquisition unit
202, 403: Storage unit
203, 301, 401: Communication unit
302: Positioning unit
303: Modification unit
304: Instruction unit
305: Notification unit
306: Cancelation unit
402: Processing unit
404: Correction unit

Claims

[Claim 1]

A vehicle-mounted device comprising:

an instruction unit that performs a charging process based on position information indicating a position of a vehicle obtained by a GNSS satellite;

a recording unit that records ambient environment information at at least one time close to a charging time at which charging is performed in the charging process;

a determination unit that determines a presence or absence of circumstances in which the charging process needs to be reviewed; and

a transmission unit that transmits specific information of a charging point at which the charging is performed, and the ambient environment information to an outside when the determination unit determines that the circumstances are present.

[Claim 2]

The vehicle-mounted device according to Claim 1, wherein

the ambient environment information at at least one time close to the charging time is ambient environment information at the charging time, a predetermined time

before the charging time, a predetermined time after the charging time, the charging point, a predetermined distance behind the charging point, or a predetermined distance ahead of the charging point.

[Claim 3]

The vehicle-mounted device according to Claim 1 or 2, wherein

the recording unit records the ambient environment information in association with time.

[Claim 4]

The vehicle-mounted device according to any one of Claims 1 to 3, wherein

the ambient environment information is information including an image captured from the vehicle.

[Claim 5]

The vehicle-mounted device according to any one of Claims 1 to 4, further comprising:

a calculation unit that calculates a degree of certainty, which indicates certainty in which the vehicle has passed the charging point, based on at least one of a running history of the vehicle, a distance between two roads, at least a part of which run parallel to each other

on a passage indicated by the running history, and accuracy of the position of the vehicle obtained by the GNSS satellite, wherein

the determination unit determines that the circumstances, in which the charging process needs to be reviewed, are present when the degree of certainty is equal to or lower than a threshold value, and

the transmission unit transmits the specific information and the ambient environment information to the outside when the determination unit determines that the circumstances, in which the charging process needs to be reviewed, are present.

[Claim 6]

The vehicle-mounted device according to any one of Claims 1 to 5, further comprising:

a notification unit that provides a notification that the charging has been performed.

[Claim 7]

The vehicle-mounted device according to any one of Claims 1 to 6, further comprising:

a reception unit that receives a fact that the charging is erroneous charging, wherein

the determination unit determines that the

circumstances are present when the reception unit receives the fact that the charging is the erroneous charging.

[Claim 8]

An information processing system including the vehicle-mounted device according to any one of Claims 1 to 7 and an information processing apparatus, the information processing system comprising:

- a performing unit that performs the charging process; and

- a changing unit that reviews the charging process based on the specific information and the ambient environment information.

[Claim 9]

A control method of a vehicle-mounted device, comprising:

- performing a charging process based on position information indicating a position of a vehicle obtained by a GNSS satellite;

- recording ambient environment information at at least one time close to a charging time at which charging is performed in the charging process;

- determining a presence or absence of circumstances in which the charging process needs to be reviewed; and

transmitting specific information of a charging point at which the charging is performed, and the ambient environment information when it is determined that the circumstances are present.

[Claim 10]

A control method of an information processing system that includes a vehicle-mounted device and an information processing apparatus, the control method comprising:

performing a charging process based on position information indicating a position of a vehicle obtained by a GNSS satellite;

recording ambient environment information at at least one time close to a charging time at which charging is performed in the charging process;

determining a presence or absence of circumstances in which the charging process needs to be reviewed;

transmitting specific information of a charging point at which the charging is performed, and the ambient environment information when it is determined that the circumstances are present;

performing the charging process; and

reviewing the charging process based on the specific information and the ambient environment information.

[Claim 11]

A program for causing a computer of a vehicle-mounted device to execute a process comprising:

performing a charging process based on position information indicating a position of a vehicle obtained by a GNSS satellite;

recording ambient environment information at at least one time close to a charging time at which charging is performed in the charging process;

determining a presence or absence of circumstances in which the charging process needs to be reviewed; and

transmitting specific information of a charging point at which the charging is performed, and the ambient environment information when it is determined that the circumstances are present.