

DESCRIPTION

Title of Invention

PARKING MANAGEMENT DEVICE AND PARKING MANAGEMENT METHOD

[Technical Field]

[0001]

The present disclosure relates to a parking management device and a parking management method.

[Background Art]

[0002]

Patent Document 1 discloses a toll collection system that installs an antenna device at each of an entrance and an exit of a parking area and performs entry/exit management and fee collection by communicating with an in-vehicle device.

[Citation List]

[Patent Document]

[0003]

Patent Document 1: Japanese Unexamined Patent Application, First Publication No. 2008-9733

[Summary of Invention]

[Technical Subject]

[0004]

However, in the toll collection system disclosed in Patent Document 1, since the antenna device is installed at each of the entrance and the exit of the parking area, there is a subject that the number of antenna devices needs to be increased in a case where the

number of entrances or exits is increased.

[0005]

The present disclosure has been made to address the above-described subject, and an object of the present disclosure is to provide a parking management device and a parking management method capable of performing parking management with a smaller number of antenna devices than the number of entrances or exits.

[Subject to be solved]

[0006]

In order to achieve the above-described object, the present disclosure relates to a parking management device including: a communication unit configured to receive probe data including identification information and position information and periodically transmitted by an in-vehicle device, using an antenna having, as a communication region, a region of a parking lot including at least all parking spaces and all entrances/exits; a calculation unit configured to recognize, based on the probe data received by the communication unit, an entry time of the in-vehicle device into the parking lot and an exit time of the in-vehicle device from the parking lot, and calculate a parking fee based on a time difference between the entry time and the exit time; and a charging unit configured to charge the parking fee to the in-vehicle device by transmitting and receiving predetermined information to and from the in-vehicle device using the communication unit.

[0007]

The present disclosure relates to a parking management method including: a step of receiving probe data including identification information and position information and periodically transmitted by an in-vehicle device, using an antenna having, as a communication region, a region of a parking lot including at least all parking

spaces and all entrances/exits; a step of recognizing, based on the probe data received by the communication unit, an entry time of the in-vehicle device into the parking lot and an exit time of the in-vehicle device from the parking lot, and calculating a parking fee based on a time difference between the entry time and the exit time; and a step of charging the parking fee to the in-vehicle device by transmitting and receiving predetermined information to and from the in-vehicle device using the communication unit.

[Advantageous Effects of Invention]

[0008]

According to the parking management device and the parking management method of the present disclosure, it is possible to perform parking management with a smaller number of antenna devices than the number of entrances or exits.

[Brief Description of Drawings]

[0009]

FIG. 1 is a schematic diagram showing a configuration example of a parking management device according to a first embodiment of the present disclosure.

FIG. 2 is a block diagram showing the configuration example of the parking management device according to the first embodiment of the present disclosure.

FIG. 3 is a block diagram showing a configuration example of an in-vehicle device according to the first embodiment of the present disclosure.

FIG. 4 is a sequence diagram showing an operation example of the parking management device and the in-vehicle device according to the first embodiment of the present disclosure.

FIG. 5 is a schematic diagram showing a configuration example of a parking management device according to a second embodiment of the present disclosure.

FIG. 6 is a sequence diagram showing an operation example of the parking management device and an in-vehicle device according to the second embodiment of the present disclosure.

FIG. 7 is a sequence diagram showing the operation example of the parking management device and the in-vehicle device according to the second embodiment of the present disclosure.

FIG. 8 is a sequence diagram showing the operation example of the parking management device and the in-vehicle device according to the second embodiment of the present disclosure.

FIG. 9 is a sequence diagram showing the operation example of the parking management device and the in-vehicle device according to the second embodiment of the present disclosure.

FIG. 10 is a schematic diagram showing a configuration example of a parking management device according to a third embodiment of the present disclosure.

FIG. 11 is a schematic block diagram showing a configuration of a computer according to at least one embodiment.

[Description of Embodiments]

[0010]

Hereinafter, a parking management device and a parking management method according to embodiments of the present disclosure will be described with reference to the accompanying drawings. In the drawings, the same reference signs are used for the same or corresponding configurations, and description thereof will be omitted as appropriate.

[0011]

<First Embodiment>

As shown in FIGS. 1 and 2, a parking management device 50 according to the present embodiment includes a data processing device 3 and a wireless communication antenna device 2. In the wireless communication antenna device 2 and an in-vehicle device 40 described later, a wireless communication scheme such as dedicated short-range communications (DSRC) may be used, but the wireless communication scheme is not limited thereto. The data processing device 3 includes a calculation unit 31, a charging unit 32, a detection unit 33, a warning unit 34, a notification unit 35, and a storage unit 36 as a functional configuration composed of a combination of hardware, software, and the like.

[0012]

As shown in FIG. 1, the parking management device 50 performs wireless communication with each in-vehicle device 40 mounted in each vehicle 4 (4a to 4h) that enters the parking lot 1 from a parking lot entrance 5a or 5b and exits (leaves) the parking lot 1 from a parking lot exit 6a or 6b, using the wireless communication antenna device 2 installed in the parking lot 1. The parking management device 50 performs entry/exit management and fee collection for each vehicle 4 by performing wireless communication with each in-vehicle device 40.

[0013]

In addition, the number of parking lot entrances 5a and 5b and the number of parking lot exits 6a and 6b are not limited to two, and may be three or more. Further, the number of parking lot entrances and the number of parking lot exits need not be the same. The parking lot entrance and the parking lot exit may each be configured, for example, by using a display such as a road-surface marking, or may each be configured by using a three-dimensional enclosure such as a fence or a signboard. In addition, a width of the parking lot entrance and a width of the parking lot exit may be a width

suitable for one vehicle to pass therethrough, or may have a width for a plurality of vehicles. In addition, it is desirable that depths (lengths in a traveling direction) of the parking lot entrance and the parking lot exit have a size that can ensure that communication is performed between the wireless communication antenna device 2 and the in-vehicle device 40 at least once during passage.

[0014]

The wireless communication antenna device 2 includes an antenna 2a, a processing device or the like configured to process signals transmitted and received by the antenna 2a, performs wireless communication with the in-vehicle device 40, transmits, for example, information indicated by the data processing device 3, and outputs received information to the data processing device 3. The antenna 2a included in the wireless communication antenna device 2 covers a region of the parking lot 1 (such as the location or land of the parking lot 1) including at least all parking spaces 7a to 7d and all entrances/exits 5a, 5b, 6a, and 6b (all parking lot entrances 5a and 5b and all parking lot exits 6a and 6b) as a communication region (communication area) 9. In the present embodiment, the wireless communication antenna device 2 (a configuration example of a "communication unit" according to the present disclosure) receives probe data including identification information and position information and periodically transmitted by the in-vehicle device 40, using the antenna 2a having, as the communication region 9, the region of the parking lot 1 including at least all parking spaces and all entrances/exits. The probe data (probe information) is, for example, information such as position, speed, and vehicle type, acquired (transmitted) from the vehicle 4 using a mobile communication system. In the present embodiment, the parking space is a space partitioned for parking, and a boundary of each parking space can be indicated by, for example, printing made on a parking surface, display by

illumination, installation of a rope, or the like.

[0015]

In the example shown in FIG. 1, vehicles 4a to 4f are located in the communication region 9, and the wireless communication antenna device 2 can communicate with each in-vehicle device 40 provided in each of the vehicles 4a to 4f. The vehicle 4a is about to enter the parking lot through the parking lot entrance 5a, and the vehicle 4d is about to enter the parking lot through the parking lot entrance 5b. The vehicle 4b is parked in the parking space 7c, and the vehicle 4e is parked in the parking space 7b. The vehicle 4c is exiting through the parking lot exit 6a, and the vehicle 4b is exiting through the parking lot exit 6b. Further, the vehicle 4g and the vehicle 4h are traveling on a road 10 outside the parking lot. In addition, all of the parking spaces 7a to 7d are hourly parking spaces.

[0016]

The calculation unit 31 recognizes an entry time of the in-vehicle device 40 into the parking lot 1 and an exit time from the parking lot 1 of the in-vehicle device 40 based on the probe data received by the wireless communication antenna device 2, and calculates a parking fee based on a time difference between the entry time and the exit time. In this case, the calculation unit 31 recognizes the entry to the parking lot 1 based on position information (range information) of the parking lot entrance 5a or 5b and the position information included in the probe data. Similarly, the calculation unit 31 recognizes the exit from the parking lot 1 based on position information (range information) of the parking lot exit 6a or 6b and the position information included in the probe data.

[0017]

The charging unit 32 charges the parking fee to the in-vehicle device 40 by

transmitting and receiving predetermined information to and from the in-vehicle device 40 using the wireless communication antenna device 2. The method of charging is not limited, and for example, the charging can be performed by the same method as an existing electronic toll collection system. In addition, the charging unit 32 charges a fine for unauthorized parking detected by a detection unit 33, which will be described later, to the in-vehicle device 40. In addition, the charging unit 32 charges the fine to the in-vehicle device 40 in a case where the unauthorized parking continues for a predetermined time or longer.

[0018]

The detection unit 33 detects the unauthorized parking in the parking lot 1 based on the probe data received by the wireless communication antenna device 2. The unauthorized parking is, for example, parking of an hourly parking vehicle (non-contracted vehicle) in a dedicated parking space for a contract holder, such as a monthly parking contract. Alternatively, the unauthorized parking is, for example, parking of a vehicle of another vehicle type in an hourly parking space limited to a specific vehicle type. Alternatively, the unauthorized parking is, for example, parking outside the parking space.

[0019]

The warning unit 34 transmits warning information indicating that the parking is unauthorized to the in-vehicle device 40 for which the unauthorized parking is detected, by using the wireless communication antenna device 2.

[0020]

The notification unit 35 notifies an administrator of the parking lot that the unauthorized parking is detected. The notification to the administrator can be performed, for example, by transmitting information to a mobile terminal carried by the

administrator, a monitoring screen, or the like, or by displaying information on a mobile terminal, a monitoring screen, or the like.

[0021]

The storage unit 36 stores, for example, an in-vehicle device ID (identification information), an entry time, and the like when the in-vehicle device 40 enters, or stores, for example, a list of in-vehicle device IDs of the in-vehicle devices 40 of the contractors of the monthly parking spaces.

[0022]

Meanwhile, as shown in FIG. 3, the in-vehicle device 40 includes a position information acquisition unit 41, a data processing unit 42, a communication unit 43, and a notifying unit 44. The position information acquisition unit 41 acquires position information (latitude, longitude, and altitude) by using a global navigation satellite system (GNSS). The communication unit 43 transmits and receives predetermined information to and from the wireless communication antenna device 2, for example, under the control of the data processing unit 42. The position information acquisition unit 41 may acquire the position based on a detection signal of a vehicle speed sensor, an angular velocity sensor, or the like instead of (or in addition to) using the GNSS.

[0023]

For example, in a case where the communication unit 43 receives a message requesting the transmission of the probe data from the wireless communication antenna device 2, the data processing unit 42 creates the probe data including the latest position information acquired by the position information acquisition unit 41 and the identification information set in the in-vehicle device 40 (or further, vehicle type information or the like which is information representing the vehicle type (classification) of the vehicle 4 equipped with the in-vehicle device 40), and transmits the probe data to

the wireless communication antenna device 2 via the communication unit 43, for example, at a predetermined cycle.

[0024]

The notifying unit 43 includes a synthesized-voice output unit, a character/graphic display unit, an interfacing unit for cooperation with an external display device, and the like, and performs, for example, output or display based on warning information transmitted by the warning unit 34.

[0025]

Hereinafter, an operation example of the parking management device 50 and the in-vehicle device 40 described with reference to FIGS. 1 to 3 will be described with reference to FIG. 4. The operation example shown in FIG. 4 corresponds to one flow in which the vehicle 4 enters the parking lot 1, parks properly, and exits from the parking lot 1. In the operation example shown in FIG. 4, the wireless communication antenna device 2 periodically transmits a predetermined wireless communication signal (continuously from step S101 onward). The predetermined wireless communication signal is, for example, a signal representing a message that requests, by broadcast, transmission of probe data from the in-vehicle device 40. When the communication unit 43 receives the predetermined wireless communication signal (step S102), the in-vehicle device 40 periodically transmits the probe data including the in-vehicle device ID, the vehicle type, and the position information (continuously from step S103 onward).

[0026]

Then, the wireless communication antenna device 2 receives the probe data and recognizes the entry (step S104). The data processing device 3 stores, in the storage unit 36, the in-vehicle device ID, the entry time, and the vehicle type of the entered in-vehicle device (step S105).

[0027]

On the other hand, when the engine key is turned off after the vehicle 4 equipped with the in-vehicle device 40 moves to an empty parking space (any one of the parking spaces 7a to 7d), the vehicle 4 is parked in the parking space (step S106). In addition, when the engine key is turned on (step S107), in the in-vehicle device 40, the communication unit 43 receives the predetermined wireless communication signal (step S108), and periodically transmits the probe data including the in-vehicle device ID, the vehicle type, and the position information (continuously from step S109 onward).

[0028]

Then, the wireless communication antenna device 2 receives the probe data and recognizes the exit (step S110). The data processing device 3 searches for the stored entry time based on the in-vehicle device ID (step S111). Next, the data processing device 3 calculates the parking time based on the time difference between the entry time and the exit time (step S112). Then, the data processing device 3 calculates the parking fee based on the vehicle type and the parking time (step S113). Next, the wireless communication antenna device 2 transmits a message for charging the fee to the in-vehicle device 40 (step S114). Next, the in-vehicle device 40 executes a charge settlement (step S115), and transmits a settlement result (step S116).

[0029]

As described above, the parking management device 50 of the present embodiment includes the wireless communication antenna device 2 (communication unit) that receives the probe data including the identification information and the position information and periodically transmitted by the in-vehicle device 40 by using the antenna 2a having, as the communication region 9, the region of the parking lot 1 including at least all parking spaces and all entrances/exits, the calculation unit 31 that

recognizes the entry time of the in-vehicle device 40 to the parking lot 1 and the exit time of the in-vehicle device 40 from the parking lot 1 based on the probe data received by the wireless communication antenna device 2 (communication unit), and calculates the parking fee based on the time difference between the entry time and the exit time, and the charging unit 32 that charges the parking fee to the in-vehicle device 40 by transmitting and receiving predetermined information to and from the in-vehicle device 40 by using the wireless communication antenna device 2 (communication unit). With this configuration, the parking management can be performed by one antenna 2a (or one wireless communication antenna device 2). Therefore, according to the present embodiment, the parking management can be performed with a smaller number of antenna devices than the number of entrances or exits.

[0030]

<Second Embodiment>

A parking management device according to a second embodiment has the same basic configuration as the configuration according to the first embodiment shown in FIGS. 1 to 3. However, as shown in FIG. 5, the second embodiment, which has the configuration corresponding to the parking lot 1 shown in FIG. 1, is different from the first embodiment in that the parking lot 1a as a management target includes a monthly parking space 8 instead of the hourly parking space 7d shown in FIG. 1. The hourly parking space 7d is a parking space in which parking can be performed without a prior contract and a fee is paid in accordance with the parking time. On the other hand, the monthly parking space 8 is a parking space in which only the vehicle 4 equipped with the in-vehicle device 40 having the in-vehicle device ID contracted in advance can park, and is a parking space in which a fee is paid monthly. In the example shown in FIG. 5, an unauthorizedly parked vehicle 4x without the parking authority is parked in the

monthly parking space 8.

[0031]

An operation example of the parking management device 50 and the in-vehicle device 40 according to the second embodiment will be described with reference to FIGS. 6 and 7. The flows shown in FIGS. 6 and 7 are connected to each other by the same connectors C11 to C13.

[0032]

The operation example shown in FIGS. 6 and 7 corresponds to a flow in which the vehicle 4x enters the parking lot 1a, unauthorizedly parks in the monthly parking space 8, and exits from the parking lot 1a. In the operation example shown in FIGS. 6 and 7, the flows from step S101 to step S105 are the same as the flows from step S101 to step S105 shown in FIG. 4 (however, the parking lot 1 in the above description with reference to FIG. 4 is read as the parking lot 1a). In FIG. 6, in step S105-1, the wireless communication antenna device 2 receives the probe data, and recognizes the parking in the monthly parking space 8 (step S105-1). In step S105-1, the wireless communication antenna device 2 compares position information (range information) of the monthly parking space 8 with the position information included in the probe data to recognize the parking in the monthly parking space 8. In the data processing device 3, the detection unit 33 collates the list of the in-vehicle device IDs of the monthly contract vehicles stored in the storage unit 36 with the in-vehicle device ID recognized in step S105-1, and recognizes that the vehicle 4x is illegally parked (step S105-2). Next, the warning unit 34 transmits the warning information indicating that the parking is unauthorized to the in-vehicle device 40 for which the unauthorized parking is detected, by using the wireless communication antenna device 2 (step S105-3).

[0033]

In the in-vehicle device 40, when the warning information transmitted by the wireless communication antenna device 2 is received, the notifying unit 44 outputs the voice information based on the warning information or displays the display information (step S105-4). When the wireless communication antenna device 2 detects that a predetermined time has elapsed since the illegal parking in the monthly parking space 8 (step S105-5), the data processing device 3 stores the in-vehicle device ID in the storage unit 36 as the fine target (step S105-6).

[0034]

The flows from step S106 to step S116 shown in FIG. 7 are the same as the flows from step S106 to step S116 shown in FIG. 4.

[0035]

In step S117 shown in FIG. 7, the data processing device 3 calculates the fine amount (step S117). Next, the wireless communication antenna device 2 transmits a message for requesting the fine to the in-vehicle device 40 as a penalty, for example, in the same manner as the toll collection (step S118). Next, the in-vehicle device 40 executes a charge settlement (step S119), and transmits a settlement result (step S120).

[0036]

Hereinafter, an operation example of the parking management device 50 and the in-vehicle device 40 when the vehicle is moved to another parking space before a predetermined time elapses in response to the warning in step S105-4 shown in FIG. 6 will be described with reference to FIG. 8. In the operation example shown in FIG. 8, the flows from step S101 to step S105-4 are the same as the flows from step S101 to step S105-4 shown in FIG. 6. In FIG. 8, in step S105-7, the vehicle 4x equipped with the in-vehicle device 40 moves to the hourly parking space while transmitting the probe data (step S105-7). The wireless communication antenna device 2 receives the probe

data transmitted by the in-vehicle device 40, and recognizes the exit from the monthly parking space 8 (step S105-8). The flows from step S106 onward are the same as the flows from step S106 onward shown in FIG. 4. In this case, the in-vehicle device ID of the vehicle 4x is not stored as the fine target.

[0037]

Hereinafter, an operation example in a case where a parking lot administrator 60 is notified that the unauthorized parking has occurred will be described with reference to FIG. 9. In the operation example shown in FIG. 9, the flows from step S101 to step S105-3 and the flows from step S105-5 onward are the same as the flows from step S101 to step S105-3 and the flows from step S105-5 onward shown in FIG. 6 and FIG. 7. In FIG. 9, in step S105-3-1, the notification unit 35 notifies the parking lot administrator 60 (a terminal or the like of the parking lot administrator) that the unauthorized parking has occurred, the position or the identification information of the parking space, the information indicating the vehicle type, and the like (step S105-3-1), and in parallel with the voice output or display of the warning by the in-vehicle device 40 in step S105-4, the information such as the unauthorized parking position is notified to the parking lot administrator 60 (step S105-4-1).

[0038]

<Third Embodiment>

A parking management device according to a third embodiment has the same basic configuration as the configuration according to the first embodiment shown in FIGS. 1 to 3. However, as shown in FIG. 1, in the first embodiment, the parking management device 50 manages one parking lot 1 as the management target, whereas in the third embodiment, as shown in FIG. 10, the parking management device 50 manages a plurality of parking lots 1b and 1c as the management targets. In the third

embodiment, the antenna 2a provided in the wireless communication antenna device 2 covers each region of the parking lot 1b and the parking lot 1c, which includes at least all parking spaces 7a and 7b and all entrances/exits 5a and 6a in the parking lot 1b, and all parking spaces 7c and 7d and all entrances/exits 5b and 6b in the parking lot 1c, as the communication region (communication area) 9. In this case, the antenna 2a has the regions of two or more parking lots, as the communication region.

[0039]

According to the present embodiment, the plurality of parking lots 1 (parking lots 1b and 1c shown in FIG. 10) can be managed by one wireless communication antenna device 2 (antenna 2a).

[0040]

(Operation and Effect)

In the parking management device and the parking management method having the above-described configuration, the probe data including the identification information and the position information and periodically transmitted by the in-vehicle device is received by using the antenna having, as the communication region, the region of the parking lot including at least all parking spaces and all entrances/exits. Therefore, the parking management can be performed with a smaller number of antenna devices than the number of the entrances or the exits.

[0041]

(Other Embodiments)

Although embodiments of the present disclosure have been described above in detail with reference to the accompanying drawings, specific configurations are not limited to these embodiments, and design changes and the like are also included insofar as they do not depart from the gist of the present disclosure. For example, as the

wireless communication scheme, instead of DSRC using the above-described GHz-band frequency, wireless communication using, for example, a frequency of less than 1 GHz may be used, or a plurality of communication schemes may be used in combination. The content (and allocation) of the processes executed by the data processing device 3 and the wireless communication antenna device 2 described above is merely an example. For example, a part of the processes to be executed by the data processing device 3 may be executed by the wireless communication antenna device 2, or a part of the processes to be executed by the wireless communication antenna device 2 may be executed by the data processing device 3.

[0042]

<Computer Configuration>

FIG. 11 is a schematic block diagram showing a configuration of a computer according to at least one embodiment.

A computer 90 includes a processor 91, a main memory 92, a storage 93, and an interface 94.

The parking management device 50, the data processing device 3, the wireless communication antenna device 2, and the like are mounted on the computer 90. The operations of the respective processing units described above are stored in the storage 93 in the form of a program. The processor 91 reads the program from the storage 93, loads the program into the main memory 92, and executes the above processing in accordance with the program. The processor 91 also allocates, in the main memory 92, storage areas corresponding to the respective storage units described above in accordance with the program.

[0043]

The program may be for implementing part of the functions to be exhibited by

the computer 90. For example, the program may cause the functions to be exhibited in combination with another program already stored in the storage, or in combination with another program implemented in another device. In another embodiment, the computer may include, in addition to the above configuration or instead of the above configuration, a custom large scale integrated circuit (LSI) such as a programmable logic device (PLD). Examples of the PLD include a programmable array logic (PAL), a generic array logic (GAL), a complex programmable logic device (CPLD), and a field-programmable gate array (FPGA). In this case, a part or all of the functions implemented by the processor may be implemented by the integrated circuit.

[0044]

Examples of the storage 93 include a hard disk drive (HDD), a solid state drive (SSD), a magnetic disk, a magneto-optical disk, a compact disc read-only memory (CD-ROM), a digital versatile disc read-only memory (DVD-ROM), and a semiconductor memory. The storage 93 may be an internal medium directly connected to a bus of the computer 90, or may be an external medium connected to the computer 90 via the interface 94 or a communication line. When the program is distributed to the computer 90 via a communication line, the computer 90 having received the distribution may load the program into the main memory 92 and execute the above processing. In at least one embodiment, the storage 93 is a non-transitory tangible storage medium.

[0045]

<Supplementary Note>

The parking management device 50 described in each of the embodiments is understood as follows, for example.

[0046]

(1) A first aspect relates to a parking management device 50 including: a

communication unit (wireless communication antenna device 2) configured to receive probe data including identification information and position information and periodically transmitted by an in-vehicle device 40, using an antenna 2a having, as a communication region 9, a region of a parking lot 1 including at least all parking spaces and all entrances/exits; a calculation unit 31 configured to recognize, based on the probe data received by the communication unit, an entry time of the in-vehicle device into the parking lot and an exit time of the in-vehicle device from the parking lot, and calculate a parking fee based on a time difference between the entry time and the exit time; and a charging unit 32 configured to charge the parking fee to the in-vehicle device by transmitting and receiving predetermined information to and from the in-vehicle device using the communication unit. According to the present aspect and each of the following aspects, parking management can be performed with a smaller number of antenna devices (antenna 2a, wireless communication antenna device 2) than the number of entrances or exits.

[0047]

(2) The first aspect relates to the parking management device 50 according to (1), further including: a detection unit 33 configured to detect unauthorized parking in the parking lot based on the probe data received by the communication unit, in which the charging unit is configured to charge a fine for the unauthorized parking to the in-vehicle device.

[0048]

(3) A third aspect relates to the parking management device 50 according to (1) or (2), in which the charging unit 32 is configured to charge the fine to the in-vehicle device when the unauthorized parking continues for a predetermined time or longer.

[0049]

(4) A fourth aspect relates to the parking management device 50 according to (1) to (3), further including: a warning unit 34 configured to transmit, using the communication unit, warning information indicating that the parking is unauthorized to the in-vehicle device for which the unauthorized parking is detected.

[0050]

(5) A fifth aspect relates to the parking management device 50 according to (1) to (4), further including: a notification unit 35 configured to notify an administrator of the parking lot that the unauthorized parking is detected.

[0051]

(6) A sixth aspect relates to the parking management device 50 according to (1) to (5), in which the unauthorized parking is parking of an hourly parking vehicle in an exclusive parking space for a contract holder.

[0052]

(7) A seventh aspect relates to the parking management device 50 according to (1) to (6), in which the antenna has, as the communication region, the regions of two or more parking lots.

[0053]

(8) An eighth aspect relates to the parking management device 50 according to (1) to (7), in which the probe data includes the identification information, the position information, and vehicle type information, and the calculation unit is configured to calculate the parking fee based on the time difference and the vehicle type information.

[Industrial Applicability]

[0054]

According to each of the aspects of the present invention, parking management can be performed with a smaller number of antenna devices than the number of entrances

or exits.

[Reference Signs List]

[0055]

1, 1a, 1b, 1c: parking lot

2: wireless communication antenna device

2a: antenna

3: data processing device

4: vehicle

9: communication region

31: calculation unit

32: charging unit

33: detection unit

34: warning unit

35: notification unit

36: storage unit

40: in-vehicle device

Claims

[Claim 1]

A parking management device comprising:

a communication unit configured to receive probe data including identification information and position information and periodically transmitted by an in-vehicle device, using an antenna having, as a communication region, a region of a parking lot including at least all parking spaces and all entrances/exits;

a calculation unit configured to recognize, based on the probe data received by the communication unit, an entry time of the in-vehicle device into the parking lot and an exit time of the in-vehicle device from the parking lot, and calculate a parking fee based on a time difference between the entry time and the exit time; and

a charging unit configured to charge the parking fee to the in-vehicle device by transmitting and receiving predetermined information to and from the in-vehicle device using the communication unit.

[Claim 2]

The parking management device according to claim 1, further comprising:

a detection unit configured to detect unauthorized parking in the parking lot based on the probe data received by the communication unit,

wherein the charging unit is configured to charge a fine for the unauthorized parking to the in-vehicle device.

[Claim 3]

The parking management device according to claim 2,

wherein the charging unit is configured to charge the fine to the in-vehicle device when the unauthorized parking continues for a predetermined time or longer.

[Claim 4]

The parking management device according to claim 3, further comprising:

a warning unit configured to transmit, using the communication unit, warning information indicating that the parking is unauthorized to the in-vehicle device for which the unauthorized parking is detected.

[Claim 5]

The parking management device according to claim 4, further comprising:

a notification unit configured to notify an administrator of the parking lot that the unauthorized parking is detected.

[Claim 6]

The parking management device according to claim 5,

wherein the unauthorized parking is parking of an hourly parking vehicle in an exclusive parking space for a contract holder.

[Claim 7]

The parking management device according to claim 6,

wherein the antenna has, as the communication region, the regions of two or more parking lots.

[Claim 8]

The parking management device according to claim 7,
wherein the probe data includes the identification information, the position information, and vehicle type information, and
the calculation unit is configured to calculate the parking fee based on the time difference and the vehicle type information.

[Claim 9]

A parking management method comprising:
a step of receiving probe data including identification information and position information and periodically transmitted by an in-vehicle device, using an antenna having, as a communication region, a region of a parking lot including at least all parking spaces and all entrances/exits;
a step of recognizing, based on the probe data received by the communication unit, an entry time of the in-vehicle device into the parking lot and an exit time of the in-vehicle device from the parking lot, and calculating a parking fee based on a time difference between the entry time and the exit time; and
a step of charging the parking fee to the in-vehicle device by transmitting and receiving predetermined information to and from the in-vehicle device using the communication unit.