



(11)

EP 3 447 739 A1

(12)

EUROPEAN PATENT APPLICATION

(43) Date of publication:
27.02.2019 Bulletin 2019/09

(51) Int Cl.:
G07C 9/00 (2006.01)

(21) Application number: **18189931.1**

(22) Date of filing: **21.08.2018**

(84) Designated Contracting States:
AL AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HR HU IE IS IT LI LT LU LV MC MK MT NL NO PL PT RO RS SE SI SK SM TR
Designated Extension States:
BA ME
Designated Validation States:
KH MA MD TN

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(30) Priority: **25.08.2017 JP 2017162802**

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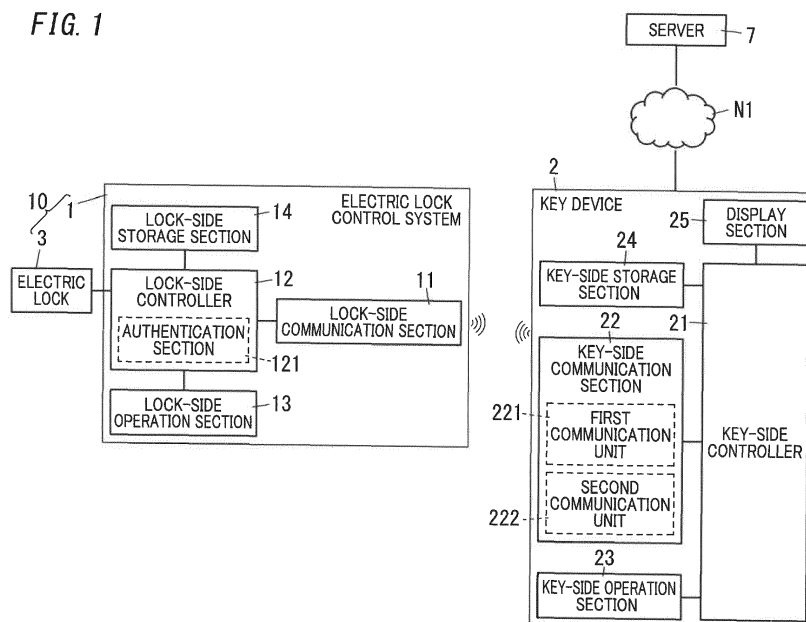
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(54) **ELECTRIC LOCK CONTROL SYSTEM, COMMUNICATION METHOD, AND PROGRAM**

(57) An object of the invention is to increase convenience in the case of updating a control program relating to control of an electric lock. An electric lock control system 1 includes a lock-side communication section 11 and a lock-side controller 12. The lock-side communication section 11 performs communication with a key device 2. The lock-side controller 12 performs control of an electric lock 3 to perform at least one of locking and unlocking of an opening and closing member configured to open and

close an opening of a building based on the communication between the key device 2 and the lock-side communication section 11. The lock-side controller 12 updates its control program based on update information of a control program. The control program relates to the control of the electric lock 3. The update information is received by the lock-side communication section 11 from the key device 2.

FIG. 1



Description

Technical Field

[0001] The present disclosure generally relates to electric lock control systems, communication methods, and programs. The present disclosure specifically relates to an electric lock control system, a communication method, and a program which are configured to control an electric lock for locking or unlocking an opening and closing member provided to a building.

Background Art

[0002] A door lock control device (electric lock control system) is disclosed (see, for example, Document 1 (JP 2009-264017 A)). The door lock control device is configured to control locking and unlocking of a door (opening and closing member) based on wireless communication with a portable device (key device). The door lock control device described in Document 1 compares specific information transmitted from the portable device with pre-registered specific information, and when the specific information matches the registered specific information, the door lock control device unlocks the door. Moreover, the door lock control device is capable of storing the specific information of the portable device acquired through the wireless communication in a storage means.

[0003] The electric lock control system described in Document 1 may require an update of a control program relating to control of an electric lock. In such a case, the electric lock control system described in Document 1 presupposes an update of the control program with a dedicated maintenance device and is thus less convenient.

Summary of Invention

[0004] In view of the foregoing, it is an object of the present disclosure to increase convenience in the case of updating a control program relating to control of an electric lock.

[0005] An electric lock control system according to one aspect of the present disclosure includes a lock-side communication section and a lock-side controller. The lock-side communication section is configured to perform communication with a key device. The lock-side controller is configured to perform control of an electric lock to perform at least one of locking and unlocking of an opening and closing member configured to open and close an opening of a building based on the communication between the key device and the lock-side communication section. The lock-side controller is configured to update, based on update information of a control program, the control program of the lock-side controller. The control program relates to the control of the electric lock. The update information is received by the lock-side communication section from the key device.

[0006] A communication method according to one as-

pect of the present disclosure is a communication method of a key device including a first communication unit and a second communication unit. The first communication unit is configured to perform communication with an electric lock control system. The second communication unit is configured to perform communication with a different system different from the electric lock control system. The communication method includes an acquisition step and a transmission step. The acquisition step is a step of acquiring update information of a control program relating to control of an electric lock serving as a control object of the electric lock control system through the communication between the second communication unit and the different system. The transmission step is a step of transmitting at least part of the update information of the control program, which is acquired, to the electric lock control system through the communication between the first communication unit and the electric lock control system.

[0007] A computer program according to one aspect of the present disclosure is a computer program including instructions which, when the program is executed by a computer system, cause the computer system to carry out the communication method.

Brief Description of Drawings

[0008]

FIG. 1 is a block diagram illustrating a configuration of an electric lock control system according to one embodiment of the present disclosure;
FIG. 2 is a conceptual view illustrating an example of use of the electric lock control system;
FIG. 3 is a flowchart illustrating an example of operation of the electric lock control system in the electric lock control system; and
FIG. 4 is a flowchart illustrating an example of operation of a key device included in the electric lock control system.

Description of Embodiments

(1) Schema

[0009] A schema of an electric lock control system 1 and an electric lock system 10 according to an embodiment will be described below. As illustrated in FIG. 1, the electric lock system 10 of the present embodiment includes the electric lock control system 1 and an electric lock 3. As illustrated in FIG. 1, the electric lock control system 1 includes a lock-side communication section 11 and lock-side controller 12.

[0010] As illustrated in FIG. 2, the electric lock control system 1 is a system configured to control the electric lock 3 for locking or unlocking an opening and closing member 5. In other words, the electric lock 3 is controlled by the lock-side controller 12 to lock or unlock the opening

and closing member 5. The opening and closing member 5 is a member configured to open and close an opening 40 of a building 4. The opening and closing member 5 is a door or a window which separates an inner side 41 of the building 4 from an outer side 42 of the building 4. The opening and closing member 5 is, for example, an entrance door, a door of a back entrance, or a patio door. In the present embodiment, the opening and closing member 5 is an entrance door. The electric lock control system 1 and the electric lock 3 are installed in the opening and closing member 5. The lock-side communication section 11 of the electric lock control system 1 performs wireless communication with a key device 2. The lock-side controller 12 of the electric lock control system 1 controls the electric lock 3 based on the communication between the key device 2 and the lock-side communication section 11.

[0011] The key device 2 has a communication function for communication with the electric lock control system 1. In the present embodiment, a communication scheme between the electric lock control system 1 and the key device 2 is wireless communication via a radio wave as a medium. Moreover, in the present embodiment, both the electric lock control system 1 and the key device 2 are driven by batteries. Furthermore, in the present embodiment, the key device 2 is, for example, a portable terminal having a telephone function. In the present embodiment, a case where the building 4 is a detached house is described as an example. Thus, a user 6 of the electric lock control system 1 is one of dwellers of the building 4 who carries the key device 2.

[0012] In the present embodiment, the key device 2 transmits key information stored in the key device 2 in advance to the electric lock control system 1 to allow the opening and closing member 5 to be unlocked and locked. That is, when the lock-side communication section 11 and the key device 2 communicate with each other, and the key information stored in the key device 2 is successfully authenticated by the lock-side controller 12, the electric lock control system 1 transitions to a state where the electric lock control system 1 can unlock or lock the opening and closing member 5. Here, in one case, an operation performed by the user 6 on a lock-side operation section 13 (which will be described later) may trigger the electric lock control system 1 to perform authentication and to lock or unlock the opening and closing member 5. In another case, after the authentication is successfully performed, the electric lock control system 1 may wait for the operation performed by the user 6 on the lock-side operation section 13 to lock or unlock the opening and closing member 5. In both of the cases, the electric lock control system 1 performs at least one of an unlock operation of switching the opening and closing member 5 from a locked state to an unlocked state and a lock operation of switching the opening and closing member 5 from the unlocked state to the locked state based on the communication with the key device 2.

[0013] In the present embodiment, the lock-side com-

munication section 11 performs communication with the key device 2, thereby acquiring update information. The update information is information based on which a control program relating to control of the electric lock 3 is updated. The control program is a program used by the lock-side controller 12. The control program is executed by the lock-side controller 12, thereby realizing a process such as the above-described authentication. In other words, the control program is firmware of the electric lock control system 1.

[0014] In the present embodiment, the lock-side controller 12 updates a control program of the lock-side controller 12 based on the update information received by the lock-side communication section 11 from the key device 2. In other words, the lock-side controller 12 updates, based on the update information, a control program used by the lock-side controller 12 before reception of the update information. Thus, after the update, the lock-side controller 12 executes a control program which is newest. In this embodiment, the update information may be a control program itself or data corresponding to a difference between a control program and a control program before the update.

[0015] The "update of the control program" mentioned in this embodiment refers to updating of algorithms used mainly by the control program, such as changing algorithms for the authentication and fixing bugs, and excludes updating data itself referred by the control program. Thus, for example, registration of the key device 2 with the electric lock control system 1 corresponds to an update of registered information (data) referred by the control program and is thus not included in the "update of the control program".

[0016] As described above, in the present embodiment, the lock-side controller 12 enables the control program of the lock-side controller 12 to be updated based on the update information received from the key device 2. Thus, the present embodiment enables the control program relating to the control of the electric lock 3 to be updated without using a dedicated maintenance device which is a device other than the key device 2. Thus, the present embodiment enables convenience in the case of updating the control program relating to the control of the electric lock 3 to be increased more than a case where the dedicated maintenance device is used.

(2) Details

[0017] With reference to FIGS. 1 and 2, the configurations of the electric lock control system 1 and the electric lock system 10 according to the present embodiment will be described below.

(2.1) Electric Lock Control System

[0018] As illustrated in FIG. 1, the electric lock control system 1 includes the lock-side communication section 11, the lock-side controller 12, the lock-side operation

section 13, and a lock-side storage section 14. In the present embodiment, the lock-side communication section 11, the lock-side controller 12, the lock-side operation section 13, and the lock-side storage section 14 are accommodated in one case.

[0019] The lock-side communication section 11 includes, for example, an antenna and a communication circuit. The lock-side communication section 11 is a communication interface configured to perform wireless communication with the key device 2 via a radio wave as a medium. A frequency band based on which the wireless communication is performed is, for example, a 420-MHz band, a 920-MHz band, or a 2.4-GHz band. The lock-side communication section 11 is configured to perform short-distance wireless communication conforming to, for example, the Bluetooth low energy (BLE) standard. In this embodiment, "BLE" is the name of a low power consumption specification in the specification of Bluetooth (registered trademark) which is a wireless personal area network (PAN) technique. The lock-side communication section 11 transmits a beacon signal in response to an instruction from the lock-side controller 12. Moreover, the lock-side communication section 11 receives a beacon response. The beacon response is transmitted from a key-side communication section 22 (which will be described later) which responds to the beacon signal. That is, the lock-side communication section 11 has a signal transmission function and a signal reception function. The lock-side communication section 11 is configured to perform bidirectional communication with the key-side communication section 22.

[0020] In the present embodiment, the lock-side communication section 11 is one communication interface and is configured to perform both communication for updating the control program and communication for authenticating the key device 2. That is, in the present embodiment, the lock-side communication section 11 is used not only to receive the update information of the control program from the key device 2 but also to perform communication between the key device 2 and an authentication section 121 (which will be described later).

[0021] The lock-side controller 12 includes, for example, a microcomputer including a processor and memory. That is, the lock-side controller 12 is realized by a computer system including a processor and memory. The processor executes an appropriate program, and thus, the computer system functions as the lock-side controller 12. The program may be stored in the memory in advance, provided over an electronic communication network such as the Internet, or provided as a non-transitory recording medium such as a memory card storing the program. The lock-side controller 12 includes the authentication section 121.

[0022] The authentication section 121 performs an authentication process of checking the key information received by the lock-side communication section 11 from key device 2 with authentication information stored in the lock-side storage section 14 to confirm whether or not

the key device 2 from which the key information is transmitted is a key device 2 which is allowed to operate the electric lock 3. That is, the authentication section 121 determines, based on the communication with the key device 2, whether or not the key device 2 from which the key information is transmitted is a valid key device. When the authentication by the authentication section 121 is successfully performed (that is, the key device 2 from which the key information is transmitted is a valid key device), the lock-side controller 12 outputs a control signal (an unlock signal or a lock signal) to the electric lock 3.

[0023] The lock-side operation section 13 has a function of receiving an operation input given by the user 6. The lock-side operation section 13 includes, for example, a push button switch. The lock-side operation section 13 is provided on each of the inner side 41 and the outer side 42 of the building 4. The lock-side operation section 13 may be, for example, a door handle (knob) provided to the opening and closing member 5 (entrance door) or a touch sensor configured to sense an operation of touching the door handle by the user 6. When receiving the operation input given by the user 6, the lock-side operation section 13 outputs to the lock-side controller 12 an operation signal according to the operation input.

[0024] The lock-side storage section 14 includes electrically rewritable nonvolatile memory, for example, electrically erasable and programmable read-only memory (EEPROM). The lock-side storage section 14 stores key information of at least one key device 2 allowed to control the electric lock 3 as authentication information. In the present embodiment, when the key device 2 is registered, specific key information is given to the key device 2. Thus, the lock-side storage section 14 stores identification information of the key device 2 and the key information given to the key device 2 in association with each other. The identification information is, for example, a specific identification (ID) of the key device 2.

(2.2) Key Device

[0025] The key device 2 is a portable terminal such as a smartphone. As illustrated in FIG. 1, the key device 2 includes a key-side controller 21, a key-side communication section 22, a key-side operation section 23, a key-side storage section 24, and a display section 25.

[0026] The key-side controller 21 includes, for example, a microcomputer including a processor and memory. That is, the key-side controller 21 is realized by a computer system including a processor and memory. The processor executes an appropriate program, and thus, the computer system functions as the key-side controller 21. The program may be stored in the memory in advance, provided over an electronic communication network such as the Internet, or provided as a non-transitory recording medium such as a memory card storing the program.

[0027] The key-side communication section 22 includes a first communication unit 221 and a second com-

munication unit 222. The first communication unit 221 and the second communication unit 222 each include, for example, an antenna and a communication circuit.

[0028] The first communication unit 221 is a communication interface configured to perform short-distance wireless communication conforming to, for example, the BLE standard with the lock-side communication section 11. The first communication unit 221 transmits a response signal to the lock-side communication section 11 in response to an instruction from the key-side controller 21. Moreover, the first communication unit 221 receives the beacon signal transmitted from the lock-side communication section 11. When receiving the beacon signal, the first communication unit 221 transmits a beacon response notifying the reception of the beacon signal to the lock-side communication section 11. That is, the first communication unit 221 has a signal transmission function and a signal reception function. The first communication unit 221 is configured to perform bidirectional communication with the lock-side communication section 11. The lock-side communication section 11 receives the beacon response from the key device 2, and thereby, authentication communication for authenticating the key device 2 is started between the electric lock control system 1 and the key device 2.

[0029] The second communication unit 222 is a communication interface conforming to, for example, the Ethernet (registered trademark) standard and is connected to a router compatible with the wireless local area network (LAN). In the present embodiment, the second communication unit 222 performs short-distance wireless communication conforming to Wi-Fi (registered trademark) with the router. The second communication unit 222 is connected to a network N1 such as the Internet via the router. The second communication unit 222 performs communication with a different system (in this embodiment, a server 7) different from the electric lock control system 1 via the network N1.

[0030] The key-side operation section 23 has a function of receiving an operation input given by the user (i.e., a person) 6. The key-side operation section 23 may include, for example, a push button switch provided to the case of the key device 2 or a lever provided to the case of the key device 2. In the present embodiment, the key-side operation section 23 includes a touch panel provided to a display device constituting the display section 25. The touch panel includes a touch sensor based on a capacitance sensing system or a touch sensor based on a pressure sensing system. When the user 6 performs an operation (e.g., a tap operation and a swipe operation) of touching the display device of the display section 25, the key-side operation section 23 outputs a signal according to the operation to the key-side controller 21.

[0031] The key-side storage section 24 includes an electrically rewritable nonvolatile memory such as EEPROM. The key-side storage section 24 stores individual identification information assigned to the key device 2, key information given from the electric lock control sys-

tem 1, and the like. Moreover, the key-side storage section 24 stores a program which the computer system of the key device 2 executes. The program may be stored in memory in advance, provided over an electronic communication network such as the Internet, or provided as a non-transitory recording medium such as a memory card storing the program. As in the present embodiment, when the key device 2 is a portable terminal such as a smartphone, the key-side storage section 24 may store an application optionally installed by the user 6.

[0032] The display section 25 is a thin display device examples of which include a liquid crystal display and an organic electro luminescence (EL) display. The key-side controller 21 controls contents to be displayed on the display section 25.

(2.3) Electric Lock

[0033] The electric lock 3 is configured to unlock and lock the opening and closing member 5 (in this embodiment, an entrance door). The electric lock 3 includes a dead bolt, a driver, and a drive circuit. The drive circuit generates a drive signal in accordance with a control signal (an unlock signal or a lock signal) provided from the lock-side controller 12 and outputs the drive signal to the driver. The driver includes an electric motor and a transmission mechanism for transmitting driving force of the electric motor to the dead bolt. The driver drives the drive motor in accordance with the drive signal input from the drive circuit. The driving force of the drive motor is transmitted to the dead bolt via the transmission mechanism, thereby moving the dead bolt to a locked position or an unlocked position. In this embodiment, in a state where the dead bolt is moved to the locked position, at least part of the dead bolt is inserted in a bolt hole formed in a door frame supporting the opening and closing member 5, and in this state, the opening and closing member 5 is maintained in a closed state. In a state in which the dead bolt is moved to the unlocked position, the entirety of the dead bolt is outside the bolt hole, and in this state, opening and closing of the opening and closing member 5 is possible.

(2.4) Server

[0034] The server 7 is disposed in a place located away from the building 4 in which the electric lock control system 1 is installed, for example, in a facility owned by a provider of the electric lock control system 1 or a provider of service including the electric lock control system 1. The server 7 performs communication with the second communication unit 222 of the key device 2 over the network N1. The server 7 includes, for example, a computer system (including a microcomputer) including a processor and memory as a main component. That is, the computer system executes an appropriate program by the processor, thereby functioning as the server 7.

[0035] The server 7 stores update information of the

control program relating to the control of the electric lock 3 and update information of a program for use in the key device 2. The "program for use in the key device 2" mentioned herein is a program executed by the key-side controller 21, in other words, firmware of the key device 2. The update information used in the key device 2 may be a program itself or data corresponding to a difference between a program and a program before the update. In the following description, pieces of the update information are collectively referred to as an "update information set".

[0036] The update information set is accordingly updated by, for example, a provider of service including the electric lock control system 1. The server 7 transmits an update information set to the key device 2 in response to a request from the key device 2 based on communication with the key device 2. For example, the user 6 causes the key-side operation section 23 to perform a specific operation, and thereby, a request signal requesting the update information set is transmitted from the key-side communication section 22 to the server 7. When receiving the request signal, the server 7 transmits the update information set to the key device 2 serving as a transmission source of the request signal.

[0037] As in the present embodiment, when the key device 2 is a portable terminal such as a smartphone, the update information set is transmitted to the key device 2 in the form of, for example, an application which includes the update information set and which is dedicated to the portable terminal. Alternatively, when a dedicated application is already installed in the key device 2, the update information set is transmitted as information for updating the dedicated application to the key device 2.

(3) Operation

[0038] Operation of the electric lock control system 1 of the present embodiment will be described below.

(3.1) Authentication

[0039] First, authentication performed by the electric lock control system 1 will be described. The lock-side controller 12 controls the lock-side communication section 11 to intermittently drive the antenna, thereby transmitting the beacon signal. In this embodiment, when the user 6 carrying the key device 2 enters a communication area of the electric lock control system 1, the key-side communication section 22 receives the beacon signal from the lock-side communication section 11. The communication area is a range within which the key device 2 can receive a radio signal from the electric lock control system 1 with intensity necessary for processes performed by the key device 2. That is, a range within which the key device 2 can receive, but cannot execute the process based on, a radio signal from the electric lock control system 1 is deemed outside of the communication area.

[0040] When receiving the beacon signal, the key device 2 transmits the beacon response to the lock-side communication section 11. The lock-side communication section 11 receives the beacon response from the key device 2, and thereby, the authentication section 121 executes the authentication process. When the authentication process is successfully performed, the lock-side controller 12 automatically controls the electric lock 3 to lock or unlock the opening and closing member 5 or waits for the operation performed by the user 6 on the lock-side operation section 13 to control the electric lock 3 to lock or unlock the opening and closing member 5. In contrast, when the authentication process is unsuccessfully performed, or when the beacon response from the key device 2 is not received during a definite time period, the lock-side controller 12 does not control the electric lock 3. That is, in this case, even if the user 6 operates the lock-side operation section 13, the lock-side controller 12 does not control the electric lock 3.

(3.2) Update in Electric Lock Control System

[0041] Next, with reference to FIG. 3, an operation of updating the control program of the lock-side controller 12 performed by the lock-side controller 12 of the electric lock control system 1 will be described. In the following description, it is assumed that in the key device 2, based on communication with the server 7, a program for use in the key device 2 is updated in advance, and the update information of the control program of the electric lock control system 1 is stored in advance.

[0042] When the user 6 carrying the key device 2 enters the communication area of the electric lock control system 1, the electric lock control system 1 starts communicating with the key device 2 (step S10). The authentication section 121 executes the authentication process (step S11). When the authentication process is unsuccessfully performed (step S12: No), the lock-side controller 12 does not control the electric lock 3 as described above. In this case, even when the update information is stored in the key device 2, the lock-side communication section 11 does not receive the update information from the key device 2. In contrast, when the authentication process is successfully performed (step S12: Yes), the lock-side controller 12 controls the electric lock 3 to lock or unlock the opening and closing member 5 (step S13).

[0043] After controlling the electric lock 3 (i.e., after the authentication is successfully performed), the lock-side communication section 11 performs communication with the key device 2, thereby receiving the update information stored in the key device 2. When receiving the update information from the key device 2 (step S14: Yes), the lock-side controller 12 updates the control program of the lock-side controller 12 based on the update information (step S15). In contrast, when the update information is not stored in the key device 2, and the lock-side communication section 11 cannot receive the update information from the key device 2 (step S14: No), the lock-

side controller 12 does not update the control program of the lock-side controller 12.

(3.3) Update in Key Device

[0044] Next, with reference to FIG. 4, an operation of updating the program of the key-side controller 21 performed mainly by the key-side controller 21 of the key device 2 will be described. In the following description, it is assumed that unlike "(3.2) Update in Electric Lock Control System", the key device 2 has not yet updated the program for use in the key device 2.

[0045] First, the key device 2 communicates with the server 7 (step S20) regularly or at a timing at which the user 6 operates the key-side operation section 23. At this time, if there is an update information set which the key device 2 has not yet received (step S21: Yes), the key device 2 requests the server 7 to transmit the update information set. In response to the request from the key device 2, the server 7 transmits the update information set to the key device 2. When the key-side communication section 22 receives the update information set from the server 7, the key-side controller 21 updates the program of the key-side controller 21 based on the update information of the program for use in key device 2 (step S22). Moreover, the key-side controller 21 causes the key-side storage section 24 to store the update information of the control program. In other words, the key device 2 acquires the update information of the control program included in the update information set (step S23). In contrast, if there is no update information set which the key device 2 has not yet received (step S21: No), the key-side controller 21 does not update the program of the key-side controller 21.

[0046] When the user 6 carrying the key device 2 then enters the communication area of the electric lock control system 1, the key device 2 starts communicating with the electric lock control system 1 (step S24). The electric lock control system 1 executes the authentication process, but if the authentication process is unsuccessfully performed (step S25: No), the electric lock 3 is not controlled, and the opening and closing member 5 is neither locked nor unlocked. In this case, even when the update information is stored in the key device 2, the key device 2 does not transmit the update information to the electric lock control system 1.

[0047] When the authentication process is successfully performed (step S25: Yes), and the update information is stored in the key device 2 (step S26: Yes), the key device 2 transmits the update information to the electric lock control system 1. Even when the authentication process is successfully performed (step S25: Yes), if the update information is not stored in the key device 2 (step S26: No), the key device 2 does not transmit the update information to the electric lock control system 1.

[0048] As described above, when the key device 2 acquires the update information in advance, the lock-side controller 12 updates the control program of the lock-side

controller 12 based on the update information received by the lock-side communication section 11 from the key device 2. Thus, the present embodiment enables the control program relating to the control of the electric lock 3 to be updated without using a dedicated maintenance device.

[0049] Moreover, in the present embodiment, the lock-side communication section 11 receives the update information of the control program in a state where the key device 2 is successfully authenticated by the authentication section 121. That is, the lock-side controller 12 updates the control program of the lock-side controller 12 only when the key device 2 is successfully authenticated by the authentication section 121. Thus, the present embodiment provides the advantage that the control program can be prevented from being illegally altered by an illegal apparatus without a new authentication means being prepared.

(4) Variation

[0050] The above-described embodiment is merely an embodiment of various embodiments of the present disclosure. Various modifications may be made to above-described embodiment depending on design and the like as long as the object of the present disclosure is achieved. Variations of the above-described embodiment will be listed below. The variations described below are applicable in appropriate combination.

[0051] A communication method according to one embodiment is a communication method of a key device 2 including a first communication unit 221 and a second communication unit 222. The first communication unit 221 is configured to perform communication with an electric lock control system 1. The second communication unit 222 is configured to perform communication with a different system (a server 7) different from the electric lock control system 1. The communication method includes an acquisition step and a transmission step. The acquisition step is a step of acquiring update information of a control program relating to control of an electric lock 3 serving as a control object of the electric lock control system 1 through the communication between the second communication unit 222 and the different system. The transmission step is a step of transmitting at least part of the update information of the control program, which is acquired to the electric lock control system 1 through the communication between the first communication unit 221 and the electric lock control system 1.

[0052] A program according to one embodiment is a computer program including instructions which, when the program is executed by a computer system, cause the computer system to carry out the communication method.

[0053] Variations of the embodiment will be listed below. The variations described below are applicable in appropriate combination.

[0054] In the above-described embodiment, "update

of the control program" may include addition of a function, for example, giving a remote control function to a key device 2 which does not have the remote control function.

[0055] In the above-described embodiment, the lock-side controller 12 controls the electric lock 3 to lock or unlock the opening and closing member 5 and thereafter checks the presence or absence of update information, but the sequence of these processes may be reversed. That is, in FIG. 3, the lock-side controller 12 may perform steps S14 and S15 before performing step S13.

[0056] In the above-described embodiment, the lock-side communication section 11 receives the update information from the key device 2 when the key device 2 is successfully authenticated by the authentication section 121, but this should not be construed as limiting. For example, the lock-side communication section 11 may receive the update information from the key device 2 regardless of whether or not the key device 2 is successfully authenticated by the authentication section 121. In other words, the lock-side controller 12 may update the control program of the lock-side controller 12 regardless of whether or not the key device 2 is successfully authenticated by the authentication section 121.

[0057] In the above-described embodiment, the key device 2 acquires the update information of the control program in advance by, for example, updating a dedicated application, but this should not be construed as limiting. For example, when the authentication is successfully performed, the electric lock control system 1 may acquire the update information of the control program from the server 7 by adopting the key device 2 as a relay. In this case, it is not necessary to cause the key device 2 to acquire the update information of the control program in advance.

[0058] In the above-described embodiment, even when the version of the control program and the version of a program for use in the key device 2 are different from each other, at least one of locking and unlocking of the opening and closing member 5 may be possible. For example, when the key device 2 updates the program for use in the key device 2 and the electric lock control system 1 does not update the control program, the versions differ. Also in such a case, the lock-side controller 12 may execute the authentication process and control the electric lock 3 to lock or unlock the opening and closing member 5. In this aspect, when the lock-side controller 12 updates the control program, the lock-side controller 12 preferably causes the lock-side storage section 14 to store the control program before the update. Moreover, in this aspect, when the key-side controller 21 updates the program for use in the key device 2, the key-side controller 21 preferably causes the key-side storage section 24 to store the program before the update.

[0059] In the above-described embodiment, the lock-side communication section 11 may transmit information regarding the control program of the lock-side communication section 11 (e.g., version information of the control program) to the key device 2. For example, when a

prescribed condition is satisfied, the lock-side communication section 11 transmits the information regarding the control program of the lock-side communication section 11 to the key device 2. The prescribed condition is, for example, locking or unlocking of the opening and closing member 5. Alternatively, the prescribed condition is, for example, that the key-side operation section 23 receives specific operation. This aspect provides the advantage that since the information regarding the control program is displayed on the display section 25, the user 6 easily grasps whether or not the control program has to be updated.

[0060] In the above-described embodiment, the lock-side controller 12 may transmit a notification signal containing information representing completion of the updating of the control program from the lock-side communication section 11 to the key device 2 when the updating of the control program is completed. Alternatively, the lock-side controller 12 may transmit a notification signal containing information representing the status of the updating of the control program from the lock-side communication section 11 to the key device 2 in real time. That is, the lock-side communication section 11 may transmit information (notification signal) regarding at least one of the status of the updating of the control program of the lock-side communication section 11 and the completion of the updating to the key device 2. In this case, on the display section 25 of the key device 2 displayed are, for example, a percentage representing the progress in the updating of the control program, a time required to complete the updating of the control program, or a progress bar. When the status of the updating of the control program is notified, the lock-side controller 12 calculates information such as a percentage in real time based on, for example, a data amount of data downloaded from the key device 2 and the total data amount of the update information, and the lock-side controller 12 transmits the calculated information from the lock-side communication section 11 to the key device 2. This aspect provides the advantage that whether or not the updating of the control program is completed or the extent of progress in the updating of the control program is easily grasped by the user 6.

[0061] In the above-described embodiment, the lock-side controller 12 preferably forgoes controlling the electric lock during the update of the control program of the lock-side controller 12. In this case, during the update of the control program, the opening and closing member 5 is not locked or unlocked even when key devices 2 (including not only the key device 2 used to update the control program but also a different key device 2) are successfully authenticated. This aspect provides the advantage that since other processes are not involved during the update of the control program, the time required to update the control program is easily reduced. This aspect further provides the advantage that since the opening and closing member 5 is not locked or unlocked during the update of the control program, security is easily en-

sured.

[0062] In the above-described embodiment, the lock-side communication section 11 receives the update information of the control program at one time, but this should not be construed as limiting. For example, the lock-side communication section 11 may perform a prescribed number of reception processes to receive the update information of the control program which is divided into pieces of information in a state where the lock-side communication section 11 can communicate with the key device 2. This aspect provides the advantage that even when the data amount of the update information of the control program is relatively large, a time required to receive the update information of the control program per one time can be shortened. Moreover, in this aspect, for example, when the key device 2 receives divided pieces of the update information of the control program each time the key device 2 enters the communication area of the electric lock control system 1, it becomes possible to update the control program as the user 6 enters and leaves the building 4 repeatedly in daily life.

[0063] In the above-described embodiment, updating of the control program is preferably performed in the locked state where the opening and closing member 5 is locked (e.g., a state in which the opening and closing member 5 is locked from the inner side 41 of the building 4). Alternatively, the updating of the control program may be performed in the unlocked state where the opening and closing member 5 is unlocked. That is, the lock-side controller 12 may update the control program of the lock-side controller 12 during an update time period in at least the locked state of the opening and closing member 5 or the unlocked state of the opening and closing member 5. This aspect provides the advantage that since the control program is updated during a limited time period such as when the user 6 stays in the building 4 or when the user 6 enters or leaves the building 4, the control program is less likely to be updated at a timing that is not intended by the user 6.

[0064] In the above-described embodiment, the lock-side communication section 11 receives the update information of the control program independently of the intention of the user 6 to perform an update, but this should not be construed as limiting. For example, when receiving a signal including information representing the intention of the user 6 carrying the key device 2 to perform an update, the lock-side communication section 11 may receive the update information of the control program.

[0065] In this aspect, for example, before lock-side controller 12 executes step S15 of FIG. 3, the key-side controller 21 displays a message for confirming the intention of the user 6 to perform an update on the display section 25. The message is, for example, "control program is ready to be updated. Do you want to update the control program?". The user 6 performs an operation of selecting, for example, "YES" or "NO" in response to the message, thereby inputting the presence or absence of an intention to update the control program. When the

key-side operation section 23 receives an input that affirms the updating of the control program, the key-side controller 21 transmits a signal including information representing the intention of a user 6 to perform an update from the key-side communication section 22 to the electric lock control system 1.

[0066] Thus, the lock-side controller 12 confirms the intention of the user 6 to perform an update and then updates the control program of the lock-side controller 12. In contrast, if the lock-side controller 12 cannot confirm the intention of the user 6 to perform an update, the lock-side controller 12 does not update the control program of the lock-side controller 12. This aspect provides the advantage that the control program is prevented from being subjected to an update of which the user 6 is unaware.

[0067] As described above, the program for use in the lock-side controller 12 may be automatically updated without the intention of the user 6 or updated after the intention of the user 6 is confirmed. It is preferable to confirm the intention of the user in the case of updating a control program relevant to the operation by the user 6, such as a change of a user interface or addition of a function. In contrast, in the case of updating a control program irrelevant to the operation by the user 6, such as a correction of a bug, the control program may be automatically updated without confirming the intention of the user 6.

[0068] In the above-described embodiment, the lock-side communication section 11 may receive update information of the program for use in the key device 2 in addition to the update information of the control program. The lock-side communication section 11 may transmit the update information of the program for use in the key device 2 to a different key device 2 different from the key device 2 (i.e., a key device 2 other than the key device 2 used to update the control program). A timing at which the update information of the program for use in the key device 2 is transmitted is, for example, a timing at which the user 6 carrying the different key device 2 enters the communication area of the electric lock control system 1. This aspect provides the advantage that in the different key device 2, the program for use in the key device 2 can be updated without acquiring the update information of the program for use in the key device 2 by, for example, updating the dedicated application. This aspect is, in particular, useful to the key device 2 which has no communication function for communicating with the server 7.

(5) Other Variations

[0069] Other variations will be listed below. The variations described below are, inclusively of the variations listed in "(4) Variation", applicable in appropriate combination.

[0070] The electric lock control system 1 or a subject which executes the communication method in the present disclosure includes a computer system. The

computer system includes a processor and memory as hardware. The processor executes a program stored in the memory of the computer system, thereby realizing a function as the electric lock control system 1 or the subject which executes the communication method of the present disclosure. The program may be stored in the memory of the computer system in advance or provided over an electronic communication network. Alternatively, the program may be provided as a non-transitory recording medium such as a computer system-readable memory card, optical disc, or hard disk drive storing the program. The processor of the computer system includes one or a plurality of electronic circuits including a semiconductor integrated circuit (IC) or a large-scale integration (LSI) circuit. The plurality of electronic circuits may be integrated on one chip or distributed over a plurality of chips. The plurality of chips may be integrated in one device or distributed over a plurality of devices.

[0071] In the above-described embodiment, the lock-side controller 12 is realized by one circuit, but the lock-side controller 12 may be realized by two or more circuits. For example, the functions of the lock-side controller 12 may be distributed over two or more circuits. Alternatively, for example, the functions of the lock-side controller 12 may be provided to one device accommodated in one case or may be distributed in a plurality of devices. Alternatively, at least some of the functions of the lock-side controller 12 may be realized by, for example, cloud computing.

[0072] In the above-described embodiment, the authentication section 121 is realized as one of the functions of the lock-side controller 12, but this should not be construed as limiting. For example, the authentication section 121 may be provided as a circuit separate from the lock-side controller 12.

[0073] In the above-described embodiment, the lock-side communication section 11 is one communication interface, but this should not be construed as limiting. For example, the lock-side communication section 11 may include two communication interfaces, namely a communication interface for updating the control program and a communication interface for authenticating the key device 2.

[0074] In the above-described embodiment, the lock-side communication section 11 and the lock-side controller 12 are accommodated in one case, but this should not be construed as limiting. For example, the lock-side communication section 11 and the lock-side controller 12 may be distributed and accommodated in two or more cases.

[0075] In the above-described embodiment, the second communication unit 222 of the key device 2 is connected to the network N1 via a router, but this should not be construed as limiting. For example, the second communication unit 222 may be connected to the network N1 via a mobile phone network (carrier network) provided by a communication business operator. Examples of the mobile phone network include a third generation (3G)

network and a long-term evolution (LTE) network. Alternatively, the second communication unit 222 may be connected to the network N1 via a public wireless LAN.

[0076] In the above-described embodiment, the key device 2 includes two communication units, namely the first communication unit 221 and the second communication unit 222, but this should not be construed as limiting. For example, the first communication unit 221 and the second communication unit 222 may be formed as one communication unit.

[0077] In the above-described embodiment, the key device 2 is a portable terminal such as a smartphone, but this should not be construed as limiting. For example, the key device 2 may be a tablet computer, or the like as long as it is a portable terminal capable of executing a program (application) for causing a computer system to operate as a key of the electric lock control system 1. Moreover, examples of the key device 2 include an electronic tag and an integrated circuit (IC) card which can be put in or attached to a bag or the like which the user 6 carries.

[0078] Here, when the key device 2 has no communication function for communicating with the server 7, for example, a business operator providing service for the electric lock control system 1 preferably updates the program for use in the key device 2 and causes the update information of the control program to be stored. For example, when the key device 2 is an electronic tag, the user 6 temporarily deposits the key device 2 at the business operator providing the service, and the above-described processes may be done by the business operator providing the service.

[0079] In the above-described embodiment, the key device 2 is capable of performing both the unlock operation and the lock operation of the opening and closing member 5, but the key device 2 may have another configuration. For example, the key device 2 may be configured to perform only the unlock operation of the opening and closing member 5. That is, the key device 2 is configured to perform at least the unlock operation of the lock operation and the unlock operation of the opening and closing member 5.

[0080] In the above-described embodiment, the opening and closing member 5 is a door (a hinged door or slide door) or a window separating the inner side 41 of the building 4 from the outer side 42 of the building 4. However, the opening and closing member 5 may be a door separating the inner side 41 of a section of the building 4 from the outer side 42 of the section of the building 4. For example, when the building 4 is an apartment block including a plurality of flats, a multi-tenant building including a plurality of retail establishments, and an office building including a plurality of offices, a door separating the inner side 41 from the outer side 42 of individual sections (flats, retail establishment buildings, office buildings) corresponds to the opening and closing member 5.

[0081] In the above-described embodiment, the electric lock control system 1 is applied to a detached house

but may be applied to, for example, each flat of an apartment block. Alternatively, the electric lock control system 1 may be applied to an entrance of a common area inside of the apartment block or a non-dwelling building 4 such as an office building, a retail establishment building, and a factory building.

(Summary)

[0082] As described above, an electric lock control system (1) according to a first aspect includes a lock-side communication section (11) and a lock-side controller (12). The lock-side communication section (11) is configured to perform communication with a key device (2). The lock-side controller (12) is configured to perform control of an electric lock (3) to perform at least one of locking and unlocking of an opening and closing member (5) configured to open and close an opening (40) of a building (4) based on the communication between the key device (2) and the lock-side communication section (11). The lock-side controller (12) is configured to update, based on update information of a control program, the control program of the lock-side controller (12). The update information of the control program is information relating to the control of the electric lock (3) and being received by the lock-side communication section (11) from the key device (2).

[0083] This aspect provides the advantage that convenience in the case of updating the control program relating to the control of the electric lock (3) is increased.

[0084] An electric lock control system (1) according to a second aspect referring to the first aspect further includes an authentication section (121) configured to authenticate the key device (2) based on the communication with the key device (2). The lock-side communication section (11) receives the update information of the control program in a state where the key device (2) is successfully authenticated by the authentication section (121).

[0085] This aspect provides the advantage that the control program can be prevented from illegal alternation by an illegal apparatus without a new authentication means being prepared.

[0086] In an electric lock control system (1) according to a third aspect referring to the second aspect, the lock-side communication section (11) is configured to perform communication between the key device (2) and the authentication section (121).

[0087] This aspect provides the advantage that using an existing authentication communication interface enables a means which receives the update information of the control program to be realized in a simple configuration.

[0088] In an electric lock control system (1) according to a fourth aspect referring to any one of the first to third aspects, the lock-side communication section (11) transmits information regarding the control program of the lock-side controller (12) to the key device (2).

[0089] This aspect provides the advantage that the user

(6) easily grasps whether or not the control program has to be updated.

[0090] In an electric lock control system (1) according to a fifth aspect referring to any one of the first to fourth aspects, the lock-side communication section (11) transmits information to the key device (2). The information relates to at least one of an update status of the control program of the lock-side controller (12) and completion of updating of the control program.

[0091] This aspect provides the advantage that whether or not the updating of the control program is completed or the extent of progress in the updating of the control program is easily grasped by the user (6).

[0092] In an electric lock control system (1) according to a sixth aspect referring to any one of the first to fifth aspects, the lock-side controller (12) forgoes controlling the electric lock (3) during updating of the control program of the lock-side controller (12).

[0093] This aspect provides the advantage that since other processes are not involved during the update of the control program, the time required to update the control program is easily reduced.

[0094] In an electric lock control system (1) according to a seventh aspect referring to any one of the first to sixth aspects, the lock-side communication section (11) performs a prescribed number of reception processes to receive the update information of the control program which is divided into pieces of information in a state where the lock-side communication section (11) is communicable with the key device (2).

[0095] This aspect provides the advantage that even when the data amount of the update information of the control program is relatively large, the time required to receive the update information of the control program per one reception process can be shortened.

[0096] In an electric lock control system (1) according to an eighth aspect referring to any one of the first to seventh aspects, the lock-side controller (12) updates the control program of the lock-side controller (12) during an update time period. The update time period is a time period during which at least one of a locked state in which the opening and closing member (5) is locked and an unlocked state in which the opening and closing member (5) is unlocked is achieved.

[0097] This aspect provides the advantage that since the control program is updated during a limited time period, the control program is less likely to be updated at a timing that is not intended by the user (6).

[0098] In an electric lock control system (1) according to a ninth aspect referring to any one of the first to eighth aspects, when receiving a signal including information representing an intention of a user (6) carrying the key device (2) to perform an update, the lock-side communication section (11) receives the update information of the control program.

[0099] This aspect provides an advantage that the control program is prevented from being subjected to an update of which the user 6 is unaware.

[0100] In an electric lock control system (1) according to a tenth aspect referring to any one of the first to ninth aspects, the lock-side communication section (11) further receives update information of a program for use in the key device (2). The lock-side communication section (11) transmits the update information of the program for use in the key device (2) to a different key device (2) different from the key device (2).

[0101] This aspect provides the advantage that in the different key device (2), the program for use in the key device (2) can be updated without acquiring the update information of the program for use in the key device (2) by, for example, updating a dedicated application.

[0102] A communication method according to an eleventh aspect is a communication method of a key device (2) including a first communication unit (221) and a second communication unit (222). The first communication unit (221) is configured to perform communication with an electric lock control system (1). The second communication unit (222) is configured to perform communication with a different system (server (7)) different from the electric lock control system (1). The communication method includes an acquisition step and a transmission step. The acquisition step is a step of acquiring update information of a control program relating to control of an electric lock (3) serving as a control object of the electric lock control system (1) through the communication between the second communication unit (222) and the different system. The transmission step is a step of transmitting at least part of the update information of the control program, which is acquired, to the electric lock control system (1) through the communication between the first communication unit (221) and the electric lock control system (1).

[0103] The aspect provides the advantage that the convenience for updating the control program relating to the control of the electric lock (3) is improved.

[0104] A program according to a twelfth aspect is a computer program including instructions which, when the program is executed by a computer system, cause the computer system to carry out the communication method of the eleventh aspect.

[0105] The aspect provides the advantage that the convenience for updating the control program relating to the control of the electric lock (3) is improved.

[0106] The configurations according to the second to tenth aspects are not essential for the electric lock control system (1) and may accordingly be omitted.

Reference Signs List

[0107]

- 1 Electric Lock Control System
- 11 Lock-Side Communication Section
- 12 Lock-Side Controller
- 121 Authentication Section
- 2 Key Device

- 221 First Communication Unit
- 222 Second Communication Unit
- 3 Electric Lock
- 4 Building
- 5 Opening Section
- 5 Opening And Closing Member
- 6 User
- 7 Server (Different System)

Claims

1. An electric lock control system (1), comprising:

a lock-side communication section (11) configured to perform communication with a key device (2); and
a lock-side controller (12) configured to perform control of an electric lock (3) to perform at least one of locking and unlocking of an opening and closing member (5) configured to open and close an opening (40) of a building (4) based on the communication between the key device (2) and the lock-side communication section (11), the lock-side controller (12) being configured to update, based on update information of a control program, the control program of the lock-side controller (12), the control program relating to the control of the electric lock (3), the update information being received by the lock-side communication section (11) from the key device (2).

2. The electric lock control system (1) according to claim 1, further comprising an authentication section (121) configured to authenticate the key device (2) based on the communication with the key device (2), wherein
the lock-side communication section (11) receives the update information of the control program in a state where the key device (2) is successfully authenticated by the authentication section (121).

3. The electric lock control system (1) according to claim 2, wherein
the lock-side communication section (11) is configured to perform communication between the key device (2) and the authentication section (121).

4. The electric lock control system (1) according to any one of claims 1 to 3, wherein
the lock-side communication section (11) transmits information relating to the control program of the lock-side controller (12) to the key device (2).

5. The electric lock control system (1) according to any one of claims 1 to 4, wherein
the lock-side communication section (11) transmits information to the key device (2), the information re-

lating to at least one of an update status of the control program of the lock-side controller (12) and completion of updating of the control program.

6. The electric lock control system (1) according to any one of claims 1 to 5, wherein the lock-side controller (12) forgoes controlling the electric lock (3) during updating of the control program of the lock-side controller (12). 5
7. The electric lock control system (1) according to any one of claims 1 to 6, wherein the lock-side communication section (11) performs a prescribed number of reception processes to receive the update information of the control program which is divided into pieces of information in a state where the lock-side communication section (11) is communicable with the key device (2). 10
8. The electric lock control system (1) according to any one of claims 1 to 7, wherein the lock-side controller (12) updates the control program of the lock-side controller (12) during an update time period, and the update time period is a time period during which at least one of a locked state in which the opening and closing member (5) is locked and an unlocked state in which the opening and closing member (5) is unlocked is achieved. 15 20 25 30
9. The electric lock control system (1) according to any one of claims 1 to 8, wherein when receiving a signal including information representing an intention of a user (6) carrying the key device (2) to perform an update, the lock-side communication section (11) receives the update information of the control program. 35
10. The electric lock control system (1) according to any one of claims 1 to 9, wherein the lock-side communication section (11) further receives update information of a program for use in the key device (2), and the lock-side communication section (11) transmits the update information of the program for use in the key device (2) to a different key device (2) different from the key device (2). 40 45
11. A communication method of a key device (2) including a first communication unit (221) configured to perform communication with an electric lock control system (1) and a second communication unit (222) configured to perform communication with a different system (7) different from the electric lock control system (1), the communication method comprising: 50

acquiring update information of a control program relating to control of an electric lock (3)

serving as a control object of the electric lock control system (1) through the communication between the second communication unit (222) and the different system (7); and transmitting at least part of the update information of the control program, which is acquired, to the electric lock control system (1) through the communication between the first communication unit (221) and the electric lock control system (1).

12. A computer program comprising instructions which, when the program is executed by a computer system, cause the computer system to carry out the communication method of claim 11.

FIG. 1

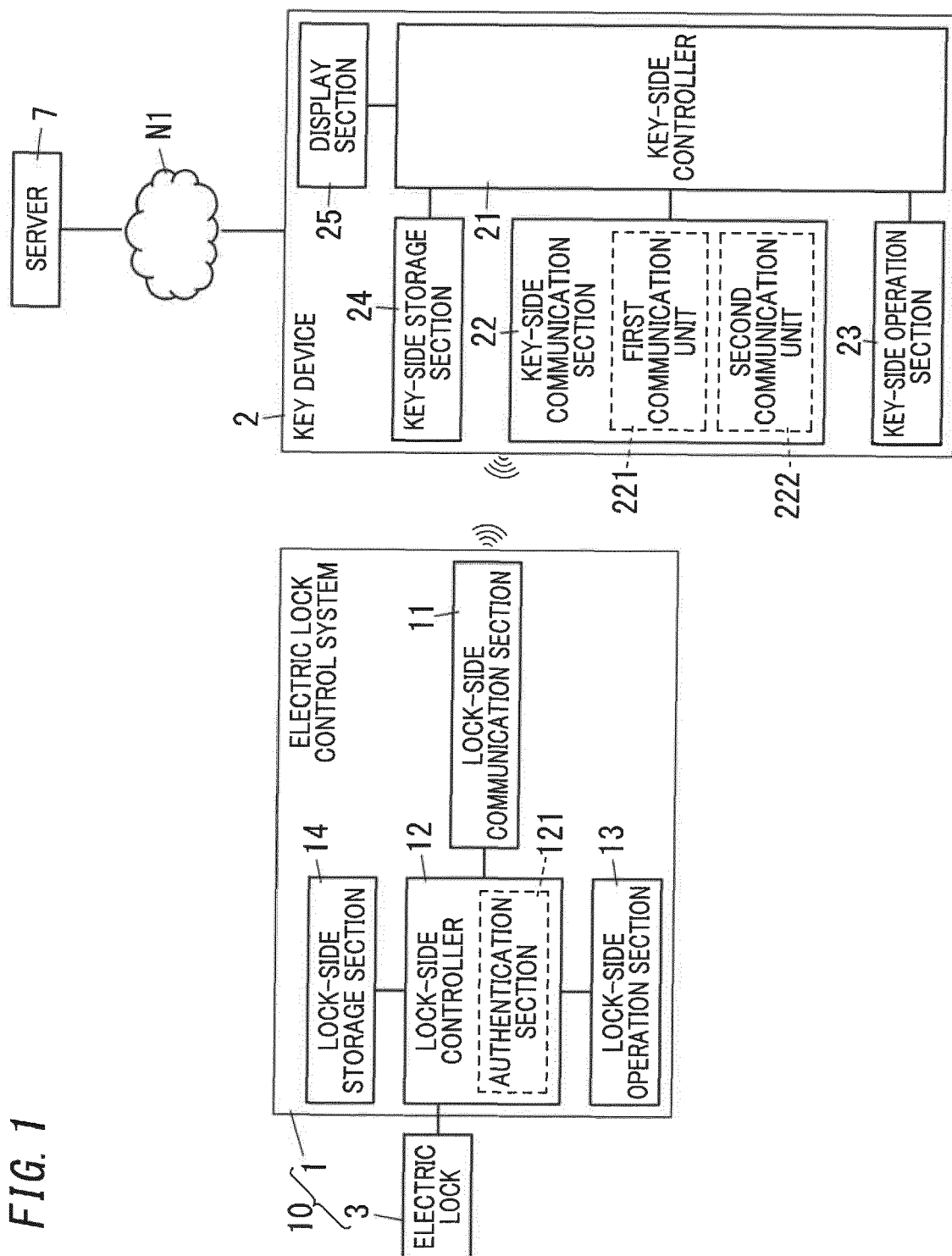


FIG. 2

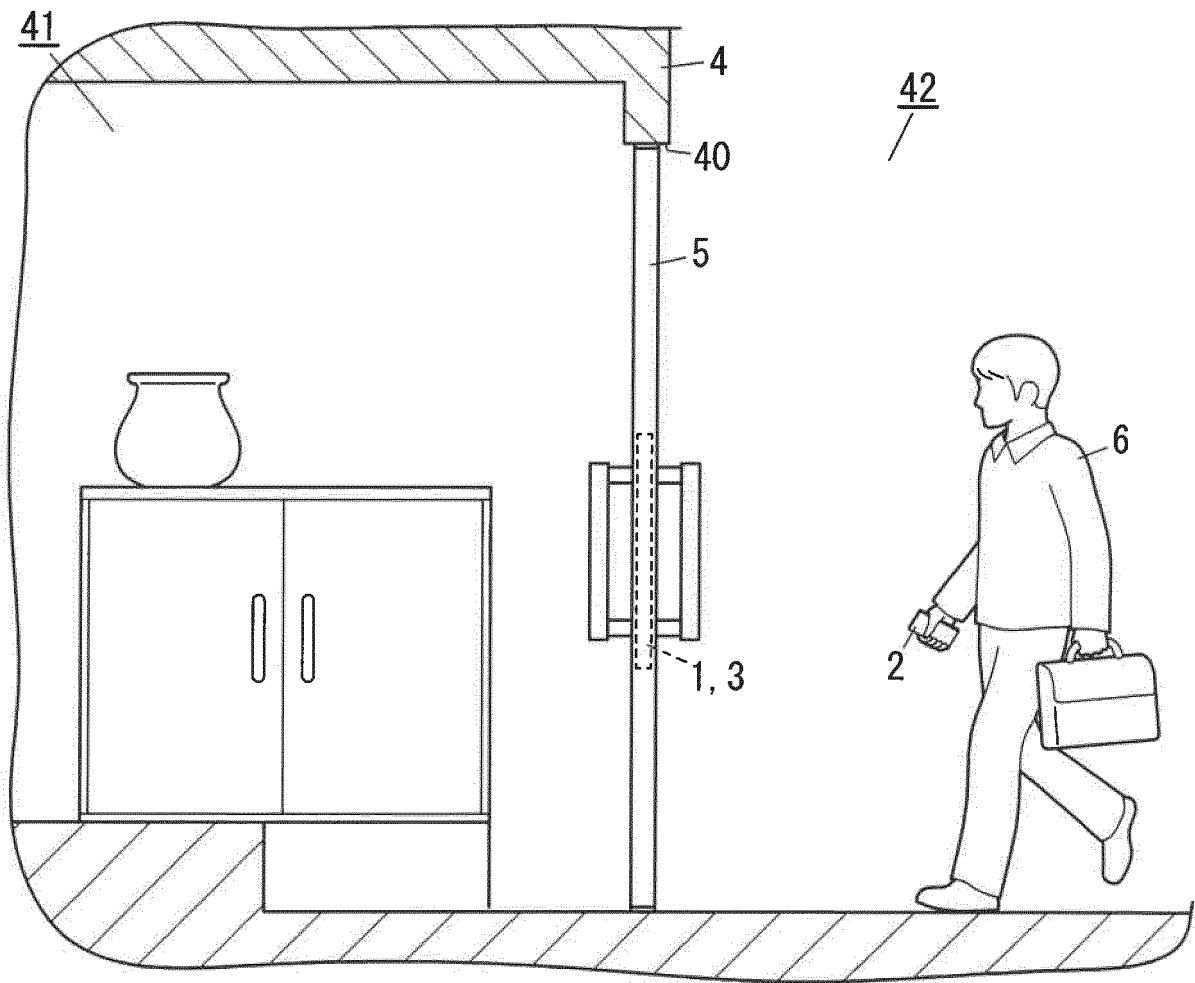


FIG. 3

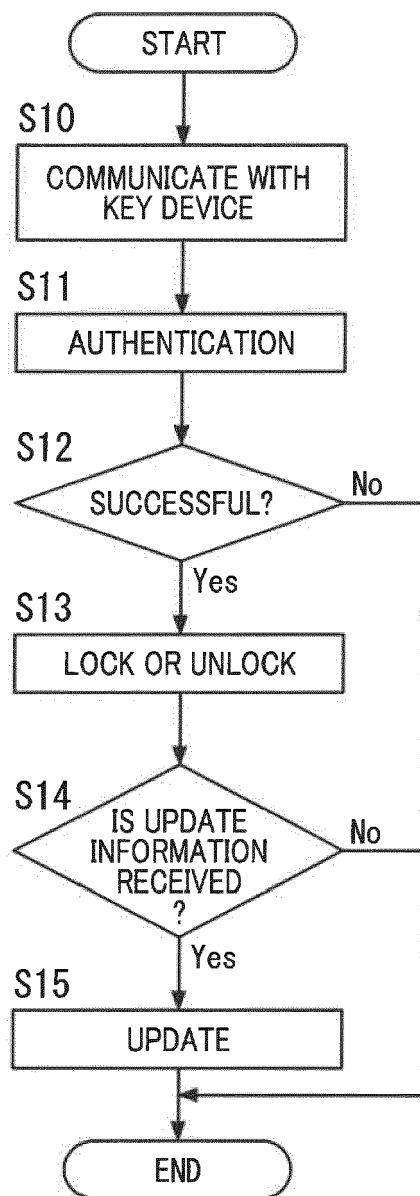
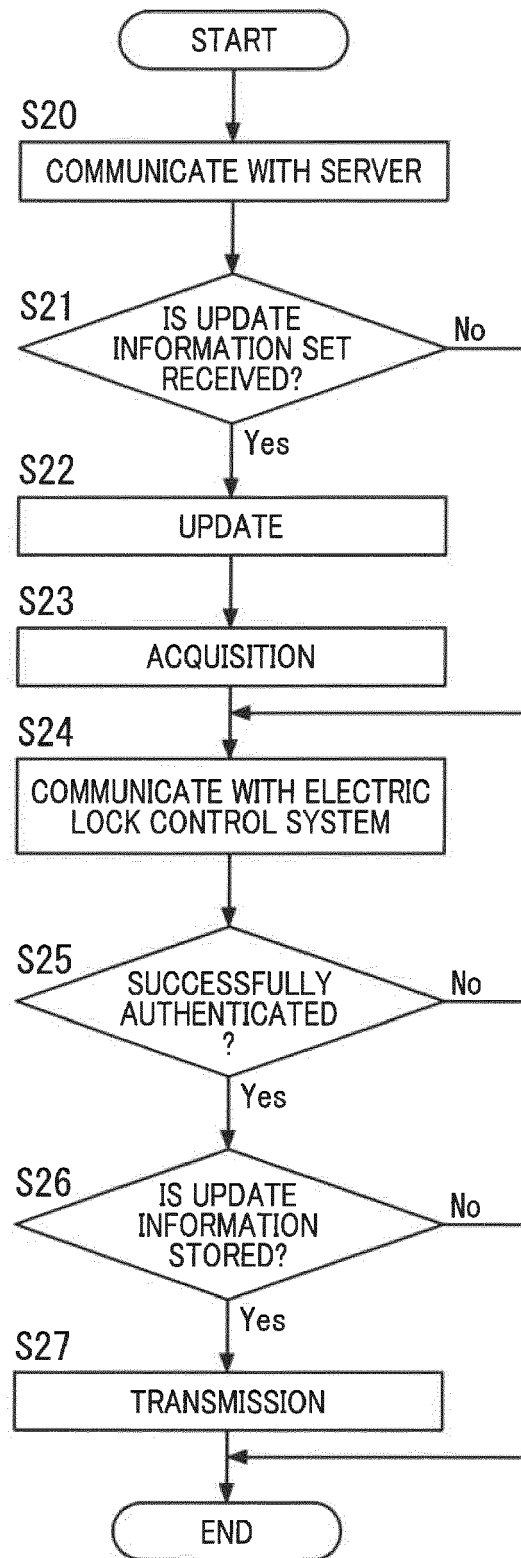


FIG. 4





EUROPEAN SEARCH REPORT

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