DESCRIPTION

Vehicle-mounted Device

Technical Field

[0001]

The present invention relates to a vehicle-mounted device, fitted in a vehicle, for exchanging information relating to fee collection by wireless with a charging communication apparatus for carrying out fee collection for toll roads etc.

Background Art

[0002]

In recent years, so-called road pricing has been implemented, where areas that are subject to charging are provided in urban areas, as measures for tackling problems such as traffic jams and air pollution caused by too many vehicles driving into the center of large metropolitan areas.

With this road pricing, gantries are provided at each of the entrances and exits of charging areas, on which wireless communications equipment for charging is mounted. Also, vehicles driving into the charging area are required to be fitted with a vehicle-mounted device. If a vehicle passes the gantries and drives in to the charging area, transfer of

information required for charging is carried out between the wireless communication equipment and the vehicle-mounted device, and charging processing for the vehicle is carried out by electronic means (refer to Japanese Unexamined Patent Application, Publication No. 2003-323648, for example).

[0003]

An ETC (Electronic Toll Collection) system is also known as a system for automatically collecting a road usage charge. On toll roads, this ETC system can automatically collect a fee by performing wireless communication between roadside wireless units installed at a tollgate, and a vehicle-mounted device mounted in a vehicle.

Patent Document 1:

Japanese Unexamined Patent Application, Publication No. 2003-323648 (Fig. 11)

Disclosure of Invention

[0004]

With the automatic collection system for road tolls such as described above, automation of fee collection is realized by storing charge information in an IC card or the like inserted into the vehicle-mounted device. This IC card is capable of being removed from the vehicle-mounted device, so that it can be used with a number of vehicles, and so in a case where it is removed from the vehicle-mounted device when

alighting the vehicle, there is a problem that if the driver forgets to insert the IC card later, automatic collection of a fee at a tollgate is not possible.

[0005]

The present invention has been conceived in view of the above described situation, and an object of the present invention is to provide a vehicle-mounted device that can avoid a situation such as an IC card not being inserted when a vehicle passes a tollgate on a toll road or the like.

[0006]

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

A first aspect of the present invention is directed to a vehicle-mounted device, fitted in a vehicle, and for exchanging information relating to a charge with a charging communication apparatus that is installed at at least one of an entrance and an exit of a charging area, or a tollgate of a toll road, comprising a card interface for exchanging information with a charging card storing information relating to a charge, zone entry detection means for detecting that a confirmation zone, provided ahead of the charging communication apparatus, has been entered, determination means for determining whether or not the charging card and the card interface are connected in a communicable state when entry into the confirmation zone has been detected, and alarm

notification means for, when the charging card and the card interface are not connected in a communicable state, issuing an alarm indicating this fact.

[0007]

According to the above described first aspect, when the fact that a confirmation zone provided ahead of the charging communication apparatus has been entered is detected by the zone entry detection section, it is determined by the determination section whether or not the charging card and the card interface are connected in a communicable state, and if the charging card and the card interface are not connected in a communicable state an alarm indicating this fact is issued. In this way, the user of a vehicle can ascertain that the charging card is not in a usable state before entering a charging area or a tollgate of a toll road. As a result, it is possible to avoid a state such as being unable to write information to the charging card or being unable to read information from the charging card at the tollgate etc.

The charging card can be any type of card, as long as it is a card that can be used in charge processing, such as a pre-paid card or an IC card. It is also possible for the charging card to be either a non-contact type card or a contact type card.

As the above-described charging area, for example, examples that can be mentioned are an area where a fixed road

usage fee is levied, such as road pricing, or an area where a usage fee is levied in accordance with usage time, such as a pay car park.

[0008]

A second aspect of the present invention is directed to a vehicle-mounted device, fitted in a vehicle, and for exchanging information relating to a charge with a charging communication apparatus that is installed at at least one of an entrance and an exit of a charging area, or a tollgate of a toll road, comprising a card interface for exchanging information with a charging card storing information relating to a charge, storage means for registering position information of a reference position provided at the periphery of an installation position of the charging communication apparatus, distance calculating means for calculating a distance to the reference position from position information of the reference position and position information of itself, determination means for determining whether or not the charging card and the card interface are connected in a communicable state when the distance is within a predetermined range, and alarm notification means for, when the charging card and the card interface are not connected in a communicable state, issuing an alarm indicating this fact.

[0009]

According to the above described second aspect, when a

vehicle is within a predetermined distance range from the charging communication apparatus, it is determined by the determination section whether or not the charging card and the card interface are connected in a communicable state, and if the charging card and the card interface are not connected in a communicable state an alarm indicating this fact is issued. In this way, the user of a vehicle can ascertain that the charging card is not in a usable state before entering a charging area or a tollgate of a toll road. As a result, it is possible to avoid a state such as being unable to write information to the charging card or being unable to read information from the charging card at the tollgate etc.

[0010]

A third aspect of the present invention is directed to a vehicle-mounted device, fitted in a vehicle, and for exchanging information relating to a charge with a charging communication apparatus that is installed at at least one of an entrance and an exit of a charging area, or a tollgate of a toll road, comprising an IC card insertion section into which an IC card is inserted, zone entry detection means for detecting that a confirmation zone, provided ahead of the charging communication apparatus, has been entered, determination means for determining whether or not the IC card is inserted in the IC card insertion section when entry into the confirmation zone has been detected, and alarm

notification means for, when the IC card is not inserted in the IC card insertion section, issuing an alarm indicating this fact.

[0011]

According to the above described third aspect, when the fact that a confirmation zone provided ahead of the charging communication apparatus has been entered is detected by the zone entry detection section, it is determined by the determination section whether or not the IC card is inserted in the IC card insertion section, and if the IC card is not inserted into the IC card insertion section an alarm indicating this fact is issued. In this way, the user of a vehicle can ascertain that the IC card is not inserted in the IC card insertion section before entering a charging area or a tollgate of a toll road. As a result, it is possible to avoid the situation, at a tollgate or the like, where an IC card is not inserted in the IC card insertion section and it is not possible to carry out fee collection processing.

[0012]

A fourth aspect of the present invention is directed to a vehicle-mounted device, fitted in a vehicle, and for exchanging information relating to a charge with a charging communication apparatus that is installed at at least one of an entrance and an exit of a charging area, or a tollgate of a toll road, comprising an IC card insertion section into which

an IC card is inserted, storage means in which position information for a reference position, that is provided at the periphery of the installation position of the charging communication apparatus, is registered, distance calculating means for calculating a distance to the reference position from the position information of the reference position and the position information of itself, determination means for determining whether or not the IC card is inserted in the IC card insertion section when the distance is within a predetermined range, and alarm notification means for, when the IC card is not inserted in the IC card insertion section, issuing an alarm indicating this fact.

[0013]

According to the above described fourth aspect, when a vehicle is within a predetermined distance from the charging communication apparatus, it is determined by the determination section whether or not the IC card is inserted in the IC card insertion section, and if the IC card is not inserted into the IC card insertion section, an alarm indicating this fact is issued. In this way, the user of a vehicle can ascertain that the IC card is not inserted in the IC card insertion section before entering a charging area or a tollgate of a toll road. As a result, it is possible to avoid the situation, at a tollgate or the like, where an IC card is not inserted in the IC card insertion section and it is not possible to carry out

charging processing.

[0014]

With the vehicle-mounted device of any of the above described first to fourth aspects, it is also possible to have a structure where the determination means determines whether or not the IC card is inserted in the IC card insertion section when the distance is within the predetermined range, and also the distance is decreasing.

[0015]

With this type of structure, whether or not the IC card is inserted is only determined when the vehicle is approaching the charging communication apparatus. In this way, in situations such as when a vehicle is far away from the charging communication apparatus, when it is not necessary to perform charging processing using the IC card, determination is not carried out, and it is possible to cut down on pointless determination.

[0016]

With the vehicle-mounted device of any of the above-described first to fourth aspects, it is also possible to have a structure where insertion detection means for mechanically detecting that the IC card has been inserted is provided in the IC card insertion section, and the determination means determines that the IC card has been inserted in the IC card insertion section when the insertion detection means detects

card insertion, and the IC card information can be read.

[0017]

With this type of structure, since the determination means determines that the IC card has been inserted in the IC card insertion section when card insertion is detected by the insertion detection means, and the IC card information can be read, it is possible to reliably determine whether or not the IC card is in a usable state.

[0018]

The vehicle-mounted device of any of the above-described first to fourth aspects can also be configured to vary the manner of alarm notification according to distance to the reference position.

[0019]

With this type of arrangement, by varying the manner of alarm notification depending on the distance to the charging communication apparatus, it is possible to more strongly provoke the user to insert the IC card as the charging communication apparatus is approached, for example, by issuing the alarm at a higher level. It is also possible for the user to ascertain the approximate distance to the charging communication apparatus depending on the manner of alarm notification.

[0020]

Incidentally, the respective structures described above

can be combined where possible.

[0021]

According to the present invention, the effect is achieved of being able to avoid a situation such as automatic collection not being possible due to an IC card not being inserted in a vehicle-mounted device, when a vehicle passes through a tollgate on a toll road or the like.

Brief Description of Drawings

[0022]

FIG. 1 is a drawing showing one example of a charging area of a first embodiment of the present invention.

Fig. 2 is a drawing of an area around a tollgate of a charging area, looking from the road shoulder.

Fig. 3 is a drawing for describing a confirmation zone provided before a tollgate.

FIG. 4 is a block diagram showing the schematic structure of a vehicle-mounted device of a first embodiment of the present invention.

FIG. 5 is a drawing for describing the operation of the vehicle-mounted device of a second embodiment of the present invention.

FIG. 6 is a drawing for describing the operation of a vehicle-mounted device of another aspect of the present invention.

Explanation of Reference Signs:

1 : vehicle

2 : tollgate

3 : charging communication apparatus

5 : first antenna

8 : second antenna

20 : vehicle-mounted device

24 : GPS receiver

25 : storage device

16 : control section

27 : communication section

30 : IC card insertion section

31 : IC card interface

32 : insertion detection section

A : charging area

B : confirmation zone

Best Mode for Carrying Out the Invention

[0024]

One embodiment of a vehicle-mounted device of the present invention will be described in the following with reference to the drawings. With this embodiment, a case used in road

pricing will be described as one example.

[0025]

[First Embodiment]

As shown in Fig. 1, tollgates 2 for collecting a road usage fee from a vehicle 1 that has entered a charging area A are provided on all roads passing across boundaries between charging areas A, which are areas subjected to road pricing. At these tollgates 2, a double column type support beam is arranged spanning a travel road at the boundary of charging area A. Charging communication apparatus 3 corresponding to each travel lane is arranged on this double column type support beam.

[0026]

As shown in Fig. 2, this charging communication apparatus 3 is, for example, provided with a first antenna 5, a camera 6, a vehicle detection unit 7 and a second antenna 8, and a control unit (not shown) for controlling these components. This charging communication apparatus 3 is for automatically levying a road usage charge by transferring information relating to charging with a vehicle-mounted device fitted to a vehicle passing the travel lane corresponding to itself. The above-described structure is only an example, and the structure of the charging communication apparatus 3 is not particularly limited.

Also, as shown in Fig. 3, in each driving lane, a

confirmation zone B is provided before the tollgate 2. This confirmation zone B is a zone for confirming if the IC card (charge card) is inserted into the vehicle-mounted device fitted in the vehicle 1.

[0027]

Fig. 4 is a block diagram showing the schematic structure of the vehicle-mounted device of this embodiment. As shown in Fig. 4, the vehicle-mounted device 20 comprises, as its main structural components, a power supply circuit 23 connected to a vehicle power supply 21 and an internal battery 22, a GPS receiver 24 for detecting current position by acquiring information relating to position information from a GPS satellite, a storage device 25 for storing various information, a control section 26, a communication section 27 for carrying out communication with the first antenna 5 and the second antenna 8 of the charging communication apparatus 3, a display section 28, an alarm notification section 29 such as buzzer or LED, an IC card insertion section 30 into which an IC card is inserted, and an IC card interface 31 provided in the IC card insertion section 30. Also, an insertion detection section (insertion detection means) 32 for mechanically detecting whether or not the IC card is in a normal inserted state is provided in the IC card insertion section 30.

[0028]

Further, an IC card to be inserted into the IC card insertion section 30 is, for example, a contact type IC card, and is internally fitted with an IC chip such as a flash memory or an MPU. As well as card information such as a card ID number, a balance and usage history are stored in this IC card. Information stored in the IC card can be written or read by the control section 26 via the IC card interface 31.

[0029]

In the vehicle-mounted device 20, the power supply circuit 23 mainly controls a voltage supplied from the vehicle power supply 21 to a voltage adopted in the vehicle-mounted device 20, and supplies this voltage to each of the sections constituting the vehicle-mounted device 20. The internal battery 22 is provided so as to be able to ensure electrical power to an extent to permit communication, even if the supply of power from the vehicle power supply 21 is cut off. Map information for the confirmation zone B is stored in the storage device 25. Also, various information that is necessary for the charging process is held in the storage device 25, such as car owner information, vehicle information including type of vehicle information, balance information read out from an IC card, and card information etc.

[0030]

The control section 26 is for performing control of each section, and is provided with a zone entry detection function

(zone entry detection means) for detecting that a vehicle 1 has entered the confirmation zone B based on position information from the GPS receiver 24 and confirmation zone B map information stored inside the storage device, and a determination function (determination means) for determining whether or not an IC card is inserted in the IC card insertion section in the event that the confirmation zone B being entered has been detected.

The communication section 27 is for transferring information with the charging communication apparatus 3 using wireless.

The display section 28 is, for example, a liquid crystal display, and is for notifying information relating to automatic collection, such as a road toll, etc., to the user of a vehicle 1, by temporarily displaying a balance stored in the IC card.

[0031]

The alarm notification section 29 is for prompting a user to correctly insert an IC card when, for example, it is detected by the control section 26 that an IC card is not inserted in the IC card insertion section 30, by issuing an alarm indicating this fact to the user. For example, the alarm notification section 29 is provided with a buzzer for giving alarm notification using sound, or an LED or the like for performing alarm notification using flashing light.

The insertion detection section 32 provided in the IC card insertion section 30 is provided with a switch that is changed from an open state to a closed state with insertion of an IC card, and if it is detected that this switch is put in a closed state an insertion detection signal is output to the control section 26.

[0032]

With the vehicle-mounted device 20 provided with this type of structure, if, as a result of a vehicle 1 entering the confirmation zone B, this fact is detected by the control section 26, the control section 26 confirms whether or not an IC card is inserted in the IC card insertion section 30. Specifically, when a detection signal is input from the insertion detection section 32, and information is read out from the IC card, the control section 26 determines that an IC card is inserted, and carries out display to notify this fact on the display section 28.

On the other hand, in the event that the control section 26 determines that an IC card is not inserted, then as well as displaying an indication of the fact that an IC card is not inserted on the display section 28, indication that an IC card is not inserted in the IC card insertion section 30 is issued as an alarm to the user by causing operation of the alarm notification section 29, to prompt for IC card insertion. In this way, it is possible for the user to ascertain that an IC

card has not been inserted.

[0033]

As has been described above, according to the vehicle-mounted device 20 of this embodiment, in the event that it is confirmed, before an entrance tollgate, such as for road pricing etc., whether or not an IC card has been inserted into an IC card insertion section 30, and an IC card is in fact not inserted, by issuing an alarm notification indicting this to the user it is possible to prevent a situation at an entrance tollgate where automatic collection of a fee can not be carried out due to the fact that an IC card is not inserted into the IC card insertion section 30.

[0034]

Further, as a result of this alarm notification, it is possible for the user to grasp that a charging area A will be entered if they have keep traveling. In this way, it is possible to prevent mistaken entry into the charging area A, for example. In this manner, alarm notification by the alarm notification section 29 not only serves as an alarm that an IC card is not inserted, but can also be used as alarm notification for entry into the charging area A.

[0035]

Incidentally, with this embodiment, description has been given for a case applied to a charging area A in road pricing, but it is also possible, for example, to widely apply the

invention to systems for carrying out charge processing using an IC card, such as toll gates and entrances and exits of toll car park, for example.

Also with this embodiment, it is detected that the IC card is inserted when a detection signal is input from the insertion detection section 32 and data is read from the IC card, but it is also possible to detect that the IC card has been inserted when only one of these conditions is detected.

Also, with this embodiment, the fact that the confirmation zone has been entered is detected based on map information and position information from a GPS receiver, but the method of detecting whether or not the confirmation zone has been entered is not limited to this example, and it is also possible to use another detection method. For example, it is possible to install an antenna at the periphery of the confirmation zone, and detect that the confirmation zone has been entered when a predetermined signal emitted from this antenna is received.

[0036]

Also, with the vehicle-mounted device 20 of this embodiment, description has been given of a device having a GPS receiver 24 built in, but instead of this it is also possible to connect to a mobile terminal unit having a GPS function, or to a car navigation system, by means of external component terminals, and to use the GPS function provided in

these device as the GPS receiver 24. Also, the embodiment is not limited to the GPS receiver 24, and it is possible to connect to other structural components via the external component terminals.

[0037]

[Second Embodiment]

Next, a vehicle-mounted device of a second embodiment of the present invention will be described.

The vehicle-mounted device 20 of this embodiment differs from the above described first embodiment in that position information of each tollgate 2 is stored in the storage section 25, instead of the map information for the confirmation zone B. The vehicle-mounted device of this embodiment will be described below, omitting description of points that are common to the first embodiment and focusing only on points of difference.

[0038]

With the vehicle-mounted device 20 of this embodiment, if the control section 26 ascertains current position (X, Y) of the vehicle based on position information acquired by the GPS receiver 24, it then determines whether or not there is position information for a tollgate 2 existing within a predetermined radius range from the current position (X, Y) based on position information of tollgates (x0, y0), (x1, y1), ..., (xn, yn) stored in the storage section 25.

If the result is that there is a tollgate 2 in the position information (x0, y0) existing within a predetermined distance range from the current position (X, Y) of the vehicle, a distance between the two is calculated based on current position (X, Y) of the vehicle acquired by the GPS receiver 24, and the position information of the tollgate (x0, y0). Then, if the distance between the two is decreasing, determination as to whether or not the IC card is inserted is carried out.

[0039]

In this way, according to the vehicle-mounted device 20 of this embodiment, when a tollgate 2 close to the current position (X, Y) of the vehicle 1 is detected and the distance to that tollgate 2 is decreasing, it is determined that the vehicle 1 is traveling towards the tollgate 2, and determination of whether or not there is an IC card inserted in carried out. In this way, it is possible to confirm whether or not an IC card is inserted only when the vehicle 1 enters the tollgate 2. In this way, when far away from a tollgate 2, that is, when there is no problem even if an IC card is not inserted into the IC card insertion section 30, determination relating to whether or not an IC card is inserted is not carried out, and so it is possible to significantly reduce pointless determination processing.

[0040]

Incidentally, in this embodiment, it is also possible to have differing ways of issuing alarm notification by the alarm notification section 29 according to the distance to the tollgate 2.

For example, it is possible to more strongly encourage a user to inert an IC card as the distance to the tollgate 2 becomes shorter. For example, if the alarm notification section 29 is a buzzer, it is possible to gradually increase the volume, or to make intervals between buzzer sounds shorter, or to use a combination of these approaches. Also, if the alarm notification section 29 is an LED, it is possible to gradually increase the amount of light emitted, or to make intervals between flashes shorter, or to adopt a combination of these approaches. Also, as shown in Fig. 6, it is also possible to divide distance to the tollgate 2 into a plurality of stages (in Fig. 6 the distance is divided into two stages), and carry out alarm notification according to each stage.

[0041]

Also, with this embodiment it is determined that the vehicle 1 is going towards the tollgate 2 because a distance between the vehicle 1 and the tollgate 2 is decreasing, but in addition to this it is also possible to consider the route used when going towards the tollgate 2. Specifically, it is possible to have an arrangement in which routes where tollgates 2 are provided are stored in advance in the storage

section 25 in association with position information of each tollgate 2, and it is determined that the vehicle 1 is going towards the tollgate 2 when the distance between the vehicle 1 and the tollgate 2 is within a predetermined distance range, and a route that is associated with that tollgate 2 is being traveled along, and further, that the distance between the vehicle 1 and the tollgate 2 is decreasing. In this way, by also taking into consideration a route towards the tollgate 2, for example, even when a plurality of roads cross three-dimensionally in the vicinity of a toll gate, it is possible to determine whether or not the IC card is inserted by restricting to vehicles traveling along a route that runs towards the tollgate 2.

[0042]

Incidentally, with this embodiment the reference position is made the position of a tollgate 2, but instead of this it is also possible to make the reference position an arbitrary position around the installation position of the tollgate 2.

[0043]

Also, the first and second embodiments above have been described with a contact type IC card as one example, but it is also possible to the use a non-contact IC card instead.

CLAIMS

1. A vehicle-mounted device, fitted in a vehicle, and for exchanging information relating to a charge with a charging communication apparatus that is installed at at least one of an entrance and an exit of a charging area, or a tollgate of a toll road, comprising

a card interface for exchanging information with a charging card storing information relating to a charge,

zone entry detection means for detecting that a confirmation zone, provided ahead of the charging communication apparatus, has been entered,

determination means for determining whether or not the charging card and the card interface are connected in a communicable state when entry into the confirmation zone has been detected, and

alarm notification means for, when the charging card and the card interface are not connected in a communicable state, issuing an alarm indicating this fact.

2 A vehicle-mounted device, fitted in a vehicle, and for exchanging information relating to a charge with a charging communication apparatus that is installed at at least one of an entrance and an exit of a charging area, or a tollgate of a toll road, comprising

a card interface for exchanging information with a charging card storing information relating to a charge,

storage means for registering position information of a reference position provided at the periphery of an installation position of the charging communication apparatus,

distance calculating means for calculating a distance to the reference position from position information of the reference position and position information of itself,

determination means for determining whether or not the charging card and the card interface are connected in a communicable state when the distance is within a predetermined range, and the distance is decreasing, and

alarm notification means for, when the charging card and the card interface are not connected in a communicable state, issuing an alarm indicating this fact.

3. A vehicle-mounted device, fitted in a vehicle, and for exchanging information relating to a charge with a charging communication apparatus that is installed at at least one of an entrance and an exit of a charging area, or a tollgate of a toll road, comprising

an IC card insertion section into which an IC card is inserted,

zone entry detection means for detecting that a confirmation zone, provided ahead of the charging

communication apparatus, has been entered,

determination means for determining whether or not the IC card is inserted in the IC card insertion section when entry into the confirmation zone has been detected, and

alarm notification means for, when the IC card is not inserted in the IC card insertion section, issuing an alarm indicating this fact.

4. A vehicle-mounted device, fitted in a vehicle, and for exchanging information relating to a charge with a charging communication apparatus that is installed at at least one of an entrance and an exit of a charging area, or a tollgate of a toll road, comprising

an IC card insertion section into which an IC card is inserted,

storage means in which position information for a reference position, that is provided at the periphery of the installation position of the charging communication apparatus, is registered,

distance calculating means for calculating a distance to the reference position, from the position information of the reference position and the position information of itself,

determination means for determining whether or not the IC card is inserted in the IC card insertion section when the distance is within a predetermined range, and

alarm notification means for, when the IC card is not inserted in the IC card insertion section, issuing an alarm indicating this fact.

5. The vehicle-mounted device of claim 4, wherein the determination means determines whether or not the IC card is inserted in the IC card insertion section when the distance is within the predetermined range, and the distance is decreasing.

6. The vehicle-mounted device of any one of claim 3 to claim 5, wherein the IC card insertion detection section is provided with means for mechanically detecting that the IC card has been inserted, and

the determination means determines that the IC card has been inserted in the IC card insertion section when the insertion detection means detects card insertion, and the IC card information can be read.

7. The vehicle-mounted device of any one of claim 4 to claim 6, wherein the manner of alarm notification is varied according to distance to the reference position.