

DESCRIPTION

COMMUNICATION SYSTEM, COMMUNICATION METHOD, AND
VEHICLE-MOUNTED DEVICE

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TECHNICAL FIELD

[0001]

The present invention relates to a communication system including a vehicle-mounted device mounted on a vehicle and a communication device communicating with the vehicle-mounted device, a communication method, and a vehicle-mounted device.

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Priority is claimed on Japanese Patent Application No. 2011-233102 filed October 24, 2011, the content of which is incorporated herein by reference.

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BACKGROUND ART

[0002]

In recent years, usage of ITS (Intelligent Transport System), such as ETC (Electronic Toll Collection) is wide-spreading. Accordingly, the number of vehicles, on which a vehicle-mounted device performing DSRC (Dedicated Short Range Communications) communication is mounted, is increasing.

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The vehicle-mounted device performs DSRC communication primarily with a beacon, which is a roadside device. By using the DSRC communication, road traffic information can be received, or billing on a toll road can be processed.

[0003]

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In a roadside parking area, it is difficult to install a beacon at a fixed position as

in the case of the toll gate of a toll road. Therefore, there is a demand for a mobile terminal type communication device with equivalent performance to the beacon in order to perform billing or the like at the location on which installation of the beacon is difficult. As one of such technologies, a communication device is disclosed in Patent

5 Literature 1 (PTL1).

[Related Art Documents]

[0004]

[Patent Literature]

PTL1: Japanese Unexamined Patent Application, First Publication No.

10 2002-245501

DISCLOSURE OF INVENTION

[Problems to be Solved by the Invention]

[0005]

15 In communication using the communication device disclosed in PTL 1, however, communication with the vehicle-mounted device cannot be done when electric power is not supplied to the vehicle-mounted device. Specifically when the vehicle is parked, electric power is not supplied to the vehicle-mounted device since electric power supply from the battery is cut off normally.

20 The present invention is made under the circumstances described above. The purpose of the present invention is to provide a communication system that is capable of performing communication between a vehicle-mounted device and a communication device even if electric power supply to the vehicle-mounted device from the vehicle is cut off.

25 [Means for Solving the Problems]

[0006]

The present invention is made for solving the above-described problems and has aspects indicated below.

(1) A communication system including: a vehicle-mounted device mounted on a
5 vehicle; and a communication device configured to communicate with the
vehicle-mounted device, wherein

the communication device includes: an output part configured to emit energy to
the vehicle-mounted part; and a vehicle information receiving part configured to receive
vehicle information, which is information regarding the vehicle that the vehicle-mounted
10 device is mounted on,

the vehicle-mounted device includes: a communication circuit configured to
communicate with the communication device; and an electric power conversion part
configured to convert the energy supplied from the communication device to electric
power and to supply the electric power to the communication circuit, and

15 the communication circuit includes: a vehicle information storing part
configured to store the vehicle information in a non-volatile manner; and a vehicle
information transmitting part configured to transmit the vehicle information stored by the
vehicle information storing part to the communication device.

[0007]

20 (2) The communication system according to (1) described above, wherein the
vehicle-mounted device further includes: a user interface circuit configured to perform
input-output of information between a user of the vehicle and the vehicle-mounted
device; and a power supply part configured to receive electric power from the vehicle
that the vehicle-mounted device is mounted on and to supply the electric power to the
25 user interface circuit and the communication circuit.

[0008]

(3) The communication system according to (2) described, wherein
the communication circuit further includes: a communication storing part
configured to store information indicating whether the communication circuit
communicated with the communication device or not in a non-volatile manner; and a
communication recording part configured to rewrite the information stored by the
communication storing part to information indicating that the communication circuit
communicated with the communication device in a case where the communication circuit
communicated with the communication device, and
the user interface circuit is configured to present predetermined information to
the user in a case where the information stored in the communication storing part
indicates that the communication circuit communicated with the communication device.

[0009]

(4) The communication system according to any one of (1) to (3) described
above, wherein the communication system further includes a parking space billing
apparatus configured to bill depending on a parking time in a case where the vehicle is in
a parked state,

the parking space billing apparatus includes: a vehicle information obtaining
part configured to obtain the vehicle information regarding the vehicle from the
communication device; and a billing part configured to calculate a billing amount based
on a time difference between a time, in which the communication device obtained the
vehicle information from the vehicle-mounted device, and a clock time, at which the
vehicle identified by the vehicle information leaves the parking state, to perform a billing
process to the vehicle identified by the vehicle information.

[0010]

(5) The communication system according to (4) described above, wherein the vehicle-mounted device further includes a detection part configured to detect movement of the vehicle that the vehicle-mounted device is mounted on, and

the billing part of the parking space billing apparatus is configured to calculate
5 the billing amount by assigning a clock time when the detection part detected the movement of the vehicle to the parking end clock time of the vehicle.

[0011]

(6) The communication system according to any one of (1) to (5) described above, wherein the communication circuit further includes:

10 a program storing part configured to store a program checking whether or not there is a malfunction in the vehicle-mounted device;

a checking target processing part which is a target to be checked by the program storing part;

a program executing part configured to execute the program stored in the
15 program storing part in a case where the electric power is supplied by the electric power conversion part; and

a check result transmitting part configured to transmit a check result obtained by the program executing part to a portable terminal.

[0012]

20 (7) The communication system according to any one of (1) to (6), wherein the output part emits the energy toward a predetermined direction, and the vehicle information receiving part receives the vehicle information through an antenna with a directionality to the direction that the output part emits the energy to.

[0013]

25 (8) A communication method using a communication system with a

vehicle-mounted device mounted on a vehicle and a communication device configured to communicate with the vehicle-mounted device, the method including the steps of:

outputting energy to a vehicle-mounted device from an output part of the communication device;

5 converting the energy supplied from the communication device to electric power with an electric power conversion part of the vehicle-mounted device to supply the electric power to a communication circuit;

transmitting vehicle information with a vehicle information transmitting part from a vehicle information storing part of the communication circuit to the
10 communication device, the vehicle information being information regarding the vehicle and stored by the vehicle information storing part in a non-volatile manner; and

receiving the vehicle information regarding the vehicle from the vehicle-mounted device with a vehicle information receiving part.

[0014]

15 (9) A vehicle-mounted device configured to be mounted on a vehicle and to communicate with a communication device, the vehicle-mounted device including:

a communication circuit configured to communicate with the communication device; and

an electric power conversion part configured to convert energy supplied from
20 the communication device to electric power and to supply the electric power to the communication circuit, wherein

the communication circuit includes: a vehicle information storing part configured to store vehicle information in a non-volatile manner, the vehicle information being information regarding the vehicle that the vehicle-mounted device is mounted on;

25 and

a vehicle information transmitting part configured to transmit the vehicle information stored in the vehicle information storing part to the communication device.

[Effects of the Invention]

[0015]

5 In the aspects of the present invention indicated above, the communication device outputs energy to the vehicle-mounted device and the vehicle-mounted device converts the energy to electric power to start up the communication circuit. Because of the configuration, the communication device can communicate with the vehicle-mounted device to which electric power supply from the vehicle is cut off.

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BRIEF DESCRIPTION OF THE DRAWINGS

[0016]

FIG. 1 is a diagram showing a basic configuration of the communication system of the present invention.

15 FIG. 2 is a drawing showing electric power allocation in the vehicle-mounted device of the communication system of the present invention.

FIG. 3 is a schematic block diagram showing a configuration of the parking space billing system, which is the first embodiment of the present invention.

20 FIG. 4 is a flowchart showing operation of the parking space billing system, which is the first embodiment of the present invention.

FIG. 5 is a schematic block diagram showing a configuration of the illegal parking monitoring system, which is the second embodiment of the present invention.

FIG. 6 is a flowchart showing operation of the illegal parking monitoring system, which is the second embodiment of the present invention.

25 FIG. 7 is a schematic block diagram showing a configuration of the check

system, which is the third embodiment of the present invention.

FIG. 8 is a flowchart showing operation of the checking system, which is the third embodiment of the present invention.

5 BEST MODE FOR CARRYING OUT THE INVENTION

[0017]

[Basic Configuration]

Embodiments of the present invention are explained in detail below in reference to drawings.

10 FIG. 1 is a diagram showing a basic configuration of the communication system of the present invention.

The communication system includes the vehicle-mounted device 100 that is mounted on the vehicle, and the communication device 200 that communicates with the vehicle-mounted device 100. DSRC communication is performed between the
15 vehicle-mounted device 100 and the communication device 200.

[0018]

The vehicle-mounted device 100 includes the main body casing 110 encasing the computer system and the antenna casing 120 encasing the antenna 121. The card insertion slot 111 receiving the card C, such as ETC card, is provided to the main body casing 110. In addition, the photovoltaic cell 122 (electric power conversion part) that
20 converts the received energy of light L to electric power is provided to the surface of the antenna casing 120. The main body casing 110 and the antenna casing 120 are connected by electrical wirings transmitting electric power and information.

[0019]

25 The casing 210 of the communication device 200 includes: the light-emitting

element 211 (output part) emitting the light L; the communication start button 213 that initiates communication to the vehicle-mounted device 100 by being pressed down; and the display 214 indicating information. The light-emitting device 211 and the antenna 212 are provided to the upper end of the casing 210 so as for the direction of the light pointed to and the directionality of the antenna 212 to be aligned in the substantially same direction. As the light-emitting device 211, LED (Light Emitting Diode), a halogen lamp, an incandescent bulb, a laser light source, or the like can be used.

[0020]

The light L is irradiated to the antenna casing 120 when the user points the upper end part of the casing 120 of the communication device 200 to the antenna casing 120 of the vehicle-mounted device 100 and presses down the communication start button 213. Because of this, the photovoltaic cell 122 provided to the antenna casing 120 converts the energy of light L irradiated and supply the electric power to the computer system and antenna 121 of the vehicle-mounted device 100. Then, the computer system of the vehicle-mounted device 100 the vehicle information transmits the information regarding the vehicle that the vehicle-mounted device 100 is mounted on through the antenna 121. At this moment, the user is pointing the upper end of the casing 210 of the communication device 200 to the antenna casing 120 of the vehicle-mounted device 100. In addition, the antenna 212 of the communication device 200 has directionality to the upper end of the casing 120. Thus, the communication device 200 captures the radio wave E irradiated from the antenna casing 120 of the vehicle-mounted device 100 to receive the vehicle information. Because of this, the communication device 200 can communicate with the vehicle-mounted device 100 even if the vehicle-mounted device 100 does not receive electric power supply from the vehicle.

[0021]

FIG. 2 is a drawing showing electric power allocation in the vehicle-mounted device of the communication system of the present invention.

Other than the antenna 121, the vehicle-mounted device 100 includes components such as: ROM 131 (Read Only Memory); CPU 132 (Central Processing Unit); RAM 134 (Random Access Memory); the flash memory 134 (vehicle information storing part); DSRC communication part 135 (vehicle information transmitting part); input device 136; the speaker 137; and the like. ROM 131 is a non-volatile memory storing information in the non-rewritable manner, and stores a programs or the like for CPU 132 to execute. RAM 133 is a volatile memory functioning as the main memory and stores variables or the like used for the program executed by the CPU 132. The flash memory 134 is a non-volatile memory storing information in the rewritable manner and stores rewritable parameters or the like of the vehicle information.

[0022]

The power supply part 138 supplying the electric power to the system of the vehicle-mounted device 100 supplies electric power to the all components provided to the vehicle-mounted device 100, when electric power is supplied from the vehicle to the vehicle-mounted device 100. Only limited amount of electric power can be obtained with the photovoltaic cell 122 by converting the light energy irradiated from the communication device 200 compared to the electric power supplied from the vehicle. Thus, it is not preferable to supply electric power to all the components in this case. Thus, the photovoltaic cell 122 only supplies the electric power to, among the components of the vehicle-mounted device 100, the communication circuit including components for communication with the communication device 200, such as the antenna 121, ROM 131, CPU 132, RAM 133, the flash memory 134, DSRC communication part 135, and the like, and does not supply the electric power to the UI circuit providing UI (User Interface)

functions performing input and output of information between the user and the vehicle-mounted device, such as the input device 136, the speaker 137, and the like.

In addition, CPU 132 suppresses electric power consumption by executing the programs required for communication with the communication device 200 alone, among
5 the programs stored in ROM 131, when the vehicle-mounted device 100 is operated by the electrical supply from the photovoltaic cell 122.

[0023]

In this basic configuration, the light-emitting device 211 is shown as an example of the output part outputting energy, and the photovoltaic cell 122 is shown as an
10 example of the electric power conversion part. However, the present invention is not limited to the description, and other combinations can be used. For example, a transmitting and receiving antenna can be used as a combination of the output part and the electric power conversion part when energy of radio wave is used as the energy. Alternatively, when magnetic energy is used as the energy, a transmitter and receiver
15 coils can be used as a combination of the output part and the electric power conversion part.

[0024]

Embodiments in which the communication system with the basic configuration is applied to specific services are explained below.

20 [0025]

[First Embodiment]

First, an embodiment, in which the communication system of the first aspect of the present invention is applied to a parking space billing system, is explained as the first embodiment of the present invention.

25 The parking space billing system of the present embodiment is a billing system

in a parking space installed inside of the charging area that is the subject of road pricing. In this case, it is necessary to stop road pricing billing during billing by the present parking space billing system in order to avoid double billing.

[0026]

5 When the parking space is installed to the roadside inside of the billing area, it is difficult to determine if the vehicle is parking on the road side parking space or driving on the road. In such a situation, switching billing modes can be appropriately performed by using the communication system of the present invention.

[0027]

10 FIG. 3 is a schematic block diagram showing a configuration of the parking space billing system, which is the first embodiment of the present invention.

 The parking space billing system includes: the vehicle-mounted device 100; the communication device 200; and the parking space billing apparatus 300. The vehicle-mounted device 100 is a device belongs to the owner of the vehicle. The communication device 200 and the parking space billing apparatus 300 are devices that the custodian of the parking space owns. The vehicle-mounted device 100 and the communication device 200 of the present embodiment are devices in which components for the parking space billing system are added to the above-explained basic configuration.

20 [0028]

 The vehicle-mounted device 100 includes: the vehicle information storing part 141 (a part of storage area of the flash memory 134) storing the vehicle information that the vehicle-mounted device is mounted on; DSRC communication part 135 communicating with the communication device 200 through the antenna 121; the billing mode managing part 142 keeping track of the billing modes of the vehicle with the

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vehicle-mounted device if it is in the area billing mode or the parking billing mode; the detection part 143 detecting the movement of the vehicle with the vehicle-mounted device; and the moving vehicle communication part 144 communicating through the mobile communication network, such as PHS (Personal Handy-phone System), the mobile telephone network, and the like. As the detection part 143, GPS (Global Positioning System), the acceleration sensor, the gyro sensor, or the like can be used, for example.

[0029]

The communication device 200 includes: DSRC communication part 221 communicating with the vehicle-mounted device 100 through the antenna 212 when the communication start button 213 is pressed down; and the wireless LAN communication part 222 communicating with the parking space billing apparatus 300 through LAN (Local Area Network).

The parking space billing apparatus 300 includes: the communication part 301 communicating with the communication device 200 and the vehicle-mounted device 100 through the network such as LAN, the internet, or the like; and the billing part 302 that performs the billing process to the vehicle parking at the parking space.

[0030]

FIG. 4 is a flowchart showing operation of the parking space billing system, which is the first embodiment of the present invention.

When the vehicle with the vehicle-mounted device 100 is parked at the roadside parking space, the owner of the vehicle normally stops the vehicle's engine. Thus, electric power supply to the vehicle-mounted device 100 from the vehicle is cut off. At this moment, the detection part 143 of the vehicle-mounted device 100 detects the stoppage of the vehicle with the vehicle-mounted device 100 to record the current clock

time in the vehicle information storing part 141 as the stop time.

Then, the custodian of the parking space equipped with the communication device 200 approaches to the vehicle in order to start billing in the parking space, directs the upper end part of the communication device 200 to the antenna casing 120 of the vehicle-mounted device 100, and presses down the communication start button 213.
[0031]

When the custodian of the parking space presses down the communication start button 213, the light-emitting device 211 of the communication device 200 starts emitting light toward the antenna casing 120 of the vehicle-mounted device 100 (Step S1). The photovoltaic cell 122 of the vehicle-mounted device 100 converts the energy of the light emitted from the communication device 200 to electric power to start up the computer system (Step S2). At this moment, the photovoltaic cell 122 supplies electric power at least to the components consisting of the vehicle information storing part 141, DSRC communication part 135, and the billing mode managing part 142. On the other hand, the photovoltaic cell 122 does not supply electric power to the components consisting of the detection part 143 and the movable vehicle communication part 144.
[0032]

Also, when the custodian of the parking space pressed down the communication start button 213, DSRC communication part 221 of the communication device 200 transmits the vehicle information request requesting transmission of the vehicle information and stop time of the vehicle to the vehicle-mounted device 100 in DSRC transmission through the antenna 212 (Step S3). When DSRC communication part 135 of the vehicle-mounted device 100 receives the vehicle information request from the communication device 200 through the antenna 212, it transmits the vehicle information and the stop time of the vehicle stored in the vehicle information storing part 141 to the

communication device 200 (Step S4). In addition, at this moment, the billing mode managing part 142 of the vehicle-mounted device 100 recognizes that the billing mode of the vehicle with the vehicle-mounted device is switched to the parking space billing mode (Step S5).

5 [0033]

When DSRC communication part 221 of the communication device 200 receives the vehicle information and the stop time of the vehicle from the vehicle-mounted device 100 through the antenna 212, the wireless LAN communication part 222 transmits the vehicle information and the stop time of the vehicle received by
10 the DSRC communication part 221 to the parking space billing apparatus 300 through the wireless LAN (Step S6). When the reception of the vehicle information and the stop time of the vehicle from the vehicle-mounted device 100 is completed, a notification of the completion of retrieval of the vehicle information and the stop time of the vehicle is indicated on the display 214 of the communication device 200. By having the notification
15 being indicated on the display, the custodian of the parking space recognizes that communication with the vehicle-mounted device 100 is completed. Thus, the custodian can release the pressed down communication start button 213.

[0034]

When the communication part 301 of the parking space billing apparatus 300
20 obtained the vehicle information and the stop time of the vehicle from the communication device 200 through the wireless LAN, it identifies the received stop time of the vehicle as the billing start time (Step S7). At this moment, it is preferable that the parking space billing apparatus 300 transmits the vehicle information to the area billing apparatus (not shown in the drawing) that performs the area billing to the vehicle to
25 notify that parking billing is started for the vehicle identified by the vehicle information.

Accordingly, the area billing apparatus can stop billing the area billing to the vehicle.

[0035]

Next, when the parking of the vehicle ends, and the owner of the vehicle starts the vehicle's engine, electric power supply from the vehicle to the vehicle-mounted
5 device 100 is started. Because of this, in addition to the vehicle information storing part 141, DSRC communication part 135, and the billing mode managing part 142, the detection part 143 and the moving vehicle communication part 144 are stated up.

When the owner of the vehicle starts driving the vehicle, the detection part 143 detects the movement of the vehicle (Step S8). Next, the moving vehicle communication
10 part 144 transmits the movement of the vehicle detected by the detection part 143 and the vehicle information stored by the vehicle information storing part 141 to the parking space billing apparatus 300 (Step S9). Also, at this moment, the billing mode managing part 142 of the vehicle-mounted device 100 recognizes that the billing mode of the vehicle with the vehicle-mounted device is switched to the area billing mode (Step S10).

[0036]

When the communication part 301 of the parking space billing apparatus 300 receives the movement of the vehicle and the vehicle information from the
vehicle-mounted device 100 through the internet, the billing part 302 identifies the current clock time as the end time of the parking space billing to the vehicle identified by
20 the vehicle information (S11).

The billing part 302 calculates the billing amount based on the billing start time identified in the step S7 and the billing end clock time identified in the step S11 to perform the parking space billing process to the vehicle (Step S12). At this moment, it is preferable that the parking space billing apparatus 300 transmits the vehicle information
25 to the area billing apparatus to notify that the parking area billing is stopped to the

vehicle identified by the vehicle information.

Because of this, the area billing apparatus can restart the area billing to the vehicle.

[0037]

5 As explained above, by applying the communication system of the present invention to a parking billing system, it becomes not essential to communicate with the vehicle-mounted device 100 before the engine of the vehicle is stopped.

[0038]

In the present embodiment, the case in which the parking space billing apparatus
10 300 performs the billing process. However, present invention is not particularly limited to the configuration, and it can be configured for the vehicle-mounted device 100 to perform the billing process.

[0039]

[Second Embodiment]

15 Next, an embodiment, in which the communication system of the other aspect of the present invention is applied to an illegal parking monitoring system, is explained as the second embodiment of the present invention.

The illegal parking monitoring system of the present embodiment is a system that reports the vehicle information regarding the vehicle illegally parking to the illegal
20 parking monitoring apparatus 400. Also, the vehicle-mounted device 100, which is mounted on the vehicle reported as an illegally parked vehicle, notifies the user of the vehicle about being reported. At this moment, normally the vehicle-mounted device 100 is shut down since the vehicle is parked and the vehicle's engine is stopped, lacking electric power supply from the vehicle. Even in such a situation, by using the
25 communication system of the present invention, it is possible to obtain the vehicle

information from the shut-downed vehicle-mounted device 100.

[0040]

FIG. 5 is a schematic block diagram showing a configuration of the illegal parking monitoring system, which is the second embodiment of the present invention.

5 The illegal parking monitoring system includes: the vehicle-mounted device 100; communication device 200, the illegal parking monitoring apparatus 400. The vehicle-mounted device 100 is a device belongs to the owner of the vehicle. The communication device 200 and the illegal parking monitoring apparatus 400 are devices that the police station owns. The vehicle-mounted device 100 and the communication
10 device 200 of the present embodiment are devices in which components for the illegal parking monitoring system are added to the above-explained basic configuration.

[0041]

 The vehicle-mounted device 100 includes: the vehicle information storing part
141 storing the vehicle information that the vehicle-mounted device is mounted on;
15 DSRC communication part 135 communicating with the communication device 200 through the antenna 121; the communication recording part 151 recording whether or not there is communication with the communication device 200 to the communication
storing part 152; the communication storing part 152 (a part of storage area of the flash
memory 134) storing the information about whether or not there is the communication
20 with the communication device 200 in a non-volatile manner; and the notifying part 153 notifying about being reported from the speaker 137 when electric power supply from the power supply part 138 starts in a case where the communication with the communication
device 200 was performed.

[0042]

25 The communication device 200 includes: DSRC communication part 221

communicating with the vehicle-mounted device 100 through the antenna 212 when the communication start button 213 is pressed down; and the wireless LAN communication part 222 communicating with the illegal parking monitoring apparatus 400 through LAN.

The illegal parking monitoring apparatus 400 includes: the communication part 401 communicating with the communication device 200 through the wireless LAN; and the monitoring part 402 performing the monitoring process to the illegally parking vehicle.

[0043]

FIG. 6 is a flowchart showing operation of the illegal parking monitoring system, which is the second embodiment of the present invention.

When the vehicle with the vehicle-mounted device 100 is parked, the owner of the vehicle normally stops the vehicle's engine. Thus, electric power supply to the vehicle-mounted device 100 from the vehicle is cut off. When the vehicle is an illegally parking vehicle, the enforcement personnel equipped with the communication device 200 approaches to the vehicle in order to perform the monitoring process to the vehicle, directs the upper end part of the communication device 200 to the antenna casing 120 of the vehicle-mounted device 100, and presses down the communication start button 213.

[0044]

When the enforcement personnel presses down the communication start button 213, the light-emitting device 211 of the communication device 200 starts emitting light toward the antenna casing 120 of the vehicle-mounted device 100 (Step S21). The photovoltaic cell 122 of the vehicle-mounted device 100 converts the energy of the light emitted from the communication device 200 to electric power to start up the computer system (Step S22). At this moment, the photovoltaic cell 122 supplies electric power at least to the components consisting of the vehicle information storing part 141, DSRC

communication part 135, the communication recording part 151, and the communication storing part 152. On the other hand, the photovoltaic cell 122 does not supply electric power to the components consisting of the notification part 153.

[0045]

5 Also, when the enforcement personnel pressed down the communication start button 213, DSRC communication part 221 of the communication device 200 transmits the vehicle information request requesting transmission of the vehicle information in DSRC transmission through the antenna 212 (Step S23). When DSRC communication part 135 of the vehicle-mounted device 100 receives the vehicle information request from
10 the communication device 200 through the antenna 212, it transmits the vehicle information stored in the vehicle information storing part 141 to the communication device 200 (Step S24). In addition, at this moment, the communication recording part 151 of the vehicle-mounted device 100 records the information indicating that there was communication with the communication device 200 to the communication storing part
15 152 (Step S25).

[0046]

 When DSRC communication part 221 of the communication device 200 receives the vehicle information from the vehicle-mounted device 100 through the antenna 212, the wireless LAN communication part 222 transmits the vehicle
20 information received by the DSRC communication part 221 to the illegal parking monitoring apparatus 400 through the wireless LAN (Step S26). When the reception of the vehicle information from the vehicle-mounted device 100 is completed, a notification of the completion of retrieval of the vehicle information is indicated on the display 214 of the communication device 200. By having the notification being indicated on the
25 display, the enforcement personnel recognize that communication with the

vehicle-mounted device 100 is completed. Thus, the personnel can release the pressed down communication start button 213.

[0047]

When the communication part 401 of the illegal parking monitoring apparatus
5 400 obtained the vehicle information from the communication device 200 through the wireless LAN, the monitoring part 402 performs the monitoring process to the vehicle identified by the vehicle information (Step S27).

[0048]

After that, the parking of the vehicle ends, the owner of the vehicle starts the
10 vehicle's engine, and electric power supply from the vehicle to the vehicle-mounted device 100 is started (Step S28). Because of this, in addition to the vehicle information storing part 141, DSRC communication part 135, the communication recording part 151, and the communication storing part 152, the notification part 153 is stated up.

The notification part 153 determines whether the communication storing part
15 152 does store the information indicating that the communication circuit communicated with the communication device 200 or not (Step S29). When the notification part 153 determined that the communication storing part 152 stores the information indicating that the communication circuit communicated with the communication device 200 (Step S29: YES), the notification part 153 notifies the vehicle's owner about being reported about
20 illegal parking through the speaker 137 (Step S30).

On the other hand, when the notification part 153 determined that the communication storing part 152 does not store the information indicating that the communication circuit communicated with the communication device 200 (Step S29: NO), the notification part 153 ends the process without notification.

25 [0049]

As explained above, by applying the communication system of the present invention to the illegal parking monitoring system, the enforcement personnel can obtain the vehicle information from the vehicle-mounted device 100 without electric power supply from the vehicle and report illegal parking.

5 [0050]

[Third Embodiment]

Next, the third embodiment of the present invention is explained. In the third embodiment, the operation check of the vehicle-mounted device 100 is performed during the retrieval of information regarding the vehicle-mounted device 100 performed in the
10 first and second embodiments.

[0051]

FIG. 7 is a schematic block diagram showing a configuration of the check system, which is the third embodiment of the present invention.

The check system includes: vehicle-mounted device 100; and the
15 communication device 200. The vehicle-mounted device 100 and the communication device 200 of the present embodiment are devices in which components for the checking system are added to those of the first and second embodiments.

[0052]

In addition to the configurations of the above-described first and second
20 embodiments, the vehicle-mounted device 100 of the third embodiment includes: the program storing part 161 (a part of storage area of ROM) storing the check program; the program executing part 162 that executes the program stored in the program storing part 161; the check result storing part 163 (a part of storage area of the flash memory 134) storing the check result obtained by executing the check program with the program
25 executing part 162 in a non-volatile manner; and the check result notifying part 164 that

notifies the check result through the speaker 137 when electric power supply from the power supply part 138 is started in the case where communication with the communication device 200 was performed.

[0053]

5 FIG. 8 is a flowchart showing operation of the checking system, which is the third embodiment of the present invention.

When the communication start button 213 of the communication device 200 is pressed down and the DSRC communication part 221 of the communication device 200 receives the vehicle information from the vehicle-mounted device 100 in the
10 above-described step S4 or the step S24 in the first or second embodiment, the DSRC communication part 221 transmits the check request requesting execution of the check program to the vehicle-mounted device 100 (Step S31).

[0054]

When DSRC communication part 135 of the vehicle-mounted device 100
15 receives the check request from the communication device 200 through antenna 121, the program executing part 162 reads out the check program stored in the program storing part 161 and executes the check program (Step S32). By executing the check program, the program executing part 162 confirms whether it is possible to receive signals from various sensors (checking target processing part) in the vehicle-mounted device 100.

20 After completion of confirmation by the program executing part 162, DSRC communication part 135 transmits the check result to the communication device 200 (Step S33). When the communication device 200 receives the vehicle information from the vehicle-mounted device 100 through antenna 212, the received check result is displayed on the display 214. In a case where the check result indicating that the
25 vehicle-mounted device 100 is illegally modified is displayed, the information may be

transmitted to the center, and the illegal traffic process may be performed in the center if necessary.

When checking is completed, the program executing part 162 records the check result to the check result storing part 163 (Step S34).

5 [0055]

After that, the parking of the vehicle ends, the owner of the vehicle starts the vehicle's engine, and electric power supply from the vehicle to the vehicle-mounted device 100 is started (Step S35). Because of this, the check result notifying part 164 is started up.

10 The check result notifying part 164 reads out the check result stored by the check result storing part 163 and notifies the vehicle's owner about the check result through the speaker 137 (Step S36).

[0056]

As explained above, by using the communication system of the present
15 invention, the operation check can be performed on the vehicle-mounted device 100 without electric power supply from the vehicle.

[0057]

While preferred embodiments of the invention have been described and illustrated above, it should be understood that these are exemplary of the invention and
20 are not to be considered as limiting. Additions, omissions, substitutions, and other modifications can be made without departing from the scope of the present invention. Accordingly, the invention is not to be considered as being limited by the foregoing description, and is only limited by the scope of the appended claims.

For example, in the above-described configuration, the vehicle-mounted device
25 100 is in a separated type and constituted by the main body casing 110 and the antenna

casing 120. However, the present invention is not limited to the configuration, and it can be in an integrated type in which the main body and the antenna are physically combined.

[0058]

Also, in the above-described basic configuration, the case in which the
5 predetermined program was executed by starting up CPU 132 during communication of the vehicle-mounted device 100 with the communication device 200 was explained. However, the present invention is not limited to the configuration.

For example, the photovoltaic cell 122 may supply electric power to the antenna 121, DSRC communication part 135, the flash memory 134, and the microprocessor
10 without supplying electric power to the ROM 131, RAM 133, and CPU 132. That is, the photovoltaic cell 122 supplies electric power to the minimum required circuits for communication with the communication device 200.

[0059]

The above-described vehicle-mounted device 100 and the communication
15 device 200 include the computer system inside. The above-described operations of each processing part are stored in the recording media that are in a program format and readable to the computer. The above-described processes are performed by reading and executing the program with the computer. The recording media readable to the computer mean the magnetic disk, magneto optical disk, CD-ROM, DVD-ROM, the
20 semiconductor memory, or the like. Alternatively, the computer program may be distributed to the computer through the communication line. In this case, the computer received the distributed program executes the program.

[0060]

Also, the above-described program may be one for realizing a part of the
25 above-described functions.

Furthermore, the program may be a differential file (differential program) for realizing the above-described functions by being combined with other programs that have already stored in the computer system.

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INDUSTRIAL APPLICABILITY

[0061]

DSRC communication can be performed to a stopped vehicle. Thus, the present invention is applicable to receiving road traffic conditions and parking space billing.

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BRIEF DESCRIPTION OF THE REFERENCE SYMBOLS

[0062]

100: Vehicle-mounted device

121: Antenna

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122: Photovoltaic cell

131: ROM

132: CPU

133: RAM

134: Flash memory

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135: DSRC communication part

136: Input device

137: Speaker

200: Communication device

211: Light-emitting device

25

212: Antenna

213: Communication start button

CLAIMS

1. A communication system comprising: a vehicle-mounted device mounted on a vehicle; and a communication device configured to communicate with the vehicle-mounted device, wherein
- the communication device comprises: an output part configured to emit energy to the vehicle-mounted part; and a vehicle information receiving part configured to receive vehicle information, which is information regarding the vehicle that the vehicle-mounted device is mounted on,
- the vehicle-mounted device comprises: a communication circuit configured to communicate with the communication device; and an electric power conversion part configured to convert the energy supplied from the communication device to electric power and to supply the electric power to the communication circuit, and
- the communication circuit comprises: a vehicle information storing part configured to store the vehicle information in a non-volatile manner; and a vehicle information transmitting part configured to transmit the vehicle information stored by the vehicle information storing part to the communication device.
2. The communication system according to Claim 1, wherein the vehicle-mounted device further comprises: a user interface circuit configured to perform input-output of information between a user of the vehicle and the vehicle-mounted device; and a power supply part configured to receive electric power from the vehicle that the vehicle-mounted device is mounted on and to supply the electric power to the user interface circuit and the communication circuit.

3. The communication system according to Claim 2, wherein
the communication circuit further comprises: a communication storing part
configured to store information indicating whether the communication circuit
communicated with the communication device or not in a non-volatile manner; and a
5 communication recording part configured to rewrite the information stored by the
communication storing part to information indicating that the communication circuit
communicated with the communication device in a case where the communication circuit
communicated with the communication device, and
the user interface circuit is configured to present predetermined information to
10 the user in a case where the information stored in the communication storing part
indicates that the communication circuit communicated with the communication device.
4. The communication system according to any one of Claims 1 to 3, wherein the
communication system further comprises a parking space billing apparatus configured to
15 bill depending on a parking time in a case where the vehicle is in a parked state,
the parking space billing apparatus comprises: a vehicle information obtaining
part configured to obtain the vehicle information regarding the vehicle from the
communication device; and a billing part configured to calculate a billing amount based
on a time difference between a time, at which the communication device obtained the
20 vehicle information from the vehicle-mounted device, and a clock time, at which the
vehicle identified by the vehicle information leaves the parking state, to perform a billing
process to the vehicle identified by the vehicle information.
5. The communication system according to Claim 4, wherein the vehicle-mounted
25 device further comprises a detection part configured to detect movement of the vehicle

that the vehicle-mounted device is mounted on, and

the billing part of the parking space billing apparatus is configured to calculate the billing amount by assigning a clock time when the detection part detected the movement of the vehicle to the parking end clock time of the vehicle.

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6. The communication system according to any one of Claims 1 to 5, wherein the communication circuit further comprises:

a program storing part configured to store a program checking whether or not there is a malfunction in the vehicle-mounted device;

10 a checking target processing part which is a target to be checked by the program storing part;

a program executing part configured to execute the program stored in the program storing part in a case where the electric power is supplied by the electric power conversion part; and

15 a check result transmitting part configured to transmit a check result obtained by the program executing part to a portable terminal.

7. The communication system according to any one of Claims 1 to 6, wherein the output part emits the energy toward a predetermined direction, and

20 the vehicle information receiving part receives the vehicle information through an antenna with a directionality to the direction that the output part emits the energy to.

8. A communication method using a communication system with a vehicle-mounted device mounted on a vehicle and a communication device configured to

25 communicate with the vehicle-mounted device, the method comprising the steps of:

outputting energy to a vehicle-mounted device from an output part of the communication device;

converting the energy supplied from the communication device to electric power with an electric power conversion part of the vehicle-mounted device to supply the electric power to a communication circuit;

transmitting vehicle information with a vehicle information transmitting part from a vehicle information storing part of the communication circuit to the communication device, the vehicle information being information regarding the vehicle and stored by the vehicle information storing part in a non-volatile manner; and

receiving the vehicle information regarding the vehicle from the vehicle-mounted device with a vehicle information receiving part.

9. A vehicle-mounted device configured to be mounted on a vehicle and to communicate with a communication device, the vehicle-mounted device comprising:

a communication circuit configured to communicate with the communication device; and

an electric power conversion part configured to convert energy supplied from the communication device to electric power and to supply the electric power to the communication circuit, wherein

the communication circuit comprises: a vehicle information storing part configured to store vehicle information in a non-volatile manner, the vehicle information being information regarding the vehicle that the vehicle-mounted device is mounted on; and

a vehicle information transmitting part configured to transmit the vehicle information stored in the vehicle information storing part to the communication device.