DESCRIPTION

Title of Invention

MONITORING SYSTEM, IN-VEHICLE DEVICE, AND MONITORING METHOD

[Technical Field]

[0001]

The present disclosure relates to a monitoring system, an in-vehicle device, and a monitoring method.

[Background Art]

[0002]

For example, on toll roads, a mechanism is used in which tolls are automatically collected by performing wireless communication with an in-vehicle device mounted in a vehicle using an electronic toll collection system (ETC (registered trademark), also referred to as an “automatic toll collection system”). The in-vehicle device includes an antenna unit for wireless communication, a main body portion that executes a toll collection process, and a coaxial cable that connects the antenna unit and the main body portion. Patent Document 1 discloses a technique of changing a display pattern of an LED provided in an antenna unit based on control of a main body portion to notify an occupant of a vehicle of the success or failure of a toll collection process. Patent Document 2 and Patent Document 3 disclose a technique of increasing the number of LEDs provided in an antenna unit to support more display patterns.

[Citation List]

[Patent Document]

[0003]

[Patent Document 1] Japanese Patent No. 4234880

[Patent Document 2] Japanese Patent No. 4639780

[Patent Document 3] Japanese Patent No. 4604252

[Summary of Invention]

[Technical Subject]

[0004]

Some roads may be provided with a time-limited parking zone in which parking is permitted only within a time limit. A user of the time-limited parking zone presents, inside a vehicle at a position visible from outside, a parking ticket issued by parking ticket issuing equipment installed on the road. In addition, an enforcement officer who monitors improper parking visually checks the description of the parking ticket to determine whether or not the parking is improper (whether or not the parking is within the time limit). In order to reduce the burden on the enforcement officer, it may be possible to indicate whether or not the parking is within the time limit by a display pattern of an LED of the in-vehicle device, instead of the parking ticket. However, when fraud is committed, for example, by attaching a dummy LED to the in-vehicle device and lighting the dummy LED so as to make it appear that the fee has been paid, there is a possibility that it may be difficult for the enforcement officer to determine whether or not the LED is fraudulent, that is, whether or not the parking is improper.

[0005]

An object of the present disclosure is to provide a monitoring system, an in-vehicle device, and a monitoring method capable of easily determining whether or not the parking is improper.

[Subject to be solved]

[0006]

An aspect of the present disclosure relates to a monitoring system including: an in-vehicle device mounted in a vehicle; and a terminal device carried by an enforcement officer who monitors improper parking, in which the in-vehicle device includes a light-emitting element provided at a position visible from outside the vehicle, and a CPU that switches a display pattern of the light-emitting element based on a display instruction received from outside, and the terminal device includes a display instruction unit that transmits the display instruction for the light-emitting element of the in-vehicle device.

[0007]

Another aspect of the present disclosure relates to an in-vehicle device including: a light-emitting element provided at a position visible from outside a vehicle; and a CPU that changes a state of the light-emitting element based on a display instruction received from outside.

[0008]

Still another aspect of the present disclosure relates to a monitoring method using a monitoring system including an in-vehicle device mounted in a vehicle, and a terminal device carried by an enforcement officer who monitors improper parking, the monitoring method including: a step of switching, via the in-vehicle device, a display pattern of a light-emitting element provided at a position visible from outside the vehicle based on a display instruction received from outside; and a step of transmitting, via the terminal device, the display instruction for the light-emitting element of the in-vehicle device.

[Advantageous Effects of Invention]

[0009]

According to the above-described aspects, it is possible to easily determine whether or not the parking is improper.

[Brief Description of Drawings]

[0010]

FIG. 1 is a schematic diagram showing an overall configuration of a monitoring system according to a first embodiment.

FIG. 2 is a diagram showing a functional configuration of an in-vehicle device according to the first embodiment.

FIG. 3 is a diagram showing an example of an LED display pattern according to the first embodiment.

FIG. 4 is a diagram showing a functional configuration of a terminal device according to the first embodiment.

FIG. 5 is a sequence diagram showing an example of a process of the monitoring system according to the first embodiment.

FIG. 6 is a diagram showing a functional configuration of an in-vehicle device according to a modification example of the first embodiment.

FIG. 7 is a diagram showing an example of an LED display pattern according to the modification example of the first embodiment.

FIG. 8 is a diagram showing a functional configuration of a central device according to a second embodiment.

FIG. 9 is a sequence diagram showing an example of a process of a monitoring system according to the second embodiment.

FIG. 10 is a sequence diagram showing an example of a process of a monitoring system according to a third embodiment.

FIG. 11 is a diagram showing a functional configuration of a central device according to a fourth embodiment.

FIG. 12 is a sequence diagram showing an example of a process of a monitoring system according to the fourth embodiment.

[Description of Embodiments]

[0011]

<First Embodiment>

Hereinafter, a first embodiment will be described in detail with reference to FIGS. 1 to 5.

[0012]

(Overall Configuration of Monitoring System)

FIG. 1 is a schematic diagram showing an overall configuration of a monitoring system according to the first embodiment. A monitoring system 100 is a system for monitoring improper parking of a vehicle V in a predetermined parking zone (time-limited parking zone) or a parking lot. The monitoring system 100 includes an in-vehicle device 1, a terminal device 5, and a central device 6.

[0013]

The in-vehicle device 1 is mounted in a vehicle V. The in-vehicle device 1 includes a main body portion 2, and an antenna unit 3. The antenna unit 3 is installed at a position visible from outside the vehicle V, such as on an inner side of a windshield. The in-vehicle device 1 according to the present embodiment performs a parking time management process in a predetermined parking zone (time-limited parking zone) or a parking lot. The in-vehicle device 1 according to the present embodiment is obtained by adding various configurations for the parking time management process to the in-vehicle device used for a toll collection process using

ETC in the related art. A specific functional configuration of the in-vehicle device 1 will be described below.

[0014]

The terminal device 5 is a device carried by an enforcement officer and used to detect improper parking of the vehicle V. The terminal device 5 performs wireless communication with the in-vehicle device 1 by short-range wireless communication such as dedicated short range communications (DSRC) or Bluetooth (registered trademark) or Wi-Fi (registered trademark). Further, the terminal device 5 performs wireless communication with the central device 6 through wide-range wireless communication (wireless wide area network (WWAN)) or the like. The terminal device 5 is a dedicated terminal for monitoring improper parking.

[0015]

The central device 6 is communicably connected to the in-vehicle device 1 and the terminal device 5 through wide-range wireless communication (wireless wide area network (WWAN)) and the like. In the present embodiment, the central device 6 receives a report of improper parking of the vehicle V from the enforcement officer through the terminal device 5.

[0016]

(Functional Configuration of In-Vehicle Device)

FIG. 2 is a diagram showing a functional configuration of the in-vehicle device according to the first embodiment. As shown in FIG. 2, the in-vehicle device 1 includes the main body portion 2, and the antenna unit 3. The main body portion 2 and the antenna unit 3 are communicably connected by a coaxial cable 4.

[0017]

The main body portion 2 includes a power supply circuit 20, a CPU 21, a self-

holding circuit 22, and a switch unit 23.

[0018]

The power supply circuit 20 supplies power converted to a predetermined voltage to each of the CPU 21, the self-holding circuit 22, and the switch unit 23 of the main body portion 2. Each unit of the main body portion 2 is connected via the power supply circuit 20 to a power supply B that can supply power even while an engine of the vehicle is in an OFF state. The power supply B is, for example, a battery (always-on power supply) mounted in the vehicle V. Further, the power supply B may be a battery or a capacitor built into the main body portion 2.

[0019]

The CPU 21 is a processor that executes the parking time management process. The parking time management process is a process of determining whether or not the vehicle V is parked within a time limit (for example, 60 minutes) of the parking zone in accordance with an elapsed time from when the vehicle V is parked in the parking zone, and notifying of a determination result. For example, when a user (an occupant of the vehicle V) performs an operation of paying a parking fee and starting parking in a roadside device (not shown) installed in the parking zone, a trigger signal for starting parking is transmitted from the central device 6 to the in-vehicle device 1. The CPU 21 counts an elapsed time after receiving the trigger signal as the parking time of the vehicle V. The CPU 21 switches between turning on (blinking) and turning off of a first light-emitting element 32 of the antenna unit 3 by turning on or off the switch unit 23 (first transistor switch circuit 24) described later, and notifies of a process result. Further, the CPU 21 according to the present embodiment switches between turning on (blinking) and turning off of the first light-emitting element 32 of the antenna unit 3 in accordance with a display instruction of the terminal device 5.

[0020]

The CPU 21 may determine a state (normal or abnormal) of the in-vehicle device 1 and notify of the determination result. For example, the state of the in-vehicle device 1 is determined to be "normal" when a predetermined condition is satisfied, such as when an ETC card is correctly inserted. Further, the state of the in-vehicle device 1 is determined to be "abnormal" when the predetermined condition is not satisfied, such as when the ETC card is not inserted, or when an error has occurred, such as when the toll collection process has failed. The CPU 21 switches between turning on and turning off of a second light-emitting element 33 of the antenna unit 3 by turning on or turning off the switch unit 23 (second transistor switch circuit 25) described later, and notifies of the state of the in-vehicle device 1.

[0021]

The self-holding circuit 22 maintains an ON or OFF state of the switch unit 23 (first transistor switch circuit 24 and second transistor switch circuit 25) input from the CPU.

[0022]

The switch unit 23 includes the first transistor switch circuit 24, and the second transistor switch circuit 25. The first transistor switch circuit 24 superimposes a first notification signal on a signal output to the antenna unit 3. The second transistor switch circuit 25 superimposes a second notification signal at a voltage level different from a voltage level of the first notification signal on the signal output to the antenna unit 3. In the present embodiment, for example, it is assumed that power supplied from the power supply circuit 20 to each transistor switch circuit is voltage-converted such that the first notification signal is 3.3 V and the second notification signal is 5 V. The voltage level of each signal may be arbitrarily changed.

[0023]

A blinking circuit 27 may be provided on a signal line 26 between the self-holding circuit 22 and the first transistor switch circuit 24. The blinking circuit 27 causes the first light-emitting element 32 of the antenna unit 3, which will be described later, to blink by switching the first transistor switch circuit 24 on and off at a predetermined blinking pitch. In addition, the blinking circuit 27 may be omitted.

[0024]

The antenna unit 3 includes a voltage level determination unit 31, the first light-emitting element 32, a second light-emitting element 33, and an antenna main body 34.

[0025]

The voltage level determination unit 31 turns on (blinks) or turns off each of the first light-emitting element 32 and the second light-emitting element 33 based on the voltage level of the signal input from the main body portion 2. For example, in the present embodiment, the voltage level of the second notification signal (5 V) is higher than the voltage level of the first notification signal (3.3 V). Therefore, the voltage level determination unit 31 determines that the second notification signal is output when the voltage level E of the signal exceeds a predetermined threshold value E1, and determines that the first notification signal is output when the voltage level E of the signal is equal to or lower than the threshold value E1. The threshold value E1 is set, for example, to an intermediate value between the first notification signal and the second notification signal.

[0026]

The first light-emitting element 32 is provided at the position visible from outside the vehicle V. For example, the enforcement officer who monitors the

parking zone can easily determine whether or not the vehicle V is improperly parked (exceeding the time limit or the like) by checking the lighting state of the first light-emitting element 32.

[0027]

The second light-emitting element 33 is provided at the position visible from inside the vehicle V. For example, the occupant of the vehicle V can easily determine whether or not the toll collection process has been normally performed by checking the lighting state of the second light-emitting element 33.

[0028]

The first light-emitting element 32 and the second light-emitting element 33 are, for example, light-emitting elements such as LEDs. In the present embodiment, the first light-emitting element 32 will be described as LED1, and the second light-emitting element 33 will be described as LED2.

[0029]

The antenna unit 3 transmits and receives various data and signals to and from the terminal device 5 by short-range wireless communication such as DSRC using the antenna main body 34. The main body portion 2 transmits and receives various data and signals to and from the central device 6 through a communication module (not shown) compatible with a WWAN standard. Further, the in-vehicle device 1 and the terminal device 5 may perform wireless communication by Bluetooth or Wi-Fi instead of DSRC. In this case, the main body portion 2 transmits and receives various data and signals to and from the terminal device 5 through a communication module (not shown) compatible with standards such as Bluetooth or Wi-Fi.

[0030]

FIG. 3 is a diagram showing an example of an LED display pattern according

to the first embodiment. As shown in FIG. 3, under the control of the CPU 21 of the main body portion 2, the LED2 is turned on when the engine of the vehicle V is on and the state of the in-vehicle device 1 is “normal”, and the LED2 is turned off when the state of the in-vehicle device 1 is “abnormal”. Further, when the engine of the vehicle V is on, the LED1 remains off regardless of the state of the in-vehicle device 1. The occupant of the vehicle V can easily ascertain the state of the in-vehicle device 1 by checking the LED2. Further, when the engine of the vehicle V is off, the LED2 remains turned off. Meanwhile, when the engine of the vehicle V is off, the LED1 is turned on (blinked in a case where the blinking circuit 27 is provided) when the parking time of the vehicle V is within the time limit, and the LED1 is turned off when the parking time of the vehicle V is outside the time limit. Since the LED1 is provided at the position visible from outside the vehicle V, the enforcement officer who monitors the parking zone can easily ascertain that parking is improper (parking exceeds the time limit or the operation of starting the parking is not performed) when the LED1 is turned off.

[0031]

In addition, the LED1 can be switched to the display pattern (turning on, blinking, or turning off) designated by a display instruction of the terminal device 5, which will be described later, in order to check the improper parking during the parking of the vehicle V. The enforcement officer can distinguish whether LED1 is genuine or unauthorized, such as a dummy LED, based on whether LED1 is switched in accordance with the display instruction.

[0032]

In addition, although FIGS. 2 and 3 show an example in which the LED1 (first light-emitting element 32) of the antenna unit 3 has two display patterns of turning on

(or blinking) and turning off, the present disclosure is not limited thereto. In another embodiment, the LED1 may have three display patterns of turning on, blinking, and turning off. In this case, the signal line 26 is branched into two lines, and the blinking circuit 27 is provided on only one of the lines. For example, the CPU 21 of the main body portion 2 turns on the LED1 at all times when the vehicle V starts to park, causes the LED1 to blink when the parking time is a predetermined time (for example, 10 minutes) before the time limit, and turns off the LED1 when the parking time exceeds the time limit.

[0033]

(Functional Configuration of Terminal Device)

FIG. 4 is a diagram showing a functional configuration of the terminal device according to the first embodiment. As shown in FIG. 1, the terminal device 5 includes a CPU 51, a memory 52, a storage 53, a short-range wireless communication unit 54, a wide-range wireless communication unit 55, a display unit 56, an operation unit 57, and a camera 58.

[0034]

The CPU 51 operates in accordance with a predetermined program to exhibit functions as a vehicle information acquisition unit 511, a wake-up instruction unit 512, a display instruction unit 513, and a notification unit 514.

[0035]

The vehicle information acquisition unit 511 acquires vehicle information for specifying the vehicle V parked in the parking zone. The vehicle information is, for example, character information (license plate information) indicated on a license plate of the vehicle V. The vehicle information acquisition unit 511 may read the license plate information from an image of the license plate captured by the camera 58 by

known image processing. Further, the vehicle information acquisition unit 511 may acquire the license plate information input by the enforcement officer through the operation unit 57.

[0036]

The wake-up instruction unit 512 transmits a wake-up instruction for waking up (canceling the sleep state of) the in-vehicle device 1 of the vehicle V.

[0037]

The display instruction unit 513 transmits a display instruction including a display pattern indicating turning on (blinking) or turning off of the LED1 of the in-vehicle device 1 of the vehicle V.

[0038]

The notification unit 514 notifies the central device 6 of the improper parking of the vehicle V.

[0039]

The memory 52 has a memory region necessary for the operation of the CPU 51.

[0040]

The storage 53 is a so-called auxiliary storage device, and is, for example, a hard disk drive (HDD), a solid-state drive (SSD), or the like. The storage 53 stores data and the like acquired, generated, and referred to by each unit of the CPU 51 during the process.

[0041]

The short-range wireless communication unit 54 performs wireless communication with the in-vehicle device 1 using DSRC, Bluetooth, or the like.

[0042]

The wide-range wireless communication unit 55 performs wireless communication with the central device 6 using WWAN or the like.

[0043]

The display unit 56 is a display device (such as a liquid-crystal display) for displaying various types of information related to monitoring of improper parking.

[0044]

The operation unit 57 is an input device for receiving an input operation or an instruction operation of the enforcement officer. The display unit 56 and the operation unit 57 may be integrally configured as a touch panel.

[0045]

The camera 58 captures the image of the license plate of the vehicle V or the like.

[0046]

(Process Example of Monitoring System)

FIG. 5 is a sequence diagram showing an example of a process of the monitoring system according to the first embodiment. Here, the process example of the monitoring system 100 will be described in detail with reference to FIG. 5.

[0047]

The enforcement officer approaches the vehicle V parked in the parking zone and operates the terminal device 5 at a position at which the LED1 of the in-vehicle device 1 is visible. The vehicle V parked in the parking zone is in an engine-off state, and the CPU 21 of the in-vehicle device 1 is in a sleep state in this case. When the enforcement officer presses a start button of the operation unit 57, the wake-up instruction unit 512 of the terminal device 5 transmits the wake-up instruction to the in-vehicle device 1 via the short-range wireless communication unit 54 (step S101).

When the CPU 21 of the in-vehicle device 1 receives the wake-up instruction, the CPU 21 cancels the sleep state and enters an active state (step S102).

[0048]

Next, the display instruction unit 513 of the terminal device 5 transmits the display instruction for designating the display of the LED1 to the in-vehicle device 1 via the short-range wireless communication unit 54 (step S103). Then, the CPU 21 of the in-vehicle device 1 switches the display of the LED1 in accordance with the display instruction received from the terminal device 5 (step S104).

[0049]

The display instruction includes the display pattern of the LED1 set in advance. The display pattern may be, for example, a pattern in which the LED1 that is being lit is blinked or turned off for n seconds, the LED1 that is being blinked is turned on or turned off for n seconds, or turning on and turning off of the LED1 are switched every n seconds and repeated a plurality of times.

[0050]

In addition, the display pattern may be designated by the enforcement officer via the operation unit 57. In this case, in step S103, the display instruction unit 513 transmits the display pattern designated by the enforcement officer operating a turning-on button, a blinking button, and a turning-off button of the operation unit 57 to the in-vehicle device 1 as the display instruction. The enforcement officer may perform an operation of switching the display pattern of the LED1 a plurality of times. The terminal device 5 and the in-vehicle device 1 repeatedly execute steps S103 and S104 each time the operation of the enforcement officer is received. The enforcement officer checks whether or not the LED1 of the in-vehicle device 1 is switched in accordance with the operation of the enforcement officer.

[0051]

Next, when the LED1 of the in-vehicle device 1 is not switched in accordance with the display instruction, the enforcement officer presses an improper parking button of the operation unit 57. When the improper parking button is pressed (step S105; YES), the vehicle information acquisition unit 511 of the terminal device 5 acquires the vehicle information of the vehicle V (step S106). For example, the vehicle information acquisition unit 511 activates the camera 58 and prompts the enforcement officer to capture the image of the license plate of the vehicle V. Further, the vehicle information acquisition unit 511 reads the license plate information by performing known image processing (for example, the same process as an existing license plate reading device) on the captured image, and acquires the read license plate information as the vehicle information of the vehicle V.

[0052]

In addition, the vehicle information acquisition unit 511 may prompt the enforcement officer to input the vehicle information (license plate information). The enforcement officer visually checks the license plate of the vehicle V, and inputs the license plate information through the operation unit 57. The vehicle information acquisition unit 511 acquires the license plate information input by the enforcement officer as the vehicle information of the vehicle V.

[0053]

Next, the notification unit 514 transmits the improper parking information to the central device 6 to notify of the improper parking (step S107). The improper parking information includes the vehicle information acquired in step S106, the date and time when the improper parking is detected, and information (parking zone ID or the like) for specifying the parking zone. In step S106, the enforcement officer may

capture images including the entire vehicle V or the surrounding scenery (parking zone) with the camera 58 as evidence of the improper parking. In this case, the improper parking information also includes these images. The central device 6 performs a process of imposing a penalty such as a fine for the improper parking on the vehicle V, based on the improper parking information.

[0054]

When the LED1 of the in-vehicle device 1 is switched as indicated by the display instruction, the enforcement officer completes the work of checking the improper parking of the vehicle V. For example, when the improper parking button is not pressed even after a certain time has elapsed after the transmission of the display instruction (step S105; NO), the vehicle information acquisition unit 511 of the terminal device 5 completes the process.

[0055]

In addition, the CPU 21 of the in-vehicle device 1 transitions to the sleep state when a certain time has elapsed after step S104 (step S108). As a result, the CPU 21 of the in-vehicle device 1 is in a power-saving mode again.

[0056]

(Operation and Effect)

As described above, the monitoring system 100 according to the present embodiment includes the in-vehicle device 1 mounted in the vehicle V and the terminal device 5 carried by the enforcement officer. The in-vehicle device 1 includes the LED1 (first light-emitting element 32) provided at the position visible from the outside of the vehicle V, and the CPU 21 that switches between turning on, blinking, and turning off of the LED1 based on the display instruction. The terminal device 5 includes the display instruction unit 513 that transmits the display instruction

for the LED1 of the in-vehicle device 1.

[0057]

In this manner, the monitoring system 100 can easily allow the enforcement officer to determine whether or not the LED1 of the in-vehicle device 1 is genuine. This makes it possible to crack down on fraudulent acts such as attaching a dummy LED.

[0058]

In addition, the display instruction unit 513 of the terminal device 5 transmits the display instruction including the display pattern for designating turning on, blinking, or turning off of the LED1 to the in-vehicle device 1 by the short-range wireless communication. The CPU 21 of the in-vehicle device 1 turns on, blinks, or turns off the LED1 based on the display pattern received from the terminal device 5.

[0059]

For example, in the environment in which a structure that shields radio waves, such as an underground parking lot, is present, it may be difficult to perform wireless communication with the in-vehicle device 1 by the wide-range wireless communication. However, in the present embodiment, since the in-vehicle device 1 and the terminal device 5 perform communication by the short-range wireless communication, it is possible to perform an operation of switching the display pattern of the LED1 from outside the vehicle V and to check whether or not the vehicle V is improperly parked, even in the environment such as an underground parking lot.

[0060]

The terminal device 5 further includes the wake-up instruction unit 512 that transmits the wake-up instruction for waking up the CPU 21 of the in-vehicle device 1.

[0061]

In this manner, in the monitoring system 100, even when the vehicle V that is parked is in the engine-off state and the CPU 21 of the in-vehicle device 1 is in the sleep state, the CPU 21 of the in-vehicle device 1 can be woken up to switch the display pattern of the LED1.

[0062]

<Modification Example of First Embodiment>

In the first embodiment, the example has been described in which the antenna unit 3 of the in-vehicle device 1 has only one LED1 (first light-emitting element 32), but the present disclosure is not limited thereto. The antenna unit 3 may include a plurality of LED1s. For example, as shown in FIG. 6, the antenna unit 3 may include LED1A and LED1B (first light-emitting elements 32A and 32B). In this case, the switch unit 23 of the main body portion 2 includes the same number (two) of first transistor switch circuits 24A and 24B as the LED1A and LED1B. In addition, as shown in FIG. 7, the in-vehicle device 1 may switch between the LED1A and the LED1B and turn on the selected LED in accordance with the remaining time until the time limit. The blinking circuit 27 may be provided between the self-holding circuit 22 and the first transistor switch circuits 24A and 24B to enable one or both of the LED1A and LED1B to blink.

[0063]

In addition, in step S103 of FIG. 5, the display instruction unit 513 of the terminal device 5 transmits, for example, a display instruction including (1) a display pattern in which the LED1A is turned on and the LED1B is turned off, (2) a display pattern in which the LED1A is turned off and the LED1B is turned on, (3) a display pattern in which both the LED1A and the LED1B are turned on, and the like to the in-vehicle device 1. The display instruction unit 513 may randomly or automatically

select any one of these display patterns in a predetermined order, or may allow the enforcement officer to select any one of these display patterns. In addition, the display pattern shown in FIG. 7 is an example, and other display patterns may be included. With such a configuration as well, the same effects as those of the first embodiment can be obtained.

[0064]

<Second Embodiment>

Hereinafter, a second embodiment will be described in detail with reference to FIGS. 8 and 9. Components common to the first embodiment will be denoted by the same reference signs, and detailed description thereof will be omitted. The present embodiment is different from the first embodiment in that the terminal device 5 does not directly communicate with the in-vehicle device 1. Therefore, the terminal device 5 may be a general portable computer such as a smartphone or a tablet, instead of a dedicated terminal for monitoring improper parking. In addition, the terminal device 5 may omit the short-range wireless communication unit 54.

[0065]

(Functional Configuration of Central Device)

FIG. 8 is a diagram showing a functional configuration of a central device according to the second embodiment. As shown in FIG. 8, the central device 6 includes a CPU 61, a memory 62, a storage 63, and a wide-range wireless communication unit 65.

[0066]

The CPU 61 operates in accordance with a predetermined program to exhibit functions as a reception unit 611 and a transmission unit 612.

[0067]

The reception unit 611 receives the vehicle information of the vehicle V and the wake-up instruction and the display instruction for the in-vehicle device 1 of the vehicle V from the terminal device 5.

[0068]

The transmission unit 612 specifies the in-vehicle device 1 serving as a transmission destination based on the vehicle information received from the terminal device 5, and transmits the wake-up instruction and the display instruction to the specified in-vehicle device 1.

[0069]

The memory 62 has a memory region necessary for the operation of the CPU 61.

[0070]

The storage 63 is a so-called auxiliary storage device, and is, for example, a hard disk drive (HDD), a solid-state drive (SSD), or the like. The storage 63 stores data and the like acquired, generated, and referred to by each unit of the CPU 61 during the process.

[0071]

The wide-range wireless communication unit 65 performs wireless communication with the in-vehicle device 1 and the terminal device 5 using WWAN or the like.

[0072]

(Process Example of Monitoring System)

FIG. 9 is a sequence diagram showing an example of a process of the monitoring system according to the second embodiment. Here, the process example of the monitoring system 100 according to the present embodiment will be described

in detail with reference to FIG. 9.

[0073]

The enforcement officer approaches the vehicle V parked in the parking zone and operates the terminal device 5 at a position at which the LED1 of the in-vehicle device 1 is visible. When the enforcement officer presses the start button of the operation unit 57, the vehicle information acquisition unit 511 of the terminal device 5 acquires the vehicle information of the vehicle V (step S201). This process is the same as the process of step S106 in FIG. 5. That is, the vehicle information acquisition unit 511 acquires, as the vehicle information of the vehicle V, the license plate information read from the image captured by the camera 58 by the enforcement officer or the license plate information input by the enforcement officer from the operation unit 57.

[0074]

When the vehicle information is acquired, the wake-up instruction unit 512 of the terminal device 5 transmits the wake-up instruction to the central device 6 together with the vehicle information of the vehicle V (step S202). When the reception unit 611 receives the vehicle information and the wake-up instruction, the transmission unit 612 of the central device 6 transmits the wake-up instruction to the in-vehicle device 1 of the vehicle V specified from the vehicle information (step S203). For example, the transmission unit 612 of the central device 6 has a transmission destination list in which the license plate information of each vehicle and the in-vehicle device are associated with each other, and specifies the in-vehicle device 1 serving as the transmission destination with reference to the transmission destination list. When the CPU 21 of the in-vehicle device 1 receives the wake-up instruction from the central device 6, the CPU 21 cancels the sleep state and enters the active state (step S204).

[0075]

Then, the display instruction unit 513 of the terminal device 5 transmits the display instruction to the central device 6 together with the vehicle information of the vehicle V (step S205). When the reception unit 611 receives the vehicle information and the display instruction, the transmission unit 612 of the central device 6 transmits the display instruction to the in-vehicle device 1 of the vehicle V specified from the vehicle information (step S206). Then, the CPU 21 of the in-vehicle device 1 switches the display of the LED1 in accordance with the display instruction (display pattern) received from the central device 6 (step S207).

[0076]

In step S205, the display instruction unit 513 of the terminal device 5 transmits the display instruction including the display pattern of the LED1 set in advance to the central device 6. In addition, the display pattern of the LED1 may be set by the enforcement officer via the operation unit 57 of the terminal device 5. The enforcement officer checks whether or not the LED1 of the in-vehicle device 1 is switched in accordance with the instruction. Further, the display pattern transmitted to the central device 6 may be displayed on the display unit 56. In this case, the enforcement officer checks whether or not the display pattern displayed on the display unit 56 matches the display pattern of the LED1 of the in-vehicle device 1.

[0077]

Next, when the improper parking button is pressed by the enforcement officer (step S208; YES), the notification unit 514 of the terminal device 5 transmits the improper parking information to the central device 6 to notify of the improper parking (step S209). This process is the same as the process in the first embodiment (step S107 in FIG. 5).

[0078]

When the LED1 of the in-vehicle device 1 is switched as indicated by the display instruction, the enforcement officer completes the work of checking the improper parking of the vehicle V. For example, when the improper parking button is not pressed even after a certain time has elapsed after the transmission of the display instruction (step S208; NO), the vehicle information acquisition unit 511 of the terminal device 5 completes the process.

[0079]

In addition, the CPU 21 of the in-vehicle device 1 transitions to the sleep state when a certain time has elapsed after step S207 (step S210). This process is the same as the process in the first embodiment (step S108 in FIG. 5).

[0080]

(Operation and Effect)

As described above, in the monitoring system 100 according to the present embodiment, the display instruction unit 513 of the terminal device 5 transmits the display instruction to the central device 6 together with the vehicle information acquired by the vehicle information acquisition unit 511. The central device 6 includes the reception unit 611 that receives the vehicle information and the display instruction from the terminal device 5, and the transmission unit 612 that specifies the in-vehicle device 1 serving as the transmission destination based on the vehicle information received from the terminal device 5 and that transmits the display instruction including the display pattern for designating turning on, blinking, or turning off of the LED1 to the specified in-vehicle device 1 by the WWAN. The CPU 21 of the in-vehicle device 1 turns on, turns off, or blinks the LED1 based on the display pattern received from the central device 6.

[0081]

In this manner, the monitoring system 100 can cause the central device 6 to transmit the display instruction for the improper parking check to the in-vehicle device 1. As a result, since the terminal device 5 does not need to directly communicate with the in-vehicle device 1, the terminal device 5 does not need to be a dedicated terminal corresponding to short-range wireless communication such as DSRC, and may be, for example, a smartphone or a tablet on which an application for monitoring improper parking is installed. Therefore, the cost required for the development and introduction of the terminal device 5 can be reduced. In addition, with such a configuration as well, the same effects as those of the first embodiment can be obtained.

[0082]

<Third Embodiment>

Hereinafter, a third embodiment will be described in detail with reference to FIG. 10. Components common to each of the above embodiments will be denoted by the same reference signs, and detailed description thereof will be omitted. The present embodiment is different from each of the above embodiments in that the terminal device 5 acquires the vehicle information from the in-vehicle device 1 by short-range wireless communication (DSRC or the like).

[0083]

(Process Example of Monitoring System)

FIG. 10 is a sequence diagram showing an example of a process of the monitoring system according to the third embodiment. Here, the process example of the monitoring system 100 according to the present embodiment will be described in detail with reference to FIG. 10.

[0084]

The enforcement officer approaches the vehicle V parked in the parking zone and operates the terminal device 5 at a position at which the LED1 of the in-vehicle device 1 is visible. When the enforcement officer presses the start button of the operation unit 57, the wake-up instruction unit 512 of the terminal device 5 transmits the wake-up instruction to the in-vehicle device 1 (step S301). When the CPU 21 of the in-vehicle device 1 receives the wake-up instruction, the CPU 21 cancels the sleep state and enters the active state (step S302).

[0085]

After the wake-up instruction is transmitted, the vehicle information acquisition unit 511 of the terminal device 5 acquires the vehicle information of the vehicle V (step S303). In the present embodiment, the vehicle information acquisition unit 511 acquires the vehicle information from the in-vehicle device 1 via the short-range wireless communication unit 54 by DSRC or the like. The vehicle information including the license plate information, the in-vehicle device ID, and the like is recorded in the in-vehicle device 1 in advance. The process of acquiring the vehicle information recorded in the in-vehicle device 1 can be performed in the same manner as the process performed in the toll collection process of the ETC in the related art, for example.

[0086]

Then, the display instruction unit 513 of the terminal device 5 transmits the display instruction to the central device 6 together with the vehicle information of the vehicle V (step S304). When the reception unit 611 receives the vehicle information and the display instruction, the transmission unit 612 of the central device 6 transmits the display instruction to the in-vehicle device 1 of the vehicle V specified from the

vehicle information (step S305). Then, the CPU 21 of the in-vehicle device 1 switches the display of the LED1 in accordance with the display instruction received from the central device 6 (step S306). The processes in steps S304 to S306 are the same as the processes in the second embodiment (S205 to S207 in FIG. 9).

[0087]

Next, when the improper parking button is pressed by the enforcement officer (step S307; YES), the notification unit 514 of the terminal device 5 transmits the improper parking information to the central device 6 to notify of the improper parking (step S308). On the other hand, when the improper parking button is not pressed even after a certain time has elapsed (step S307; NO), the process ends. In addition, the CPU 21 of the in-vehicle device 1 transitions to the sleep state when a certain time has elapsed after step S306 (step S309). These processes are the same as the processes in the second embodiment (steps S208 to S210 in FIG. 9).

[0088]

In FIG. 10, the example is shown in which the display instruction unit 513 of the terminal device 5 transmits the display instruction to the central device 6 and the transmission unit 612 of the central device 6 transmits the display instruction, but the present disclosure is not limited thereto. The display instruction unit 513 of the terminal device 5 may directly transmit the display instruction to the in-vehicle device 1, as in the first embodiment (step S103 in FIG. 5).

[0089]

(Operation and Effect)

As described above, in the monitoring system 100 according to the present embodiment, the vehicle information acquisition unit 511 of the terminal device 5 performs short-range wireless communication with the in-vehicle device 1, and

acquires the vehicle information recorded in advance in the in-vehicle device 1.

[0090]

In this manner, the monitoring system 100 can automatically acquire the vehicle information by wireless communication with the in-vehicle device 1, and thus it is possible to eliminate the need for the enforcement officer to perform work such as capturing the image of the license plate or manually inputting the vehicle information. That is, it is possible to reduce the load on the enforcement officer. Further, the camera 58 of the terminal device 5 can be omitted, and the terminal device 5 can be made compact and inexpensive.

[0091]

<Fourth Embodiment>

Hereinafter, a fourth embodiment will be described in detail with reference to FIGS. 11 and 12. Components common to each of the above embodiments will be denoted by the same reference signs, and detailed description thereof will be omitted. The present embodiment is different from each of the above embodiments in that the central device 6 sets the display pattern of the LED1.

[0092]

(Functional Configuration of Central Device)

FIG. 11 is a diagram showing a functional configuration of the central device according to the fourth embodiment. As shown in FIG. 11, the CPU 61 of the central device 6 according to the present embodiment further includes a setting unit 613. The setting unit 613 receives, for example, an operation of an administrator of the monitoring system 100 and sets the display pattern of the LED1 of the in-vehicle device 1.

[0093]

(Process Example of Monitoring System)

FIG. 12 is a sequence diagram showing an example of a process of the monitoring system according to the fourth embodiment. Here, the process example of the monitoring system 100 according to the present embodiment will be described in detail with reference to FIG. 12. Here, it is assumed that the setting unit 613 of the central device 6 has already set the display pattern of the LED1 of the in-vehicle device 1 in advance.

[0094]

The enforcement officer approaches the vehicle V parked in the parking zone and operates the terminal device 5 at a position at which the LED1 of the in-vehicle device 1 is visible. When the enforcement officer presses the start button of the operation unit 57, the wake-up instruction unit 512 of the terminal device 5 transmits the wake-up instruction to the in-vehicle device 1 (step S401). When the CPU 21 of the in-vehicle device 1 receives the wake-up instruction, the CPU 21 cancels the sleep state and enters the active state (step S402). After the wake-up instruction is transmitted, the vehicle information acquisition unit 511 of the terminal device 5 acquires the vehicle information of the vehicle V (step S403). These processes are the same as the processes in the third embodiment (steps S301 to S303 in FIG. 10).

[0095]

Then, the display instruction unit 513 of the terminal device 5 transmits the display instruction to the central device 6 together with the vehicle information of the vehicle V (step S304). This display instruction does not include the display pattern.

[0096]

When the reception unit 611 receives the vehicle information and the display instruction, the transmission unit 612 of the central device 6 reads out the display

pattern recorded in the storage 63 and notifies the terminal device 5 of the display pattern (step S405). Then, the display instruction unit 513 of the terminal device 5 displays the display pattern received from the central device 6 on the display unit 56 (step S406). Further, the transmission unit 612 of the central device 6 transmits the display instruction including the read display pattern to the in-vehicle device 1 (step S406). Then, the CPU 21 of the in-vehicle device 1 switches the display of the LED1 in accordance with the display instruction received from the central device 6 (step S407).

[0097]

The enforcement officer checks whether or not the display pattern displayed on the display unit 56 matches the display pattern of the LED1 of the in-vehicle device 1. When the display patterns do not match, the enforcement officer presses the improper parking button of the operation unit 57 of the terminal device 5. When the improper parking button is pressed by the enforcement officer (step S409; YES), the notification unit 514 of the terminal device 5 transmits the improper parking information to the central device 6 to notify of the improper parking (step S410). On the other hand, when the improper parking button is not pressed even after a certain time has elapsed (step S409; NO), the process ends. In addition, the CPU 21 of the in-vehicle device 1 transitions to the sleep state when a certain time has elapsed after step S408 (step S411). These processes are the same as the processes in the second embodiment (steps S208 to S210 in FIG. 9).

[0098]

(Operation and Effect)

As described above, in the monitoring system 100 according to the present embodiment, the central device 6 further includes the setting unit 613 that sets the

display pattern. The transmission unit 612 of the central device 6 transmits the display pattern set by the setting unit 613 to the terminal device 5, and transmits the display instruction including the display pattern set by the setting unit 613 to the in-vehicle device 1.

[0099]

In this manner, for example, the administrator of the monitoring system 100 can periodically or irregularly change the display pattern for monitoring improper parking. As a result, for example, it is possible to more effectively suppress fraudulent acts such as attaching an improper LED that imitates the display pattern for improper parking monitoring.

[0100]

FIG. 12 shows the example in which the wake-up instruction unit 512 of the terminal device 5 transmits the wake-up instruction to the in-vehicle device 1 (step S401) and the vehicle information acquisition unit 511 acquires the vehicle information from the in-vehicle device 1 by the short-range wireless communication (step S403), but the present disclosure is not limited thereto. The vehicle information acquisition unit 511 of the terminal device 5 may acquire the vehicle information by image processing or manual input of the enforcement officer (step S201 in FIG. 9) and the wake-up instruction unit 512 may transmit the wake-up instruction to the central device together with the vehicle information (step S202 in FIG. 9), as in the second embodiment. In this manner, as in the second embodiment, a smartphone, a tablet, or the like can be used as the terminal device 5 instead of a dedicated terminal for monitoring improper parking.

[0101]

<Other Embodiments>

Although the embodiments have been described above in detail with reference to the accompanying drawings, the specific configuration is not limited to the above examples, and various design changes and the like may be made. That is, in another embodiment, the order of the above processes may be changed as appropriate. Further, some of the processes may be executed in parallel.

[0102]

<Supplementary Note>

The monitoring system, the in-vehicle device, and the monitoring method described in the above embodiments are understood as follows, for example.

[0103]

(1) A first aspect relates to a monitoring system 100 including: an in-vehicle device 1 mounted in a vehicle V; and a terminal device 5 carried by an enforcement officer who monitors improper parking, in which the in-vehicle device 1 includes a light-emitting element 32 provided at a position visible from outside the vehicle V, and a CPU 21 that switches a display pattern of the light-emitting element 32 based on a display instruction received from outside, and the terminal device 5 includes a display instruction unit 513 that transmits the display instruction for the light-emitting element 32 of the in-vehicle device 1.

[0104]

In this manner, the monitoring system 100 can easily allow the enforcement officer to determine whether or not the LED1 (light-emitting element 32) of the in-vehicle device 1 is genuine. This makes it possible to crack down on fraudulent acts such as attaching a dummy LED.

[0105]

(2) A second aspect relates to the monitoring system 100 according to the first

aspect, in which the display instruction unit 513 of the terminal device 5 transmits, to the in-vehicle device 1 by short-range wireless communication, the display instruction including a display pattern designating turning on, blinking, or turning off of the light-emitting element 32, and the CPU 21 of the in-vehicle device 1 turns on, blinks, or turns off the light-emitting element 32 based on the display pattern received from the terminal device 5.

[0106]

For example, in the environment in which a structure that shields radio waves, such as an underground parking lot, is present, it may be difficult to perform wireless communication with the in-vehicle device 1 by the wide-range wireless communication. However, in the present embodiment, since the in-vehicle device 1 and the terminal device 5 perform communication by the short-range wireless communication, it is possible to perform an operation of switching the display pattern of the LED1 (light-emitting element 32) from outside the vehicle V and to check whether or not the vehicle V is improperly parked, even in the environment such as an underground parking lot.

[0107]

(3) A third aspect relates to the monitoring system 100 according to the first aspect, further including: a central device 6 communicably connected to the in-vehicle device 1 and the terminal device 5 by wide-range wireless communication, in which the terminal device 5 further includes a vehicle information acquisition unit 511 that acquires vehicle information for specifying the vehicle V, the display instruction unit 513 of the terminal device 5 transmits the display instruction together with the vehicle information to the central device 6, the central device 6 includes a reception unit 611 that receives the vehicle information and the display instruction from the terminal

device 5, and a transmission unit 612 that specifies, based on the vehicle information received from the terminal device 5, an in-vehicle device 1 serving as a transmission destination, and transmits, to the specified in-vehicle device 1, the display instruction including a display pattern designating turning on, blinking, or turning off of the light-emitting element 32, and the CPU 21 of the in-vehicle device 1 turns on, turns off, or blinks the light-emitting element 32 based on the display pattern received from the central device 6.

[0108]

In this manner, the monitoring system 100 can cause the central device 6 to transmit the display instruction for the improper parking check to the in-vehicle device 1. As a result, since the terminal device 5 does not need to directly communicate with the in-vehicle device 1, the terminal device 5 does not need to be a dedicated terminal corresponding to short-range wireless communication such as DSRC, and may be, for example, a smartphone or a tablet on which an application for monitoring improper parking is installed. Therefore, the cost required for the development and introduction of the terminal device 5 can be reduced. In addition, with such a configuration as well, the same effects as those of the first embodiment can be obtained.

[0109]

(4) A fourth aspect relates to the monitoring system 100 according to any one of the first to third aspects, in which the vehicle information acquisition unit 511 of the terminal device 5 performs short-range wireless communication with the in-vehicle device 1, and acquires the vehicle information recorded in advance in the in-vehicle device 1.

[0110]

In this manner, the monitoring system 100 can automatically acquire the vehicle information by wireless communication with the in-vehicle device 1, and thus it is possible to eliminate the need for the enforcement officer to perform work such as capturing the image of the license plate or manually inputting the vehicle information. That is, it is possible to reduce the load on the enforcement officer. Further, the camera 58 of the terminal device 5 can be omitted, and the terminal device 5 can be made compact and inexpensive.

[0111]

(5) A fifth aspect relates to the monitoring system 100 according to the third aspect, in which the central device 6 further includes a setting unit 613 that sets the display pattern, and the transmission unit 612 of the central device 6 transmits the display pattern set by the setting unit 613 to the terminal device 5, and transmits the display instruction including the display pattern set by the setting unit 613 to the in-vehicle device 1.

[0112]

In this manner, for example, the administrator of the monitoring system 100 can periodically or irregularly change the display pattern for monitoring improper parking. As a result, for example, it is possible to more effectively suppress fraudulent acts such as attaching an improper LED that imitates the display pattern for improper parking monitoring.

[0113]

(6) A sixth aspect relates to the monitoring system 100 according to any one of the first to fifth aspects, in which the terminal device 5 further includes a wake-up instruction unit 512 that transmits a wake-up instruction for waking up the CPU 21 of the in-vehicle device 1.

[0114]

In this manner, in the monitoring system 100, even when the vehicle V that is parked is in the engine-off state and the CPU 21 of the in-vehicle device 1 is in the sleep state, the CPU 21 of the in-vehicle device 1 can be woken up to switch the display pattern of the LED1.

[0115]

(7) A seventh aspect relates to an in-vehicle device 1 including: a light-emitting element 32 provided at a position visible from outside a vehicle V; and a CPU 21 that changes a state of the light-emitting element 32 based on a display instruction received from outside.

[0116]

In this manner, the in-vehicle device 1 can allow the enforcement officer to check whether or not the vehicle V is improperly parked from outside the vehicle V.

[0117]

(8) An eighth aspect relates to a monitoring method using the monitoring system 100 including an in-vehicle device 1 mounted in a vehicle V, and a terminal device 5 carried by an enforcement officer who monitors improper parking, the monitoring method including: a step of switching, via the in-vehicle device 1, a display pattern of a light-emitting element 32 provided at a position visible from outside the vehicle V based on a display instruction received from outside; and a step of transmitting, via the terminal device 5, the display instruction for the light-emitting element 32 of the in-vehicle device 1.

[Industrial Applicability]

[0118]

According to the above-described aspects, it is possible to easily determine

whether or not the parking is improper.

[Reference Signs List]

[0119]

100: monitoring system

1: in-vehicle device

2: main body portion

20: power supply circuit

21: CPU

22: self-holding circuit

23: switch unit

24, 24A, 24B: first transistor switch circuit

25: second transistor switch circuit

26: signal line

27: blinking circuit

3: antenna unit

31: voltage level determination unit

32, 32A, 32B: first light-emitting element (LED1)

33: second light-emitting element (LED2)

4: coaxial cable

5: terminal device

51: CPU

511: vehicle information acquisition unit

512: wake-up instruction unit

513: display instruction unit

514: notification unit

52: memory

53: storage

54: short-range wireless communication unit

55: wide-range wireless communication unit

56: display unit

57: operation unit

58: camera

6: central device

61: CPU

611: reception unit

612: transmission unit

613: setting unit

62: memory

63: storage

65: wide-range wireless communication unit

V: vehicle

Claims

[Claim 1]

A monitoring system comprising:

an in-vehicle device mounted in a vehicle; and

a terminal device carried by an enforcement officer who monitors improper parking,

wherein the in-vehicle device includes

a light-emitting element provided at a position visible from outside the vehicle, and

a CPU that switches a display pattern of the light-emitting element based on a display instruction received from outside, and

the terminal device includes a display instruction unit that transmits the display instruction for the light-emitting element of the in-vehicle device.

[Claim 2]

The monitoring system according to claim 1,

wherein the display instruction unit of the terminal device transmits, to the in-vehicle device by short-range wireless communication, the display instruction including a display pattern designating turning on, blinking, or turning off of the light-emitting element, and

the CPU of the in-vehicle device turns on, blinks, or turns off the light-emitting element based on the display pattern received from the terminal device.

[Claim 3]

The monitoring system according to claim 1, further comprising:

a central device communicably connected to the in-vehicle device and the terminal device by wide-range wireless communication,

wherein the terminal device further includes a vehicle information acquisition unit that acquires vehicle information for specifying the vehicle,

the display instruction unit of the terminal device transmits the display instruction together with the vehicle information to the central device,

the central device includes

a reception unit that receives the vehicle information and the display instruction from the terminal device, and

a transmission unit that specifies, based on the vehicle information received from the terminal device, an in-vehicle device serving as a transmission destination, and transmits, to the specified in-vehicle device, the display instruction including a display pattern designating turning on, blinking, or turning off of the light-emitting element, and

the CPU of the in-vehicle device turns on, turns off, or blinks the light-emitting element based on the display pattern received from the central device.

[Claim 4]

The monitoring system according to claim 3,

wherein the vehicle information acquisition unit of the terminal device performs short-range wireless communication with the in-vehicle device, and acquires the vehicle information recorded in advance in the in-vehicle device.

[Claim 5]

The monitoring system according to claim 3,

wherein the central device further includes a setting unit that sets the display pattern, and

the transmission unit of the central device transmits the display pattern set by the setting unit to the terminal device, and transmits the display instruction including the display pattern set by the setting unit to the in-vehicle device.

[Claim 6]

The monitoring system according to any one of claims 1 to 5,

wherein the terminal device further includes a wake-up instruction unit that transmits a wake-up instruction for waking up the CPU of the in-vehicle device.

[Claim 7]

An in-vehicle device comprising:

a light-emitting element provided at a position visible from outside a vehicle; and

a CPU that changes a state of the light-emitting element based on a display instruction received from outside.

[Claim 8]

A monitoring method using a monitoring system including an in-vehicle device mounted in a vehicle, and a terminal device carried by an enforcement officer who monitors improper parking, the monitoring method comprising:

a step of switching, via the in-vehicle device, a display pattern of a light-emitting element provided at a position visible from outside the vehicle based on a

display instruction received from outside; and

a step of transmitting, via the terminal device, the display instruction for the light-emitting element of the in-vehicle device.