

[DESCRIPTION]

[TITLE OF INVENTION]

ROAD PRICING SYSTEM, BILLING REQUEST DEVICE, CONTROL METHOD,
AND PROGRAM

5 [Technical Field]

[0001]

The present invention relates to a road pricing system, a billing request device, a control method, and a program. Particularly, the present invention relates to a road pricing system which performs billing for use of a specific zone by a vehicle, a billing
10 request device which requires a billing-processing device which performs billing for use of the specific zone by the vehicle to perform billing for use of the specific zone when the vehicle enters the specific zone, a control method for controlling the billing request device, and a program for the billing request device.

Priority is claimed on Japanese Patent Application No. 2011-288687, filed
15 December 28, 2011, the content of which is incorporated herein by reference.

[Background Art]

[0002]

Road pricing is one TDM (Transportation Demand Management) policy, which is a policy which promotes rationalization of vehicle use or a change of traffic behavior
20 and achieves suppression of a vehicle traffic volume by billing vehicle users in a specific road, area, or time zone.

[0003]

Systems for performing road pricing have been introduced mainly in large cities. A representative road pricing system performs wireless communication between a DSRC
25 (Dedicated Short Range Communication) roadside wireless device provided in an

approach path leading to a road or an area serving as a billing target and a vehicle-mounted device provided in a vehicle to perform a billing process. However, in such a road pricing system, the DSRC roadside wireless device must be provided in all approach paths leading to the road or the area serving as a billing target, which is
5 problematic in terms of a cost.

[0004]

For example, in a technology described in Patent Literature 1, the problem described above can be solved by detecting an approach to a road or an area serving as a billing target using the GPS (Global Positioning System) and performing a billing
10 process. Further, in the technology described in Patent Literature 1, a current position can be recognized by providing the DSRC roadside wireless device in a place in which it is difficult to receive radio waves from a GPS satellite and by a vehicle-mounted device wirelessly communicating with the DSRC roadside wireless device.

[Citation List]

15 [Patent Literature]

[0005]

[Patent Literature 1] Japanese Unexamined Patent Application, First Publication No. 2007-183752

[Summary of Invention]

20 [Technical Problem]

[0006]

In the technology described in Patent Literature 1, when an approach path leading to a road or an area serving as a billing target is in a place in which it is difficult to receive radio waves from a GPS satellite, a DSRC roadside wireless device is provided
25 in the approach path. Also, the vehicle-mounted device performs a billing process by

receiving data transmitted from the DSRC roadside wireless device.

[0007]

However, the vehicle-mounted device may receive radio waves from GPS satellites whose number allows a current position to be measured accurately to some extent depending on positions of the GPS satellites even in a place in which it is difficult to receive the radio waves from the GPS satellites in an approach path in which the DSRC roadside wireless device has been provided. In this case, not only does the vehicle-mounted device perform the billing process by receiving data transmitted from the DSRC roadside wireless device, also it performs the billing process when detecting an approach to the road or the area serving as a billing target using the GPS. Thus, duplicate billing is performed.

[Solution to Problem]

[0008]

In order to solve the above problems, according to a first aspect of the present invention, a road pricing system is provided which performs billing for use of a specific zone by a vehicle, the road pricing system including: a GPS reception device which is provided in the vehicle and receives radio waves from a GPS satellite to measure a current position; a roadside wireless device which is provided in an approach path in which it is difficult to receive the radio waves from the GPS satellite among approach paths leading to the specific zone, and wirelessly transmits zone data indicating the specific zone corresponding to the approach path; a billing-processing device which performs a billing process for use of the specific zone by the vehicle; and a billing request device which requests the billing-processing device to perform the billing process for use of the specific zone when the vehicle enters the specific zone, wherein the billing request device includes a billing request unit which requests the billing-processing device

to perform the billing process for use of the specific zone when the current position measured by the GPS reception device corresponds to the specific zone and the billing process has not been performed for use of the specific zone, and requests the billing-processing device to perform the billing process for use of the specific zone when
5 the billing request unit has received the zone data from the roadside wireless device and the billing process has not been performed for use of the specific zone indicated by the zone data.

[0009]

The billing request device may further include a fee calculation unit which
10 calculates a usage fee of the specific zone, and the billing request unit may request the billing-processing device to perform a billing process of the usage fee calculated by the fee calculation unit.

[0010]

The billing request device may further include a billing determination unit
15 which determines whether the billing process has been performed for use of the specific zone, and the billing request unit may request the billing-processing device to perform the billing process for use of the specific zone when the billing determination unit determines that the billing process has not been performed for use of the specific zone.

[0011]

20 The billing request device may further include a position determination unit which determines whether the current position measured by the GPS reception device corresponds to the specific zone, and when the position determination unit has determined that the current position measured by the GPS reception device corresponds to the specific zone and the billing process has not been performed for use of the specific
25 zone, the billing request unit may request the billing-processing device to perform the

billing process for use of the specific zone.

[0012]

According to a second aspect of the present invention, a billing request device is provided which requests a billing-processing device which performs a billing process for use of a specific zone by a vehicle to perform the billing process for use of the specific zone when the vehicle enters the specific zone, the billing request device including a billing request unit which requests the billing-processing device to perform the billing process for use of the specific zone when a current position measured by a GPS reception device, which is provided in the vehicle and receives radio waves from a GPS satellite to measure the current position, corresponds to the specific zone and the billing process has not been performed for use of the specific zone, and requests the billing-processing device to perform the billing process for use of the specific zone when the billing request unit has received zone data from a roadside wireless device, which is provided in an approach path in which it is difficult to receive the radio waves from the GPS satellite among approach paths leading to the specific zone and wirelessly transmits the zone data indicating the specific zone corresponding to the approach path, and the billing process has not been performed for use of the specific zone indicated by the zone data.

[0013]

According to a third aspect of the present invention, a control method for controlling a billing request device is provided which requests a billing-processing device which performs a billing process for use of a specific zone by a vehicle to perform the billing process for use of the specific zone when the vehicle enters the specific zone, the control method including a billing request step for requesting the billing-processing device to perform the billing process for use of the specific zone when a current position measured by a GPS reception device, which is provided in the vehicle and receives radio

waves from a GPS satellite to measure the current position, corresponds to the specific zone and the billing process has not been performed for use of the specific zone, and requesting the billing-processing device to perform the billing process for use of the specific zone when zone data has been received from a roadside wireless device, which is provided in an approach path in which it is difficult to receive the radio waves from the GPS satellite among approach paths leading to the specific zone and wirelessly transmits the zone data indicating the specific zone corresponding to the approach path, and the billing process has not been performed for use of the specific zone indicated by the zone data.

10 [0014]

According to a fourth aspect of the present invention, a program for a billing request device is provided which requests a billing-processing device which performs a billing process for use of a specific zone by a vehicle to perform the billing process for use of the specific zone when the vehicle enters the specific zone, the program causing the billing request device to function as: a billing request unit which requests the billing-processing device to perform the billing process for use of the specific zone when a current position measured by a GPS reception device, which is provided in the vehicle and receives radio waves from a GPS satellite to measure the current position, corresponds to the specific zone and the billing process has not been performed for use of the specific zone, and requests the billing-processing device to perform the billing process for use of the specific zone when the billing request unit has received zone data from a roadside wireless device, which is provided in an approach path in which it is difficult to receive the radio waves from the GPS satellite among approach paths leading to the specific zone and wirelessly transmits the zone data indicating the specific zone corresponding to the approach path, and the billing process has not been performed for

use of the specific zone indicated by the zone data.

[0015]

Further, the summary of the invention above does not describe all the necessary characteristics of the present invention, and a sub-combination of a group of characteristics can also be the invention.

[Advantageous Effects of Invention]

[0016]

As seen from the description above, the present invention can prevent duplicate billing when billing for use of the specific zone is performed using the current position measured by the GPS reception device and the data received from the roadside wireless device in the road pricing system.

[Brief Description of Drawings]

[0017]

Fig. 1 is a diagram illustrating an example of a use environment of a road pricing system 100 according to one embodiment.

Fig. 2 is a diagram illustrating an example of a block configuration of a vehicle-mounted device 110.

Fig. 3 is a diagram illustrating an example of information stored in a zone information storage unit 117 in a table format.

Fig. 4 is a diagram illustrating an example of information stored in a billing history information storage unit 118 in a table format.

Fig. 5 is a diagram illustrating an example of information stored in a fee information storage unit 119 in a table format.

Fig. 6 is a diagram illustrating an example of an operation flow of the vehicle-mounted device 110.

Fig. 7 is a diagram illustrating an example of a hardware configuration when the vehicle-mounted device 110 includes an electronic information processing device such as a computer.

[Description of Embodiments]

5 [0018]

Hereinafter, the present invention will be described through embodiments of the invention, but the following embodiments do not limit the invention according to claims, and all combinations of characteristics described in the embodiments are not essential to a solution of the invention.

10 [0019]

Fig. 1 illustrates an example of a use environment of a road pricing system 100 according to one embodiment. The road pricing system 100 is a system which performs billing for use of a road or an area serving as a billing target by a vehicle V. Further, the road or the area serving as a billing target may be an example of a “specific zone” in the present invention.

[0020]

The road pricing system 100 includes a vehicle-mounted device 110, a GPS receiver 130, a DSRC roadside wireless device 150, and a billing server 170. Further, the vehicle-mounted device 110 may be one example of a “billing request device” in the present invention. Further, the GPS receiver 130 may be one example of a “GPS reception device” in the present invention. Further, the DSRC roadside wireless device 150 may be one example of a “roadside wireless device” in the present invention. Further, the billing server 170 may be one example of a “billing-processing device” in the present invention.

25 [0021]

The vehicle-mounted device 110 is provided in the vehicle V. Also, when the vehicle V enters the road or the area serving as a billing target, the vehicle-mounted device 110 requests the billing server 170 to perform a billing process for use of the road or the area serving as a billing target via a communication line N. Here, the communication line N includes a computer network such as the Internet, a core network of a communication service provider, or any local network.

[0022]

The GPS receiver 130 is provided in the vehicle V. Also, the GPS receiver 130 receives radio waves from a GPS satellite and measures a current position.

10 [0023]

The DSRC roadside wireless device 150 is provided in an approach path in which it is difficult to receive the radio waves from the GPS satellite among approach paths leading to the road or the area serving as a billing target. Here, the approach path in which it is difficult to receive the radio waves from the GPS satellite is, for example, an approach path in which it is easy for GPS radio waves to be multiply reflected due to peripheral buildings. Also, the DSRC roadside wireless device 150 wirelessly transmits zone data indicating the road or the area serving as a billing target corresponding to the approach path.

[0024]

20 The billing server 170 performs a billing process for use of the road or the area serving as a billing target by the vehicle V.

[0025]

Fig. 2 illustrates an example of a block configuration of the vehicle-mounted device 110. The vehicle-mounted device 110 includes a measurement data input reception unit 111, a zone data reception unit 112, a position determination unit 113, a

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billing determination unit 114, a fee calculation unit 115, a billing request unit 116, a zone information storage unit 117, a billing history information storage unit 118, and a fee information storage unit 119. Hereinafter, a function and an operation of each component will be described.

5 [0026]

The measurement data input reception unit 111 receives an input of measurement data indicating the current position measured by the GPS receiver 130 from the GPS receiver 130.

[0027]

10 The zone data reception unit 112 receives the zone data wirelessly transmitted from the DSRC roadside wireless device 150.

[0028]

The position determination unit 113 determines whether the current position measured by the GPS receiver 130 corresponds to the road or the area serving as a billing
15 target.

[0029]

The billing determination unit 114 determines whether the billing process has been performed for use of the road or the area serving as a billing target.

[0030]

20 The fee calculation unit 115 calculates a usage fee for the road or the area serving as a billing target.

[0031]

When the current position measured by the GPS receiver 130 corresponds to the road or the area serving as a billing target and the billing process has not been performed
25 for use of the road or the area serving as a billing target, the billing request unit 116

requests the billing server 170 to perform the billing process for use of the road or the area serving as a billing target. Further, when the billing request unit 116 has received the zone data from the DSRC roadside wireless device 150 and the billing process has not been performed for use of the road or the area serving as a billing target indicated by the zone data, the billing request unit 116 requests the billing server 170 to perform the billing process for use of the road or the area serving as a billing target. More specifically, the billing request unit 116 requests the billing server 170 to perform the billing process of the usage fee calculated by the fee calculation unit 115. Further, when the billing determination unit 114 has determined that the billing process has not been performed for use of the road or the area serving as a billing target, the billing request unit 116 requests the billing server 170 to perform the billing process for the road or the area serving as a billing target. Further, when the position determination unit 113 has determined that the current position measured by the GPS receiver 130 corresponds to the road or the area serving as a billing target and the billing process has not been performed for use of the road or the area serving as a billing target, the billing request unit 116 requests the billing server 170 to perform the billing process for the road or the area serving as a billing target.

[0032]

Fig. 3 illustrates an example of information stored in the zone information storage unit 117 in a table format. Respective information of a zone and a boundary position is stored in association in the zone information storage unit 117.

[0033]

The information of the zone is information indicating the road or the area serving as a billing target. The information of the boundary position is information for identifying a position of a boundary of the road or the area serving as a billing target

indicated by the information of the zone.

[0034]

Fig. 4 illustrates an example of information stored in the billing history information storage unit 118 in a table format. The respective information of the zone and billing date and time (year/month/day/hour:minute:second) is stored in association in the billing history information storage unit 118.

[0035]

The information of the zone is information indicating the road or the area serving as a billing target that the vehicle V has entered. The information of the billing date and time (year/month/day/hour:minute:second) is information indicating a date and time at which billing has been performed for use of the road or the area serving as a billing target indicated by the information of the zone.

[0036]

Fig. 5 illustrates an example of information stored in the fee information storage unit 119 in a table format. Respective information of a zone, a time zone (hour:minute to hour:minute), and a fee (Japanese yen) is stored in association in the fee information storage unit 119.

[0037]

The information of the zone is information indicating the road or the area serving as a billing target. The information of the time zone (hour:minute to hour:minute) is information indicating a period of time between a certain time and another certain time in one day. The information of the fee (Japanese yen) is information indicating a usage fee when the road or the area serving as a billing target indicated by the information of the zone has been used at a time indicated by the information of the time zone.

[0038]

Fig. 6 illustrates an example of an operation flow of the vehicle-mounted device 110. This operation flow illustrates an operation of the vehicle-mounted device 110 when the vehicle V enters the road or the area serving as a billing target. Figs. 1 to 5 will be referred to together in a description of this operation flow.

[0039]

The GPS receiver 130 receives the radio waves from the GPS satellite, measures the current position, and outputs measurement data indicating the current position that is a result of the measurement at predetermined time intervals.

10 [0040]

When the measurement data input reception unit 111 of the vehicle-mounted device 110 receives an input of the measurement data output from the GPS receiver 130 (S101), the measurement data input reception unit 111 sends the measurement data to the position determination unit 113.

15 [0041]

When the position determination unit 113 of the vehicle-mounted device 110 receives the data sent from the measurement data input reception unit 111, the position determination unit 113 determines whether the current position indicated by the measurement data corresponds to the road or the area serving as a billing target by referring to the information stored in the zone information storage unit 117 (S102). More specifically, the boundary position information for identifying the position of the boundary of the road or the area serving as a billing target is stored in the zone information storage unit 117, as illustrated in Fig. 3. For example, the boundary of the road serving as a billing target is assumed to be a line connecting two coordinates stored as the information of the boundary position. Similarly, the boundary of the area serving

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as a billing target is assumed to be a line connecting a plurality of coordinates stored as the information of the boundary position. In other words, when the current position indicated by the measurement data exceeds the boundary line of the area serving as a billing target, the position determination unit 113 determines that the current position of the vehicle V corresponds to the road or the area serving as a billing target (S102: Yes). Also, when the position determination unit 113 has determined that the current position of the vehicle V corresponds to the road or the area serving as a billing target, the position determination unit 113 sends data indicating the road or the area serving as a billing target to the billing determination unit 114.

10 [0042]

Incidentally, the DSRC roadside wireless device 150 is provided in the approach path in which it is difficult to receive the radio waves from the GPS satellite among the approach paths leading to the road or a passage serving as a billing target, as described above. Also, the DSRC roadside wireless device 150 transmits the zone data indicating the road or the area serving as a billing target corresponding to the approach path.

[0043]

When the zone data reception unit 112 of the vehicle-mounted device 110 receives the zone data which is transmitted from the DSRC roadside wireless device 150 as the vehicle V enters a communication range of the DSRC roadside wireless device 150 (S103: Yes), the zone data reception unit 112 sends the zone data to the billing determination unit 114.

[0044]

When the billing determination unit 114 of the vehicle-mounted device 110 receives the data sent from the position determination unit 113, the billing determination unit 114 determines whether a billing process has been performed for use of the road or

the area serving as a billing target indicated by the data by referring to the information stored in the billing history information storage unit 118 (S104). More specifically, when the information of the billing date and time at which billing has been performed for use of the road or the area serving as a billing target indicated by the data received from the position determination unit 113 has been stored in the billing history information storage unit 118, the billing determination unit 114 determines that the billing process has been performed (S104: Yes). Similarly, even when the billing determination unit 114 receives the data sent from the zone data reception unit 112, the billing determination unit 114 determines whether the billing process has been performed for use of the road or the area serving as a billing target indicated by the zone data by referring to the information stored in the billing history information storage unit 118. Also, when the billing determination unit 114 has determined that the billing process has been performed for use of the road or the area serving as a billing target, the billing determination unit 114 sends data indicating the road or the area serving as a billing target to the fee calculation unit 115.

[0045]

When the fee calculation unit 115 of the vehicle-mounted device 110 receives the data sent from the billing determination unit 114, the fee calculation unit 115 calculates a usage fee of the road or the area serving as a billing target indicated by the data by referring to the information stored in the fee information storage unit 119 (S105). Also, the fee calculation unit 115 sends data indicating the calculated usage fee to the billing request unit 116.

[0046]

When the billing request unit 116 of the vehicle-mounted device 110 receives the data sent from the fee calculation unit 115, the billing request unit 116 transmits data

requesting a billing process of the usage fee indicated by the data to the billing server 170 (S106). Also, the billing request unit 116 stores information of billing date and time at which the billing request unit 116 has requested the billing process in the billing history information storage unit 118.

5 [0047]

When the billing server 170 receives the data transmitted from the vehicle-mounted device 110, the billing server 170 performs the billing process of the usage fee according to the request indicated by the data.

[0048]

10 As described above, the road pricing system 100 can prevent duplicate billing when billing for use of the road or the area serving as a billing target is performed using the current position measured by the GPS receiver 130 and the zone data received from the DSRC roadside wireless device 150.

[0049]

15 Further, in the embodiment described above, the example in which the vehicle-mounted device 110 performs the billing request with respect to the billing server 170 has been described. However, for example, a billing request server which is communicatively connected to the vehicle-mounted device 110 and the billing server 170 via the communication line N may perform the billing request process with respect to the
20 billing server 170. In this case, other configuration requirements, at least including the billing request unit 116, other than the measurement data input reception unit 111 and the zone data reception unit 112 of the vehicle-mounted device 110 may be configuration requirements of the billing request server. However, when the vehicle-mounted device 110 has all configuration requirements as a system including no billing request server as
25 in the embodiment described above, there is no time lag due to communication between

the vehicle-mounted device 110 and the billing request server and thus a time until billing is requested is shortened.

[0050]

Fig. 7 illustrates an example of a hardware configuration when the vehicle-mounted device 110 includes an electronic information processing device such as a computer. The vehicle-mounted device 110 includes a CPU (Central Processing Unit) peripheral unit, an input/output unit, and a legacy input/output unit. The CPU peripheral unit includes a CPU 802, a RAM (Random Access Memory) 803, a graphic controller 804, and a display device 805 which are connected to each other by a host controller 801. The input/output unit includes a communication interface 807, a hard disk drive 808 and a CD-ROM (Compact Disk Read Only Memory) drive 809 which are connected to the host controller 801 by an I/O controller 806. The legacy input/output unit includes a ROM (Read Only Memory) 810, a flexible disk drive 811, and an input/output chip 812 which are connected to the I/O controller 806.

[0051]

The host controller 801 connects the RAM 803, the CPU 802 which accesses the RAM 803 at a high transfer rate, and the graphic controller 804. The CPU 802 operates based on programs stored in the ROM 810 and the RAM 803 and controls each unit. The graphic controller 804 acquires image data generated on a frame buffer provided within the RAM 803 by the CPU 802 or the like, and displays an image on the display device 805. Alternatively, the graphic controller 804 may include a frame buffer which stores the image data generated by the CPU 802 or the like.

[0052]

The I/O controller 806 connects the host controller 801 with the hard disk drive 808 which is a relatively high speed input/output device, the communication interface

807, and the CD-ROM drive 809. The hard disk drive 808 stores programs and data used by the CPU 802. The communication interface 807 connects to the network communication device 891 and transmits or receives a program or data. The CD-ROM drive 809 reads a program or data from the CD-ROM 892 and provides the program or the data to the hard disk drive 808 and the communication interface 807 via the RAM 803.

[0053]

The ROM 810, the flexible disk drive 811 and a relatively low speed input/output device of the input/output chip 812 are connected to the I/O controller 806.

10 The ROM 810 stores a booting program executed by the vehicle-mounted device 110 at the time of start-up, a program dependent on the hardware of the vehicle-mounted device 110, or the like. The flexible disk drive 811 reads a program or data from the flexible disk 893 and provides the program or the data to the hard disk drive 808 and the communication interface 807 via the RAM 803. The input/output chip 812 connects

15 various input/output devices via the flexible disk drive 811 or a parallel port, a serial port, a keyboard port, a mouse port or the like.

[0054]

The program executed by the CPU 802 is stored in a recording medium such as the flexible disk 893, the CD-ROM 892 or an IC (Integrated Circuit) card and provided

20 by a user. The program stored in the recording medium may be compressed or may not be compressed. The program is installed in the hard disk drive 808 from the recording medium, read into the RAM 803, and executed by the CPU 802. The program executed by the CPU 802 causes the vehicle-mounted device 110 to function as the measurement data input reception unit 111, the zone data reception unit 112, the position determination

25 unit 113, the billing determination unit 114, the fee calculation unit 115, the billing

request unit 116, the zone information storage unit 117, the billing history information storage unit 118, and the fee information storage unit 119 described with reference to Figs. 1 to 6.

[0055]

5 The program shown above may be stored in an external storage medium. For the storage medium, an optical recording medium such as a DVD (Digital Versatile Disk) or a PD (Phase Disk), a magneto-optical recording medium such as an MD (MiniDisk), a tape medium, a semiconductor memory such as an IC card, or the like, as well as the flexible disk 893 and the CD-ROM 892, may be used. Further, a storage medium such
10 as a hard disk or a RAM provided in a server system connected to a dedicated communication network or the Internet may be used as the recording medium and may be provided as a program over a network.

[0056]

 While the present invention has been described above using the embodiments,
15 the technical scope of the present invention is not limited to the scope described in the embodiments described above. It is apparent to those skilled in the art that various changes or improvements can be made to the embodiments. It is apparent from the description of claims that embodiments to which the various changes or improvements have been made can also be included within the technical scope of the present invention.

20 [Industrial Applicability]

[0057]

 According to some aspects of the present invention, it is possible to perform billing for use of a specific zone by a vehicle.

[Reference Signs List]

25 [0058]

- 100 electric hot water supply system
- 110 heat pump unit control device
- 111 set data input reception unit
- 112 threshold data input reception unit
- 5 113 total power demand prediction unit
- 114 weather forecast data input reception unit
- 115 supply power prediction unit
- 116 power supply and demand predicted value calculation unit
- 117 excess power time calculation unit
- 10 118 accumulated heat amount data input reception unit
- 119 demand amount prediction unit
- 120: accumulated heat amount predicted value calculation unit
- 121 accumulated heat amount set value data input reception unit
- 122 requested heat amount calculation unit
- 15 123 required operation time calculation unit
- 124 time determination unit
- 125 schedule generation unit
- 126 control data output unit
- 127 set data storage unit
- 20 128 threshold data storage unit
- 129 total power demand data storage unit
- 130 demand amount data storage unit
- 131 accumulated heat amount set value data storage unit
- 140 solar power generation device
- 25 150 commercial power supply

- 160 rechargeable battery
- 170 distribution board
- 180 nature refrigerant heat pump water heater
- 181 heat pump unit
- 5 182 hot water storage tank
- 190 home appliance
- 190a microwave oven
- 190b toaster
- 190c mixer
- 10 200 web server
- 210 communication line
- 801 host controller
- 802 CPU
- 803 RAM
- 15 804 graphic controller
- 805 display device
- 806 input/output controller
- 807 communication interface
- 808 hard disk drive
- 20 809 CD-ROM drive
- 810 ROM
- 811 flexible disk drive
- 812 input/output chip
- 891 network communication device
- 25 892 CD-ROM

893 flexible disk

[CLAIMS]

[Claim 1]

A road pricing system which performs billing for use of a specific zone by a vehicle, the road pricing system comprising:

a GPS reception device which is provided in the vehicle and receives radio waves from a GPS satellite to measure a current position;

a roadside wireless device which is provided in an approach path in which it is difficult to receive the radio waves from the GPS satellite among approach paths leading to the specific zone, and wirelessly transmits zone data indicating the specific zone corresponding to the approach path;

a billing-processing device which performs a billing process for use of the specific zone by the vehicle; and

a billing request device which requests the billing-processing device to perform the billing process for use of the specific zone when the vehicle enters the specific zone,

wherein the billing request device includes

a billing request unit which requests the billing-processing device to perform the billing process for use of the specific zone when the current position measured by the GPS reception device corresponds to the specific zone and the billing process has not been performed for use of the specific zone, and requests the billing-processing device to perform the billing process for use of the specific zone when the billing request unit has received the zone data from the roadside wireless device and the billing process has not been performed for use of the specific zone indicated by the zone data.

[Claim 2]

The road pricing system according to claim 1, wherein:

the billing request device further comprises a fee calculation unit which calculates a usage fee of the specific zone, and

the billing request unit requests the billing-processing device to perform a billing process of the usage fee calculated by the fee calculation unit.

[Claim 3]

The road pricing system according to claim 1 or 2, wherein:

the billing request device further comprises a billing determination unit which determines whether the billing process has been performed for use of the specific zone, and

the billing request unit requests the billing-processing device to perform the billing process for use of the specific zone when the billing determination unit determines that the billing process has not been performed for use of the specific zone.

[Claim 4]

The road pricing system according to any one of claims 1 to 3, wherein:

the billing request device further comprises a position determination unit which determines whether the current position measured by the GPS reception device corresponds to the specific zone, and

when the position determination unit has determined that the current position measured by the GPS reception device corresponds to the specific zone and the billing process has not been performed for use of the specific zone, the billing request unit requests the billing-processing device to perform the billing process for use of the specific zone.

[Claim 5]

A billing request device which requests a billing-processing device which performs a billing process for use of a specific zone by a vehicle to perform the billing process for use of the specific zone when the vehicle enters the specific zone, the billing request device comprising:

a billing request unit which requests the billing-processing device to perform the billing process for use of the specific zone when a current position measured by a GPS reception device, which is provided in the vehicle and receives radio waves from a GPS satellite to measure the current position, corresponds to the specific zone and the billing process has not been performed for use of the specific zone, and requests the billing-processing device to perform the billing process for use of the specific zone when the billing request unit has received zone data from a roadside wireless device, which is provided in an approach path in which it is difficult to receive the radio waves from the GPS satellite among approach paths leading to the specific zone and wirelessly transmits the zone data indicating the specific zone corresponding to the approach path, and the billing process has not been performed for use of the specific zone indicated by the zone data.

[Claim 6]

A control method for controlling a billing request device which requests a billing-processing device which performs a billing process for use of a specific zone by a vehicle to perform the billing process for use of the specific zone when the vehicle enters the specific zone, the control method comprising:

a billing request step for requesting the billing-processing device to perform the billing process for use of the specific zone when a current position measured by a GPS reception device, which is provided in the vehicle and receives radio waves from a GPS satellite to measure the current position, corresponds to the specific zone and the billing process has not been performed for use of the specific zone, and requesting the billing-processing device to perform the billing process for use of the specific zone when zone data has been received from a roadside wireless device, which is provided in an approach path in which it is difficult to receive the radio waves from the GPS satellite among approach paths leading to the specific zone and wirelessly transmits the zone data indicating the specific zone corresponding to the approach path, and the billing process has not been performed for use of the specific zone indicated by the zone data.

[Claim 7]

A program for a billing request device which requests a billing-processing device which performs a billing process for use of a specific zone by a vehicle to perform the billing process for use of the specific zone when the vehicle enters the specific zone, the program causing the billing request device to function as:

a billing request unit which requests the billing-processing device to perform the billing process for use of the specific zone when a current position measured by a GPS reception device, which is provided in the vehicle and receives radio waves from a GPS satellite to measure the current position, corresponds to the specific zone and the billing process has not been performed for use of the specific zone, and requests the billing-processing device to perform the billing process for use of the specific zone when the billing request unit has received zone data from a roadside wireless device, which is provided in an approach path in which it is difficult to receive the radio waves from the GPS satellite among approach paths leading to the specific zone and wirelessly transmits the zone data

indicating the specific zone corresponding to the approach path, and the billing process has not been performed for use of the specific zone indicated by the zone data.