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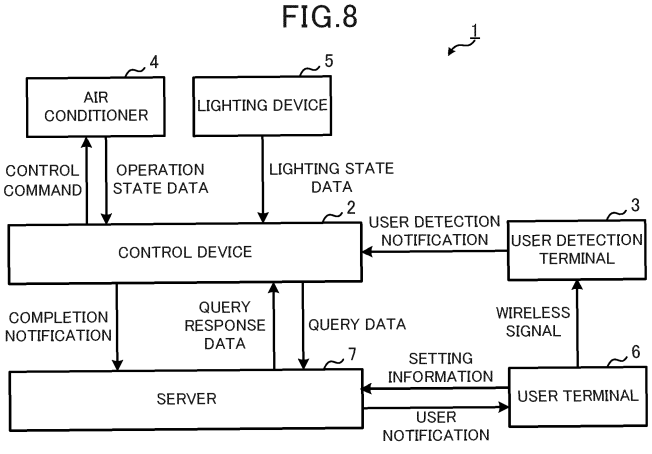
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(54) AIR CONDITIONING CONTROL SYSTEM, CONTROL DEVICE, AIR CONDITIONING CONTROL METHOD, AND PROGRAM

(57) An air-conditioning control system (1) includes an air conditioner (4) to air-condition a room, a server (7) to store, on a user basis, user information including at least identification information of a user terminal (6) and air-conditioning control information relating to air-conditioning control of the room, a user detection terminal (3) installed outside the room and configured to detect passage of the user by communication with the user terminal (6), a control device (2) to control, when the passage of the user is detected by the user detection terminal (3), the air conditioner (4) to pre-cool or pre-heat the room based on the air-conditioning control information corresponding to the user.

FIG.8



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Description

Technical Field

[0001] The present disclosure relates to an air-conditioning control system, a control device, an air-conditioning control method, and a program.

Background Art

[0002] A technique of air-conditioning a room in consideration of user's preferences for air conditioning is proposed (for example, Patent Literature 1). In an environment adjustment system suggested in Patent Literature 1, an environment server checks pre-registered information about the user's preferences for air conditioning (e.g., degree of cooling, airflow intensity, etc.) against environment information, such as temperature, detected in real time via an environment sensor, such as a temperature sensor, and instructs an air-conditioning facility device to perform air conditioning in accordance with the user's preferences.

Citation List

Patent Literature

[0003] Patent Literature 1: Unexamined Japanese Patent Application Publication No. 2004-101048

Summary of Invention

Technical Problem

[0004] The above conventional technique performs air conditioning in a case where a user is present in a closed space (that is, a space to be air-conditioned), such as a room. Thus, for example, in a case where a user first enters a workroom that is not used by anyone on the day in summer or winter, a temperature difference between a temperature desired by the user and the room temperature is large, and this may pose a problem in that the user feels uncomfortable and work efficiency is impaired.

[0005] Although the above problem can be solved by continuous air conditioning regardless of presence or absence of a user, this is not practical as such operation results in unnecessary energy consumption. Thus, a proposal is desired for a new technique that can provide comfort to a user entering a room, while reducing unnecessary energy consumption.

[0006] The present disclosure is made in view of the above circumstances, and an objective of the present disclosure is to provide an air-conditioning control system, a control device, an air-conditioning control method, and a program, capable of providing comfort to a user entering a room, while reducing unnecessary energy consumption.

Solution to Problem

[0007] To achieve the above objective, an air-conditioning control system according to the present disclosure includes:

an air conditioner to air-condition a room;
user information storage means for storing, on a user basis, user information including at least identification information of a portable terminal and air-conditioning control information relating to air-conditioning control of the room;
a user detection terminal installed outside the room and configured to detect passage of a user by communication with the portable terminal; and
air-conditioning control means for controlling, when the passage of the user is detected by the user detection terminal, the air conditioner to pre-cool or pre-heat the room based on the air-conditioning control information corresponding to the user.

Advantageous Effects of Invention

[0008] According to the present disclosure, comfort can be provided to a user entering a room, while unnecessary energy consumption is reduced.

Brief Description of Drawings

[0009]

FIG. 1 is a diagram illustrating an overall configuration of an air-conditioning control system in an embodiment;
FIG. 2 is a block diagram illustrating a hardware configuration of a control device in the embodiment;
FIG. 3 is a diagram for describing installation of a user detection terminal in the embodiment;
FIG. 4 is a block diagram illustrating a hardware configuration of the user detection terminal in the embodiment;
FIG. 5 is a block diagram illustrating a hardware configuration of a user terminal in the embodiment;
FIG. 6 is a block diagram illustrating a hardware configuration of a server in the embodiment;
FIG. 7 is a diagram illustrating an example of user information in the embodiment;
FIG. 8 is a diagram illustrating a data transmission and reception relationship in the embodiment;
FIG. 9 is a block diagram illustrating a functional configuration of the user terminal in the embodiment;
FIG. 10 is a diagram illustrating an example of a pre-cooling/pre-heating control setting screen in the embodiment;
FIG. 11 is a block diagram illustrating a functional configuration of the user detection terminal in the embodiment;
FIG. 12 is a block diagram illustrating a functional

configuration of the control device in the embodiment;

FIG. 13 is a block diagram illustrating a functional configuration of the server in the embodiment;

FIG. 14 is a flow chart illustrating steps of a pre-cooling/pre-heating start process in the embodiment;

FIG. 15 is a flow chart illustrating steps of a pre-cooling/pre-heating end process in the embodiment;

FIG. 16 is a diagram for describing an example of a case where a building has a plurality of entrances, in a modified example of the embodiment; and

FIG. 17 is a diagram illustrating an example of a pre-cooling/pre-heating control setting screen in a modified example of the embodiment.

Description of Embodiments

[0010] An embodiment of the present disclosure is hereinafter described in detail with reference to the drawings.

[0011] FIG. 1 is a diagram illustrating an overall configuration of an air-conditioning control system 1 in an embodiment of the present disclosure. The air-conditioning control system 1 is an example of an air-conditioning control system according the present disclosure, and is a system for controlling, for example, air conditioning of each of workrooms in a building B where manufacturing, development, and the like are conducted in a company. The air-conditioning control system 1 includes a control device 2, a user detection terminal 3, sets of air conditioners 4 and lighting devices 5, each set of which is installed in its corresponding workroom, user terminals 6 carried by users, and a server 7.

<Control device 2>

[0012] The control device 2 is an example of a control device according to the present disclosure. The control device 2 is a facility device controller that is installed at an appropriate place in the building B and controls each set of the air conditioner 4 and the lighting device 5 corresponding to its respective workroom. As illustrated in FIG. 2, the control device 2 includes, as hardware components, a first communication interface 20, a second communication interface 21, a central processing unit (CPU) 22, a read only memory (ROM) 23, a read only memory (RAM) 24, and an auxiliary storage device 25. These components are connected to one another via a bus 26.

[0013] The first communication interface 20 is a wired or wireless LAN interface for communication via a network N1, such as a local area network (LAN) or a campus area network (CAN), with another device, for example, the user detection terminal 3, each air conditioner 4, each lighting device 5, and the like. The second communication interface 21 is a wired or wireless LAN interface for communication via a network N2, such as the LAN, the CAN, a metropolitan area network (MAN), a wide area network (WAN), or the Internet, with another device, for example, the server 7 and the like.

[0014] The CPU 22 performs overall control over the control device 2. Details of functions of the control device 2 achieved by the CPU 22 are described later. The ROM 23 stores firmware and data for use in execution of the firmware. The RAM 24 is used as a work area of the CPU 22.

[0015] The auxiliary storage device 25 includes a readable and writable non-volatile semiconductor memory, a hard disk drive (HDD), and the like. The readable and writable non-volatile semiconductor memory is, for example, an electrically erasable programmable read-only memory (EEPROM), a flash memory, or the like. The auxiliary storage device 25 stores various types of programs including a program (hereinafter referred to as a facility device control program) for control of each air conditioner 4 and each lighting device 5, and data for use in execution of these programs.

[0016] The above facility device control program and an update program for updating the facility device control program can both be downloaded from another device, such as the server 7, to the control device 2. Also, by connection of a computer-readable recording medium with these programs stored to the control device 2, the control device 2 can import these programs. The computer-readable recording medium is, for example, a compact disc read only memory (CD-ROM), a digital versatile disc (DVD), a magneto-optical disc, a universal serial bus (USB) memory, an HDD, a solid state drive (SSD), a memory card, or the like.

<User detection terminal 3>

[0017] The user detection terminal 3 is an example of a user detection terminal according to the present disclosure. The user detection terminal 3 is installed near an entrance of the building B as illustrated in FIG. 3, and by wireless communication with the user terminal 6 carried by a user, the user detection terminal 3 detects passage of the user, in other words, entry of the user into the building B. As illustrated in FIG. 4, the user detection terminal 3 includes, as a hardware configuration, a first communication interface 30, a second communication interface 31, a CPU 32, a ROM 33, a RAM 34, and an auxiliary storage device 35. These components are connected to one another via a bus 36.

[0018] The first communication interface 30 is a wireless communication interface for short-range wireless communication with the user terminal 6 carried by each user. For example, the first communication interface 30 communicates with the user terminal 6 in accordance with Bluetooth (registered trademark) Low Energy. The second communication interface 31 is a wired or wireless LAN interface for communication with the control device 2 via the network N1.

[0019] The CPU 32 performs overall control over the

user detection terminal 3. Details of functions of the user detection terminal 3 achieved by the CPU 32 are described later. The ROM 33 stores firmware and data for use in execution of the firmware. The RAM 34 is used as a work area of the CPU 32.

[0020] The auxiliary storage device 35 includes a readable and writable non-volatile semiconductor memory, an HDD, and the like. The readable and writable non-volatile semiconductor memory is, for example, an EEPROM, a flash memory, or the like. The auxiliary storage device 35 stores a user detection program and data for use in execution of the user detection program. The user detection program is a program describing a process for receiving a wireless signal transmitted by the user terminal 6 and extracting, from the received wireless signal, identification (ID) that is identification information for identifying the user terminal 6, and a process for transmitting to the control device 2 notification (hereinafter referred to as user detection notification) including the extracted ID.

[0021] The above user detection program and an update program for updating the user detection program can both be downloaded from another device, such as the control device 2, to the user detection terminal 3. Also, by connection of a computer-readable recording medium with these programs stored to the user detection terminal 3, the user detection terminal 3 can import these programs. The computer-readable recording medium is, for example, a CD-ROM, a DVD, a magneto-optical disc, a USB memory, an HDD, an SSD, a memory card, or the like.

<Air conditioner 4>

[0022] Each air conditioner 4 is an example of an air conditioner according to the present disclosure. Each air conditioner 4 includes an indoor unit installed in a room and an outdoor unit installed outside the room, both of which are not illustrated, and air-conditions the corresponding workroom. Each air conditioner 4 includes a wired or wireless LAN interface for communication with the control device 2 via the network N1, and operation of each air conditioner 4 is controlled by a control command from the control device 2.

<Lighting device 5>

[0023] Each lighting device 5 includes a light emitting diode (LED), a microcomputer, an inverter control circuit, and the like, none of which are illustrated, and illuminates the workroom where each lighting device 5 is installed. The lighting device 5 is turned on or off by user operation of the corresponding switch or the corresponding lighting remote control, and when turned on, the lighting device 5 illuminates the workroom at a specified output level.

[0024] The lighting device 5 includes a wired or wireless LAN interface for communication with the control device 2 via the network N1, and transmits, to the control device 2, lighting state data including the ID that is identification information of the lighting device 5 and information indicating a current operation state (on or off) in accordance with a request from the control device 2.

<User terminal 6>

[0025] The user terminal 6 is an example of a portable terminal according to the present disclosure. The user terminal 6 is an electronic device carried by each user who conducts work in the building B. For example, the user terminal 6 is a smart device, such as a smartphone or a tablet terminal. As illustrated in FIG. 5, the user terminal 6 includes a display 60, an operation receiver 61, a first communication interface 62, a second communication interface 63, a CPU 64, a ROM 65, a RAM 66, and an auxiliary storage device 67. These components are connected to one another via a bus 68.

[0026] The display 60 is configured to include a display device, such as a liquid crystal display or an organic electro luminescence (EL) display. The display 60 displays, under control of the CPU 64, various types of screens and the like in accordance with a user operation.

[0027] The operation receiver 61 is configured to include one or more input devices, such as a push button, a touch panel, and a touch pad, and receives an operation input from a user and sends to the CPU 64 a signal relating to the received operation.

[0028] The first communication interface 62 is a wireless communication interface for short-range wireless communication with the user detection terminal 3. The second communication interface 63 is a wireless LAN interface for communication with another device, for example, the server 7 via the network N2.

[0029] The CPU 64 performs overall control over the user terminal 6. Details of functions of the user terminal 6 achieved by the CPU 64 are described later. The ROM 65 stores firmware and data for use in execution of the firmware. The RAM 66 is used as a work area of the CPU 64.

[0030] The auxiliary storage device 67 is configured to include a readable and writable non-volatile semiconductor memory, such as an EEPROM or a flash memory. The auxiliary storage device 67 stores various types of programs including a program (hereinafter referred to as pre-cooling/pre-heating application) for receiving a service (hereinafter referred to as pre-cooling/pre-heating service) provided by the air-conditioning control system 1, and data for use in execution of these programs.

[0031] The pre-cooling/pre-heating application and an update program for the pre-cooling/pre-heating application can both be downloaded from another device, such as the server 7, to the user terminal 6. Also, by connection of a computer-readable recording medium with these programs stored to the user terminal 6, the user terminal 6 can import these programs. The computer-readable recording medium is, for example, a CD-ROM, a DVD, a magneto-optical disc, a USB memory, an HDD, an

SSD, a memory card, or the like.

<Server 7>

[0032] The server 7 is an example of a server according to the present disclosure. The server 7 is a so-called cloud server, and is connected to the network N2. As illustrated in FIG. 6, the server 7 includes a communication interface 70, a CPU 71, a ROM 72, a RAM 73, and an auxiliary storage device 74. These components are connected to one another via a bus 75.

[0033] The communication interface 70 is a wired or wireless LAN interface for communication with another device, for example, the control device 2 via the network N2. The CPU 71 performs overall control over the server 7. Details of functions of the server 7 achieved by the CPU 71 are described later. The ROM 72 stores firmware and data for use in execution of the firmware. The RAM 73 is used as a work area of the CPU 71.

[0034] The auxiliary storage device 74 is an example of a user information storage means according to the present disclosure. The auxiliary storage device 74 includes a readable and writable non-volatile semiconductor memory, an HDD, and the like. The readable and writable non-volatile semiconductor memory is, for example, an EEPROM, a flash memory, or the like. The auxiliary storage device 74 stores a user information DB 740. The auxiliary storage device 74 also stores various types of programs including a program (hereinafter referred to as a cloud program) for achieving a cloud computing service, and data for use in execution of these programs, both of which data are not illustrated.

[0035] The above cloud program and an update program for updating the cloud program can both be downloaded from another server to the server 7. Also, by connection of a computer-readable recording medium with these programs stored to the server 7, the server 7 can import these programs. The computer-readable recording medium is, for example, a CD-ROM, a DVD, a magneto-optical disc, a USB memory, an HDD, an SSD, a memory card, or the like.

[0036] The user information DB 740 is a database to consolidate and manage, on a user basis, information (hereinafter referred to as user information) relating to a user having subscribed to the pre-cooling/pre-heating service for each site (that is, each building B). The user information for the number of subscribers is registered in the user information DB 740. As illustrated in FIG. 7, the user information includes a user ID, a password, a user terminal ID, pre-cooling/pre-heating control information, and the like.

[0037] The user information is newly generated and registered in the user information DB 740 by a user starting the pre-cooling/pre-heating application installed in the user terminal 6 and registering as the user via an unillustrated user registration screen. The user can update their own user information as appropriate using the pre-cooling/pre-heating application.

[0038] In FIG. 7, the user terminal ID is identification information for identification of the user terminal 6 carried by the user, and the user terminal ID is, for example, an international mobile equipment identity (IMEI) of the user terminal 6, a serial number, or the like. The user terminal ID is obtained automatically by the server 7 at the time of user registration and stored in the user information.

[0039] The pre-cooling/pre-heating information is an example of air-conditioning control information according to the present disclosure, and is information set by the user and relating to pre-cooling/pre-heating control. The pre-cooling/pre-heating control is control to air-condition (cool or heat) the workroom beforehand so as not to make the user feel discomfort when the user enters the workroom. The pre-cooling/pre-heating control information includes workroom information, setting temperature, specified operation time, and the like.

[0040] The workroom information is information indicating a workroom where the user works, and for example, may be a name of the workroom, such as "4th floor, control lab" (or may be a room number, such as "401"). The setting temperature is a room temperature desired by the user for the time of entry into the workroom. The specified operation time is an example of a longest duration according to the present disclosure and is the operation time, set by the user, of a pre-cooling/pre-heating mode in the air conditioner 4 corresponding to the workroom. The pre-cooling/pre-heating mode is described later. The user sets, as the specified operation time, an approximate time required after entry into the building B until entry into the workroom. For example, the user determines the specified operation time in consideration of time required not only for time for moving to the workroom but also for changing into work clothes, routine meetings in the other rooms, and the like.

[0041] FIG. 8 is a schematic diagram illustrating a data transmission and reception relationship in the air-conditioning control system 1. As illustrated in FIG. 8, the user terminal 6 transmits setting information to the server 7. The user terminal 6 also transmits a wireless signal. The user detection terminal 3 receives a wireless signal transmitted by the user terminal 6 and transmits to the control device 2 user detection notification based on the received wireless signal.

[0042] When receiving the user detection notification transmitted by the user detection terminal 3, the control device 2 transmits to the server 7 query data based on the received user detection notification. The control device 2 receives query response data transmitted by the server 7 as a response to the transmitted query data. The control device 2 obtains operation state data and lighting state data from the air conditioner 4 and the lighting device 5, respectively, selected based on the received query response data. The control device 2 also transmits a control command to the selected air conditioner 4. Upon completing the pre-cooling/pre-heating control, the control device 2 transmits completion notification to the server 7.

[0043] When receiving the completion notification transmitted by the control device 2, the server 7 transmits the user notification to the corresponding user terminal 6.

<Functional configuration of user terminal 6>

[0044] FIG. 9 is a block diagram illustrating a function configuration of the user terminal 6. As illustrated in FIG. 9, the user terminal 6 functionally includes a setting receiver 600, a setting information transmitter 601, a wireless signal transmitter 602, a notification receiver 603, and a notification screen displayer 604. These functional components of the user terminal 6 are achieved by the CPU 64 running the aforementioned pre-cooling/pre-heating application stored in the auxiliary storage device 67.

[0045] The setting receiver 600 receives setting relating to the pre-cooling/pre-heating control from the user. For example, the setting receiver 600 displays a pre-cooling/pre-heating control setting screen as illustrated in FIG. 10 and receives setting of each item relating to the pre-cooling/pre-heating control from the user. The user enters via the pre-cooling/pre-heating control setting screen the name of the workroom to be used, that is, the workroom to be pre-cooling/pre-heating controlled, the setting temperature, and the specified operation time of the pre-cooling/pre-heating mode. The setting receiver 600 may be provided with a checklist, a radio button, a list box, and/or the like so that the user can set each item by selection operation.

[0046] The setting information transmitter 601 transmits, to the server 7 via the network N2, information (hereinafter referred to as setting information) indicating content set by the user.

[0047] The wireless signal transmitter 602 periodically transmits a wireless signal including the user terminal ID of the user terminal 6.

[0048] The notification receiver 603 receives the user notification transmitted by the server 7 upon completion of the operation in the pre-cooling/pre-heating mode. When the user notification is received by the notification receiver 603, the notification screen displayer 604 displays on the display 60 the notification screen for notifying the user that the operation in the pre-cooling/pre-heating mode is complete.

<Functional configuration of user detection terminal 3>

[0049] FIG. 11 is a block diagram illustrating a functional configuration of the user detection terminal 3. The user detection terminal 3 functionally includes a wireless signal receiver 300 and a user detection notifier 301. These functional components of the user detection terminal 3 are achieved by the CPU 32 executing the aforementioned user detection program stored in the auxiliary storage device 35.

[0050] When a user carrying the user terminal 6 enters the building B, the user detection terminal 3 detects passage of the user. Specifically, in the user detection terminal 3, the wireless signal receiver 300 receives the wireless signal transmitted by the user terminal 6, and obtains the user terminal ID of the user terminal 6 from the received wireless signal. The user detection notifier 301 generates the user detection notification including an ID that is identification information of the user detection terminal 3 and the user terminal ID obtained by the wireless signal receiver 300, and transmits the generated user detection notification to the control device 2 via the network N1.

<Functional configuration of control device 2>

[0051] FIG. 12 is a block diagram illustrating a functional configuration of the control device 2. As illustrated in FIG. 12, the control device 2 functionally includes a notification receiver 200, a user information querier 201, a query response data receiver 202, an air-conditioning controller 203, and a completion notifier 204. These functional components of the control device 2 are achieved by the CPU 22 executing the aforementioned facility device control program stored in the auxiliary storage device 25.

[0052] The notification receiver 200 is an example of notification reception means according to the present disclosure. The notification receiver 200 receives the user detection notification transmitted by the user detection terminal 3. The notification receiver 200 supplies the received user detection notification to the user information querier 201. The user information querier 201 is an example of query means according to the present disclosure. When the user detection notification is supplied from the notification receiver 200, the user information querier 201 queries the server 7 for the user information corresponding to the user detected by the user detection terminal 3. Specifically, the user information querier 201 extracts the user terminal ID from the user detection notification and generates the query data including the extracted user terminal ID. Then the user information querier 201 transmits the generated query data to the server 7 via the network N2.

[0053] The query response data receiver 202 is an example of air-conditioning control information receiving means according to the present disclosure. The query response data receiver 202 receives, as a response to the transmitted query data, the query response data transmitted by the server 7. When information indicating that the corresponding user information is not found is included in the received query response data, the query response data receiver 202 discards the query response data. When information indicating that the corresponding user information is found is included in the received query response data, the query response data receiver 202 extracts the pre-cooling/pre-heating control information from the query response data and supplies the extracted pre-cooling/pre-heating control information to the air-conditioning controller 203.

[0054] The air-conditioning controller 203 is an example of air-conditioning control means according to the present disclosure. The air-conditioning controller 203 selects the workroom corresponding to the user from the workroom information included in the pre-cooling/pre-heating control information supplied from the query response data receiver 202. Then the air-conditioning controller 203 selects the air conditioner 4 and the lighting device 5 corresponding the workroom based on the selected workroom and the device information DB 250. The device information DB 250 is a database in which information about the workroom, the air conditioner 4, and the lighting device 5 that are associated with each other is registered, and is stored in the auxiliary storage device 25. For example, information about the name of the workroom, the ID of the air conditioner 4, and the ID of the lighting device 5 that are associated with each other is registered in the device information DB 250.

[0055] The air-conditioning controller 203 obtains the operation state data from the selected air conditioner 4. Specifically, the air-conditioning controller 203 transmits, to the air conditioner 4 via the network N1, notification requesting the operation information data. The air conditioner 4 having received such notification transmits to the control device 2 the operation state data including the current air-conditioning mode, the current room temperature, and the like. In the present embodiment, the air-conditioning mode includes a normal operation mode, an off mode, and a pre-cooling/pre-heating mode.

[0056] The normal operation mode means a state of operation in accordance with a user operation via an unillustrated air-conditioning remote controller disposed in each workroom, or, in a case where the air conditioner 4 has an artificial intelligence (AI) function, a state of operation in accordance with the AI function. The off mode means an operation stop state. The pre-cooling/pre-heating mode is an air-conditioning mode started in accordance with the control command from the control device 2 and means a state in which cooling operation or heating operation is performed so that the room temperature of the workroom reaches a user's desired temperature after a lapse of the aforementioned specified operation time. Since the pre-cooling/pre-heating mode normally provides air conditioning over a longer period of time, the air conditioner 4 has lower power consumption in the pre-cooling/pre-heating mode than in the normal operation mode.

[0057] The air-conditioning controller 203 obtains the aforementioned lighting state data from the selected lighting device 5. As described above, the lighting state data includes information indicating whether the lighting device 5 is on or off.

[0058] When the selected air conditioner 4 is in the off mode and the selected lighting device 5 is off, the air-conditioning controller 203 generates the control command for staring the operation of the selected air conditioner 4 in the pre-cooling/pre-heating mode, and transmits the generated control command to the air conditioner 4 via the network N1. The control command in this case includes information for instruction to switch to the pre-cooling/pre-heating mode and the setting temperature and the specified operation time extracted from the pre-cooling/pre-heating control information. The air conditioner 4 having received the control command switches the air-conditioning mode to the pre-cooling/pre-heating mode, and the air conditioner 4 air-conditions the workroom so that the room temperature of the workroom reaches the setting temperature included in the control command after a lapse of the specified operation time included in the control command.

[0059] In a case where there is a plurality of selected air conditioners 4, that is, a plurality of air conditioners 4 corresponds to the workroom, the above condition in generation of the above control command that "the selected air conditioner 4 is in the off mode" is assumed to mean that "all the selected air conditioners 4 are in the off mode". Also, in a case where there is a plurality of selected lighting device 5, that is, a plurality of lighting devices 5 is installed in the workroom, the above condition in generation of the above control command that "the selected lighting device 5 is off" is assumed to mean that "all the selected lighting devices 5 are off".

[0060] In a case where the selected air conditioner 4 is in a mode other than the off mode or the selected lighting device 5 is on, the air-conditioning controller 203 determines that pre-cooling/pre-heating for the workroom is not necessary and does not generate the above control command.

[0061] In a case where the plurality of air conditioners 4 corresponds to the workroom, the above condition in not generating the above control command that "the selected air conditioner 4 is in the mode other than the off mode" is assumed to mean that "any of the air conditioners 4 is in the mode other than the off mode". Also, in a case where the plurality of lighting devices 5 is installed in the workroom, the above condition in not generating the above control command that "the selected lighting device 5 is on" is assumed to mean that "any of the lighting devices 5 is on".

[0062] Upon a lapse of the specified operation time after transmission of the control command, the air-conditioning controller 203 switches the air-conditioning mode of the air conditioner 4 from the pre-cooling/pre-heating mode to the off mode and notifies the completion notifier 204 of the switching.

[0063] Upon turning-on of the lighting device 5 in the workroom before a lapse of the specified operation time after transmission of the above control command, the air-conditioning controller 203 assumes that the user enters the workroom, and switches the air-conditioning mode of the air conditioner 4 from the pre-cooling/pre-heating mode to the normal operation mode. In a case where the plurality of lighting devices 5 is installed in the workroom, the air-conditioning controller 203 assumes, upon turning-on of any of the lighting devices 5 in the workroom, that the user enters the workroom, and switches the air-

conditioning mode of the air conditioner 4 from the pre-cooling/pre-heating mode to the normal operation mode.

[0064] Upon receiving the above notification from the air-conditioning controller 203, the completion notifier 204 generates completion notification including (i) information indicating that pre-cooling/pre-heating of the workroom is complete, (ii) the ID of the air conditioner, and (iii) the user terminal ID of the corresponding user terminal 6, and transmits the generated completion notification to the server 7 via the network N2.

<Functional configuration of server 7>

[0065] FIG. 13 is a block diagram illustrating a functional configuration of the server 7. As illustrated in FIG. 13, the server 7 functionally includes a setting information receiver 700, a user information manager 701, a query data receiver 702, a user information searcher 703, a query responder 704, a notification receiver 705, and a user notifier 706. These functional components of the server 7 are achieved by the CPU 71 executing the aforementioned cloud program stored in the auxiliary storage device 74.

[0066] The setting information receiver 700 receives setting information transmitted by the user terminal 6. The setting information receiver 700 supplies the received setting information to the user manager 701.

[0067] The user information manager 701 updates the user information DB 740 based on the setting information supplied from the setting information receiver 700. Specifically, in a case where the setting information is based on user registration, the user information manager 701 newly generates user information based on the setting information and registers the generated user information in the user information DB 740. In a case where the setting information is based on setting change, the user information manager 701 updates, based on the setting information, the corresponding user information registered in the user information DB 740.

[0068] The query data receiver 702 receives the query data transmitted by the control device 2. The query data receiver 702 supplies the received query data to the user information searcher 703.

[0069] The user information searcher 703 searches user information DB 740 for the corresponding user information using as a key the user terminal ID included in the query data supplied from the query data receiver 702.

[0070] The query responder 704 generates, based on the search result of the user information searcher 703, query response data for response to the control device 2. The query response data includes information indicating whether or not the corresponding user information is found. In a case where the corresponding user information is found, the query response data further includes the pre-cooling/pre-heating control information included in the user information. The query responder 704 transmits the generated query response data to the control device 2 via the network N2.

[0071] The notification receiver 705 receives the completion notification transmitted by the control device 2. The notification receiver 705 supplies the received completion notification to the user notifier 706.

[0072] Upon supply of the completion notification from the notification receiver 705, the user notifier 706 transmits, via the network N2 to the user terminal 6 of the user terminal ID included in the completion notification, user notification for notifying the user of completion of the operation in the pre-cooling/pre-heating mode.

[0073] FIG. 14 is a flowchart illustrating steps of a pre-cooling/pre-heating start process executed by the air-conditioning control system 1.

(Step S101)

[0074] The user detection terminal 3 determines whether or not a user is detected. Specifically, upon receiving the wireless signal from the user terminal 6 carried by a user, the user detection terminal 3 determines that the user passes through a place where the user detection terminal 3 is installed, that is, the entrance of the building B. When the passage of the user is detected (Yes in step S 101), the processing by the air-conditioning control system 1 goes to step S102. When the passage of the user is not detected (No in step S101), the user detection terminal 3 continuously performs determination of step S101.

(Step S 102)

[0075] The user detection terminal 3 notifies the control device 2 of the detection of the user. Specifically, the user detection terminal 3 extracts the user terminal ID included in the wireless signal received from the user terminal 6. Then the user detection terminal 3 generates the user detection notification including the ID of the user detection terminal 3 and the extracted user terminal ID, and transmits the generated user detection notification to the control device 2 via the network N1. Then the processing by the air-conditioning control system 1 goes to step S103.

(Step S103)

[0076] The control device 2 queries the server 7 for the user information corresponding to the user detected by the user detection terminal 3. Specifically, the control device 2 extracts the user terminal ID from the user detection notification received from the user detection terminal 3, and generates query data including the extracted user terminal ID. Then the control device 2 transmits the generated query data to the server 7 via the network N2. Then the processing by the air-conditioning control system 1 goes to step S104.

(Step S104)

[0077] The server 7 searches for the user information corresponding to the user and responds to the control device 2 with the search result. Specifically, the server 7 searches the user information DB 740 for the corresponding user information using as a key the user terminal ID included in the query data received from the control device 2. Then the server 7 generates, based on the search result of the user information, query response data for response to the control device 2.

[0078] The query response data includes information indicating whether or not the user information is found. In a case where the corresponding user information is found, the query response data further includes the pre-cooling/pre-heating control information included in the user information. The server 7 transmits the generated query response data to the control device 2 via the network N2. Then the processing by the air-conditioning control system 1 goes to step S105.

(Step S105)

[0079] The control device 2 determines, based on the query response data received from the server 7, whether or not there is user information corresponding to the user detected by the user detection terminal 3. When there is not user information corresponding to the user (No in step S 105), the control device 2 discards the query response data. Then the processing by the air-conditioning control system 1 returns to step S101. When there is user information corresponding to the user (Yes in step S 105), the processing by the air-conditioning control system 1 goes to step S106.

(Step S106)

[0080] The control device 2 selects, based on the query response data received from the server 7, the workroom corresponding to the user, and selects the air conditioner 4 and the lighting device 5 corresponding to the selected workroom. Then the processing by the air-conditioning control system 1 goes to step S107.

(Step S107)

[0081] The control device 2 obtains operation state data and lighting state data from the selected air conditioner 4 and the selected lighting device 5, respectively, and determines whether or not the selected air conditioner 4 is in off mode and the selected lighting device 5 is off. When the selected air conditioner 4 is in the off mode and the selected lighting device 5 is off (Yes in step S 107), the processing by the air-conditioning control system 1 goes to step S 108. When the selected air conditioner 4 is in a mode other than the off mode or the selected lighting device 5 is on (No in step S 107), the control device 2 determines that the pre-cooling/pre-heating of the workroom is not necessary, and the processing by the air-conditioning control system 1 returns to step S101.

(Step S 108)

[0082] The control device 2 generates a control command for instruction to start the operation of the pre-cooling/pre-heating mode, and transmits the generated control command to the air conditioner 4. The control command includes a setting temperature that is a target room temperature of the pre-cooling/pre-heating mode and a specified operation time of the pre-cooling/pre-heating mode. The air conditioner 4 having received such a control command air-conditions the workroom so that the room temperature of the workroom reaches the setting temperature after a lapse of the specified operation time. After step S108 in the process, the processing by the air-conditioning control system 1 returns to step S101.

[0083] FIG. 15 is a flowchart illustrating steps of a pre-cooling/pre-heating end process executed by the air-conditioning control system 1. The pre-cooling/pre-heating end process is executed per workroom where the pre-cooling/pre-heating is currently performed.

(Step S201)

[0084] The control device 2 obtains lighting state data from the lighting device 5 in the workroom periodically (for example, in one-minute cycles), and determines whether or not the lighting device 5 is turned on, that is, whether the operation state of the lighting device 5 changes from off to on. When the lighting device 5 is not turned on (No in step S201), the processing by the air-conditioning control system 1 goes to step S203. When the lighting device 5 is turned on (Yes in step S201), the processing by the air-conditioning control system 1 goes to step S202.

(Step S202)

[0085] Assuming entry of the user into the workroom, the control device 2 switches the air-conditioning mode of the air conditioner 4 from the pre-cooling/pre-heating mode to the normal operation mode. As described above, in the normal operation mode, operation is in accordance with user operation via the unillustrated air-conditioning remote controller, or is in accordance with the AI function. In a case where the air conditioner 4 does not have an AI function and the user does not operate the air-conditioning remote controller when entering the workroom, the air conditioner 4 air-conditions the workroom in accordance with content (setting temperature, volume of air, and the like) set by the user beforehand via the air-conditioning remote controller. Then the air-conditioning control system 1 ends the pre-cooling/pre-heating end process for the workroom.

(Step S203)

[0086] The control device 2 determines whether or not elapsed time from start of the operation in the pre-cooling/pre-heating mode by the air conditioner 4 reaches the specified operation time. When the elapsed time from the start of the operation in the pre-cooling/pre-heating mode does not reach the specified operation time (No in step S203), the processing by the air-conditioning control system 1 returns to step S201. When the elapsed time from the start of the operation in the pre-cooling/pre-heating mode reaches the specified operation time (Yes in step S203), the processing by the air-conditioning control system 1 goes to step S204.

(Step S204)

[0087] The control device 2 switches the air-conditioning mode of the air conditioner 4 from the pre-cooling/pre-heating mode to the off mode. Then the processing by the air-conditioning control system 1 goes to step S205.

(Step S205)

[0088] The control device 2 notifies the server 7 of completion of pre-cooling/pre-heating. Specifically, the control device 2 generates completion notification including information indicating completion of pre-cooling/pre-heating of the workroom, the ID of the air conditioner, and the user terminal ID of the corresponding user terminal 6, and transmits the generated completion notification to the server 7 via the network N2. Then the processing by the air-conditioning control system 1 goes to step S206.

(Step S206)

[0089] Upon receiving the completion notification transmitted by the control device 2, the server 7 notifies the corresponding user terminal 6 of completion of the pre-cooling/pre-heating. Specifically, the server 7 transmits via the network N2 to the user terminal 6 corresponding to the user terminal ID included in the received completion notification, the user notification for notifying the user of completion of the operation in the pre-cooling/pre-heating mode. Then the processing by the air-conditioning control system 1 goes to step S207.

(Step S207)

[0090] Upon receiving the user notification transmitted by the server 7, the user terminal 6 notifies the user of completion of the pre-cooling/pre-heating. Specifically, the user terminal 6 displays on the display 60 a notification screen indicating that the operation in the pre-cooling/pre-heating mode is complete. Then the air-conditioning control system 1 ends the pre-cooling/pre-heating end process for the workroom.

<In a case where a plurality of users is set for the same workroom>

[0091] In a case where a plurality of users is set for the same workroom, control for a user who is expected to arrive at the workroom earlier (determined based on a timing detected by the user detection terminal 3 and the specified operation time) is highly prioritized. For example, in a case where the workrooms of users A and B are the same and the specified operation time is set to 30 min, when the user A is first detected, the air-conditioning mode of the air conditioner 4 corresponding to the workroom is switched from the off mode to the pre-cooling/pre-heating mode, and the operation in the pre-cooling/pre-heating mode is performed with the content of the pre-cooling/pre-heating control information previously set by the user A.

[0092] The user B is assumed to be detected 10 minutes after the user A is detected. In this case, as the user A is expected to arrive at the workroom earlier than the user B, the operation in the pre-cooling/pre-heating mode is continuously performed with the content of the pre-cooling/pre-heating control information corresponding to the user A. In a case where no one enters the workroom even after a lapse of 30 minutes since start of the pre-cooling/pre-healing, the operation in the pre-cooling/pre-heating mode based on the setting of the user A ends. However, as the user B is expected to arrive at the workroom 10 minutes later, the control device 2 changes the target user from the user A to the user B.

[0093] As a result, the control device 2 does not switch the air-conditioning mode of the air conditioner 4 to the OFF mode even after the operation in the pre-cooling/pre-heating mode based on the setting of the user A is complete, and for the following 10 minutes, the control device 2 then performs pre-cooling/pre-heating control based on the content of the pre-cooling/pre-heating control information previously set by the user B.

[0094] Next, another case is described in which the specified operation time for the user A is set to 10 minutes, and the user A is detected 10 minutes before the user B is detected. In this case, the operation in the pre-cooling/pre-heating mode is first performed with the content of the pre-cooling/pre-heating control information previously set by the user A, but if the user B is detected afterwards, the control device 2 changes the target user from the user A to the user B because the user B is expected to arrive at the workroom earlier. As a result, the pre-cooling/pre-heating control is subsequently performed based on the content of the pre-cooling/pre-heating control information previously set by the user B.

[0095] Then, in a case where no one enters the workroom even after a lapse of 10 minutes, which is the specified operation time set by the user B, the operation in the pre-cooling/pre-heating mode based on the setting by the user B ends. However, since the time of arrival of the user A at the workroom is 10 minutes later, the control device 2 changes the target user from the user B to the

user A. As a result, the control device 2 subsequently performs pre-cooling/pre-heating control based on the content of the pre-cooling/pre-heating control information previously set by the user A.

[0096] As described above, the air-conditioning control system 1 of the present embodiment can provide comfort to the user entering the workroom while reducing unnecessary energy consumption, thereby improving work efficiency of the user.

[0097] The present disclosure is not limited to the embodiment described above, and various modifications are, of course, possible without departing from the gist of the present disclosure.

[0098] For example, modification may be made to allow detection of a user in the workroom by further installing the user detection terminal 3 in each workroom and the user terminal detection 3 receiving a wireless signal from the user terminal 6. In this case, the control device 2 switches the air-conditioning mode of the air conditioner 4 to the normal operation mode, assuming that the determination condition is satisfied, in step S201 of the pre-cooling/pre-heating end process (see FIG. 15), even when the user detection notification is received from the user detection terminal 3 installed in the workroom.

[0099] When the determination condition in step S203 of the pre-cooling/pre-heating end process (see FIG. 15) is satisfied, the control device 2 may switch the air-conditioning mode of the air conditioner 4 not to the off mode but rather to a power-saving mode that performs cooling or heating but provides a lower level of air conditioning than the normal operation mode and the pre-cooling/pre-heating mode, that is, has lower power consumption than the normal operation mode and pre-cooling/pre-heating mode.

[0100] In the above case, the user may be able to preset the operation of the power-saving mode via the user terminal 6. In this case, the user terminal 6 receives settings via the pre-cooling/pre-heating control setting screen (see FIG. 10) as to which of the OFF mode and the power-saving mode is switched to from the pre-cooling/pre-heating mode. Furthermore, the user terminal 6 may also receive the setting of the operation time in the power-saving mode and the setting of the setting temperature in the power-saving mode. The server 7 may then manage, in the user information DB 740, the user information including the pre-cooling/pre-heating control information in which information relating to such settings is included.

[0101] Also, a plurality of user detection terminals 3 that detects entry of a user into the building B may be installed. In this case, in order to prevent detection errors due to failures or the like, two or more user detection terminals 3 may be installed near the same entrance of the building B, or user detection terminals 3 may be installed at a plurality of locations within the building B. As illustrated in FIG. 16, in a case where the building B has a plurality of entrances (entrances a and b) in the building B, each of a plurality of user detection terminals 3 (user detection terminals 3a and 3b) may be installed at its corresponding entrance.

[0102] In a case where a plurality of user detection terminals 3 that detects passage of a user is installed, the user terminal 6 may receive, from a user via the pre-cooling/pre-heating control setting screen (see FIG. 10), selection of one or more user detection terminals 3 that match a route through which the user moves to the workroom. In this case, the user terminal 6 may display information indicating a location where each user detection terminal 3 is installed, and receive, from the user, selection of one or more locations that match the route through which the user moves to the workroom, thereby receiving selection of the corresponding one or more user detection terminals 3.

[0103] In the above case, the pre-cooling/pre-heating control information in the user information corresponding to the user managed by the server 7 includes the ID of each user detection terminal 3 selected by the user. Upon receiving the user detection notification from the user detection terminal 3, the control device 2 generates query data including the ID of the user detection terminal 3 extracted from the user detection terminal and the user terminal ID, and transmits the query data to the server 7. The server 7 having received the query data searches the user information DB 740 for the corresponding user information using as a key the ID of the user detection terminal 3 and the user terminal ID included in the query data.

[0104] The air-conditioning control system 1 may also target a plurality of buildings for air conditioning. In this case, for example, the user terminal 6 may receive, from a user, specification of entrances of a building to be used (in other words, the user detection terminal 3 installed at the entrance), as illustrated in FIG. 17.

[0105] The user terminal 6 may also receive, from a user via the pre-cooling/pre-heating control setting screen (see FIG. 10), a plurality of settings of combinations of workrooms and one or more user detection terminals 3 that detect the user. In this case, the user terminal 6 may receive from the user the settings of the set temperature, the specified operation time, and the like, for each combination.

[0106] The user terminal 6 may also receive, from a user via the pre-cooling/pre-heating control setting screen (see FIG. 10), setting as to whether or not the pre-cooling/pre-heating control is conducted, setting of an interval (e.g., four hours, etc.) between the end of the pre-cooling/pre-heating and re-start of the pre-cooling/pre-heating for the same workroom, setting of notification necessity for the user at the end of the pre-cooling/pre-heating, and the like.

[0107] The user terminal 6 may also receive, from a user via the pre-cooling/pre-heating control setting screen (see FIG. 10), setting of sensory characteristics for air temperature (e.g., sensitive to heat, sensitive to cold, etc.), setting of requests for air conditioning (e.g., higher than usual, lower than usual, etc.), and the like.

In this case, the control device 2 adjusts the setting temperature, the volume of air, and the like, in consideration of the sensory characteristics of the user, the requests for air conditioning, and the like. For example, in a case where "sensitive to heat" is set, the target room temperature at pre-cooling is set to the setting temperature -0.5°C, and in a case where "sensitive to cold" is set, the target room temperature at pre-heating is set to the setting temperature +0.5°C.

[0108] In a case where a user wears a wearable device, such as a smartwatch, equipped with a sensor that measures biometric data, a measurement value of each sensor may be taken into account in the pre-cooling/pre-heating control. Sensors that measure the biometric data include, for example, a body temperature sensor, a heart rate sensor, and a perspiration rate sensor. The measurement value of each sensor is transmitted from the wearable device to the user terminal 6 and transferred from the user terminal 6 to the server 7.

[0109] The server 7 compares the measurement value of the biometric data transmitted by the user terminal 6 with the normal value in the type of biometric data, and transmits to the control device 2 the comparison result (e.g., normal, high, low, etc.) as biometric information of the user, together with the query response data. Here, the normal value of the biometric data may adopt a value in the normal range of a general adult, or a value statistically obtained from the history of the biometric data obtained from the user in question. In the latter case, the server 7 stores and manages in the user information DB 740 the history of each type of biometric data of each user for a certain period of time in the past.

[0110] When the biometric data is sent from the server 7, the control device 2 performs pre-cooling/pre-heating control in consideration of the biometric data. For example, if the user's heart rate is high, the target room temperature of the pre-cooling/pre-heating is set to the "setting temperature - 0.5°C", and if the user's heart rate is low, the target room temperature of the pre-cooling/pre-heating is set to the "setting temperature + 0.5°C".

[0111] The user terminal 6 may also receive from a user not only specification of the workroom to be used, but also setting of a use area in the workroom. In a case where there is a plurality of air conditioners 4 corresponding to the workroom, the control device 2 may let only the air conditioner 4 corresponding to the set use area operate in the pre-cooling/pre-heating mode. In a case where there is a single indoor unit in the workroom, the user terminal 6 may adjust an air direction of the indoor unit so as to intensively air condition the set use area.

[0112] The control device 2, the user terminal 6, or the server 7 may learn the operation time of the pre-cooling/pre-heating mode each time by measuring the time from the user's entry into the building B until the user's entry into the set workroom.

[0113] In the above embodiment, upon receiving a control command indicating the start of operation in the pre-cooling/pre-heating mode from the control device 2, the air conditioner 4 switches the air-conditioning mode to the pre-cooling/pre-heating mode and executes the operation in the pre-cooling/pre-heating mode based on the specified operation time and the setting temperature included in the control command. In other words, the air conditioner 4 in the above embodiment has a pre-cooling/pre-heating-mode operation function. However, the air conditioner 4 does not necessarily have the pre-cooling/pre-heating-mode operation function. In such a case, the control device 2 monitors the operation state of the air conditioner 4 at any time and adjusts output of the air conditioner 4 so that the room temperature of the workroom reaches the temperature desired by the user after a lapse of the specified operation time.

[0114] It is sufficient that the user terminal 6 carried by the user has a function (wireless signal transmitter 602 in FIG. 9) to periodically transmit a wireless signal including the user terminal ID of the user terminal 6. In other words, the user terminal 6 does not necessarily have a function (the setting receiver 600 and the setting information transmitter 601 of FIG. 9) to receive settings relating to the pre-cooling/pre-heating control from the user and transmit to the server 7 information indicating the received content, and a function (notification receiver 603 and notification screen displayer 604 of FIG. 9) to receive the user notification from the server 7 and display the user notification. In this case, it is sufficient that, via a terminal (the terminal may be an air-conditioning remote controller of each workroom) installed separately in the building B, the user performs settings relating to the pre-cooling/pre-heating control and confirms the notification from the server 7.

[0115] The control device 2 may manage user information for each user. That is, the control device 2 may be configured to include a database similar to the user information DB 740.

[0116] All or some of the functional components (see FIG. 12) of the control device 2 may be achieved by dedicated hardware, all or some of the functional components (see FIG. 11) of the user detection terminal 3 may be achieved by dedicated hardware, all or some of the functional components (see FIG. 9) of the user terminal 6 may be achieved by dedicated hardware, and all or some of the functional components (see FIG. 13) of the server 7 may be achieved by dedicated hardware. The dedicated hardware is, for example, a single circuit, a composite circuit, a programmed processor, an application specific integrated circuit (ASIC), a field-programmable gate array (FPGA), or a combination thereof.

[0117] Technical concepts of each of the above modified examples may be achieved independently or in combination as appropriate.

[0118] The foregoing describes some example embodiments for explanatory purposes. Although the foregoing discussion has presented specific embodiments, persons skilled in the art will recognize that changes may be made in form and detail without departing from the broader spirit and scope of the invention. Accordingly,

the specification and drawings are to be regarded in an illustrative rather than a restrictive sense. This detailed description, therefore, is not to be taken in a limiting sense, and the scope of the invention is defined only by the included claims, along with the full range of equivalents to which such claims are entitled.

Industrial Applicability

[0119] The present disclosure can be used with advantage in an air-conditioning control system for air-conditioning a building.

Reference Signs List

[0120]

1	Air-conditioning control system
2	Control device
3	User detection terminal
4	Air conditioner
5	Lighting device
6	User terminal
7	Server
20, 30, 62	First communication interface
21, 31, 63	Second communication interface
22, 32, 64, 71	CPU
23, 33, 65, 72	ROM
24, 34, 66, 73	RAM
25, 35, 67, 74	Auxiliary storage device
26, 36, 68, 75	Bus
60	Display
61	Operation receiver
70	Communication interface
200, 603, 705	Notification receiver
201	User information querier
202	Query response data receiver
203	Air-conditioning controller
204	Completion notifier
250	Device information DB
300	Wireless signal receiver
301	User detection notifier
600	Setting receiver
601	Setting information transmitter
602	Wireless signal transmitter
604	Notification screen displayer
700	Setting information receiver
701	User information manager
702	Query data receiver
703	User information searcher
704	Query responder
706	User notifier
740	User information DB

Claims

1. An air-conditioning control system, comprising:

an air conditioner to air-condition a room;
user information storage means for storing, on a user basis, user information including at least identification information of a portable terminal and air-conditioning control information relating to air-conditioning control of the room;
a user detection terminal installed outside the room and configured to detect passage of a user by communication with the portable terminal; and
air-conditioning control means for controlling, when the passage of the user is detected by the user detection terminal, the air conditioner to pre-cool or pre-heat the room based on the air-conditioning control information corresponding to the user.

2. The air-conditioning control system according to claim 1, wherein the air-conditioning control information includes information relating to air conditioning desired by the user.

3. The air-conditioning control system according to claim 1 or 2, wherein

the air-conditioning control information includes a longest duration of pre-cooling or pre-heating of the room, and
after start of the pre-cooling or the pre-heating of the room, the air-conditioning control means stops the pre-cooling or the pre-heating of the room upon first occurrence of either elapsing of the longest duration or detecting of entry of a person into the room.

4. The air-conditioning control system according to claim 3, wherein, when the pre-cooling or the pre-heating of the room stops upon a lapse of the longest duration, the air-conditioning control means controls the air conditioner to continue the air conditioning of the room with lower power consumption than during the pre-cooling or the pre-heating.

5. The air-conditioning control system according to any one of claims 1 to 4, wherein

the room is a room previously selected by the user from among a plurality of rooms, and
the air-conditioning control information includes information indicating the room selected by the user.

6. The air-conditioning control system according to any one of claims 1 to 5, wherein

a plurality of the user detection terminals is installed,
the air-conditioning control information includes

identification information of each of one or more user detection terminals selected by the user, and
upon detection of passage of the user by any of the one or more user detection terminals selected by the user, the air-conditioning control means controls the air conditioner so as to pre-cool or pre-heat the room based on the air-conditioning control information corresponding to the user.

7. The air-conditioning control system according to any one of claims 1 to 6, further comprising:

a server comprising the user information storage means; and
a control device comprising the air-conditioning control means, wherein
upon receiving notification, from the user detection terminal by communication with the user detection terminal, that passage of the user is detected, the control device obtains, from the server by communication with the server, the air-conditioning control information corresponding to the user.

8. A control device to control an air conditioner that air-conditions a room, the control device comprising:

notification reception means for receiving, from a user detection terminal that is installed outside the room and detects passage of a user, user detection notification indicating that passage of the user is detected;
query means for querying, upon reception of the user detection notification, a server for air-conditioning control information relating to air-conditioning control of the room and corresponding to the user;
air-conditioning control information receiving means for receiving the air-conditioning control information transmitted by the server in response to the query; and
air-conditioning control means for controlling the air conditioner to pre-cool or pre-heat the room based on the air-conditioning control information.

9. An air-conditioning control method for controlling an air conditioner that air-conditions a room, the method comprising:

receiving, from a user detection terminal that is installed outside the room and detects passage of a user, user detection notification indicating that passage of the user is detected;
querying, upon receiving the user detection notification, a server for air-conditioning control information relating to air-conditioning control of the room and corresponding to the user;
receiving the air-conditioning control information transmitted by the server in response to the query; and
controlling the air conditioner to pre-cool or pre-heat the room based on the air-conditioning control information.

10. A program for causing a computer to function as:

notification reception means for receiving, from a user detection terminal that is installed outside the room and detects passage of a user, user detection notification indicating that passage of the user is detected;
query means for querying, upon reception of the user detection notification, a server for air-conditioning control information relating to air-conditioning control of the room and corresponding to the user;
air-conditioning control information receiving means for receiving the air-conditioning control information transmitted by the server in response to the query; and
air-conditioning control means for controlling the air conditioner corresponding to the room to pre-cool or pre-heat the room based on the air-conditioning control information.

FIG.1

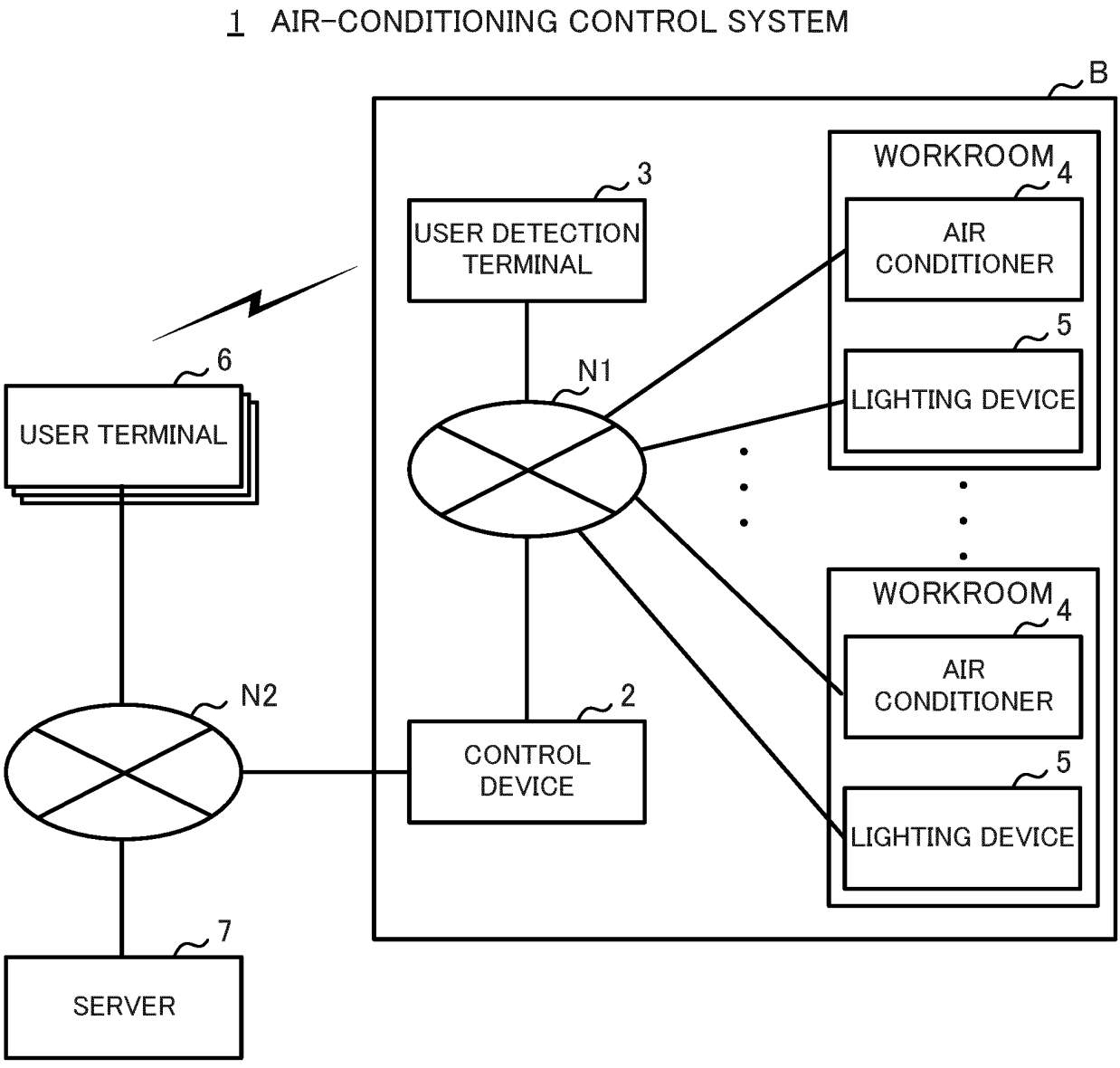

1 AIR-CONDITIONING CONTROL SYSTEM
B
WORKROOM
4
AIR CONDITIONER
5
LIGHTING DEVICE
3
USER DETECTION TERMINAL
N1
6
USER TERMINAL
N2
2
CONTROL DEVICE
7
SERVER

FIG.2

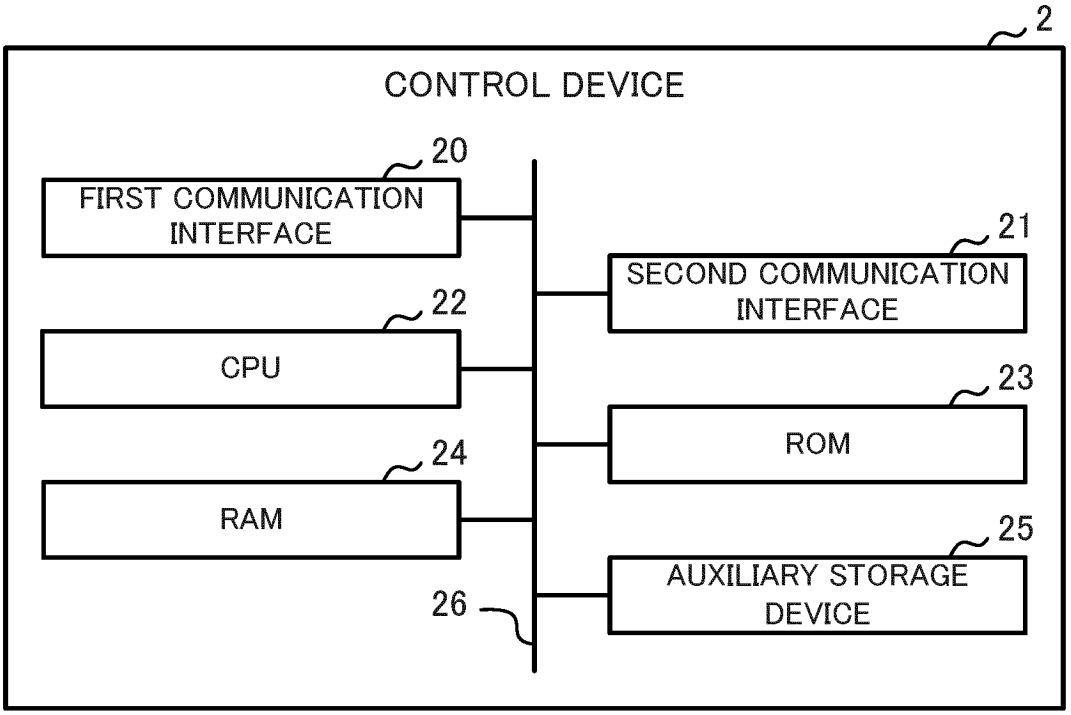

2
CONTROL DEVICE
20
FIRST COMMUNICATION INTERFACE
21
SECOND COMMUNICATION INTERFACE
22
CPU
23
ROM
24
RAM
25
AUXILIARY STORAGE DEVICE
26

FIG.3

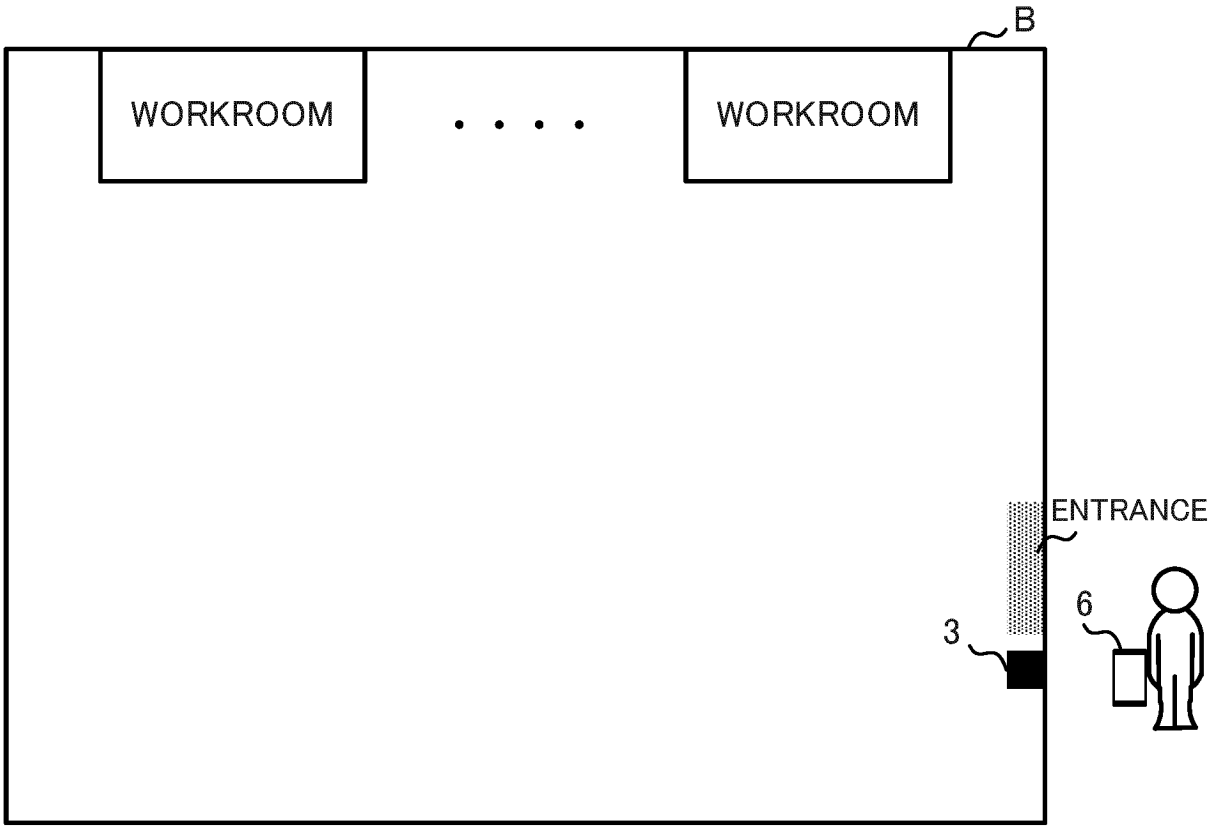

B
WORKROOM
. . . .
WORKROOM
ENTRANCE
6
3

FIG.4

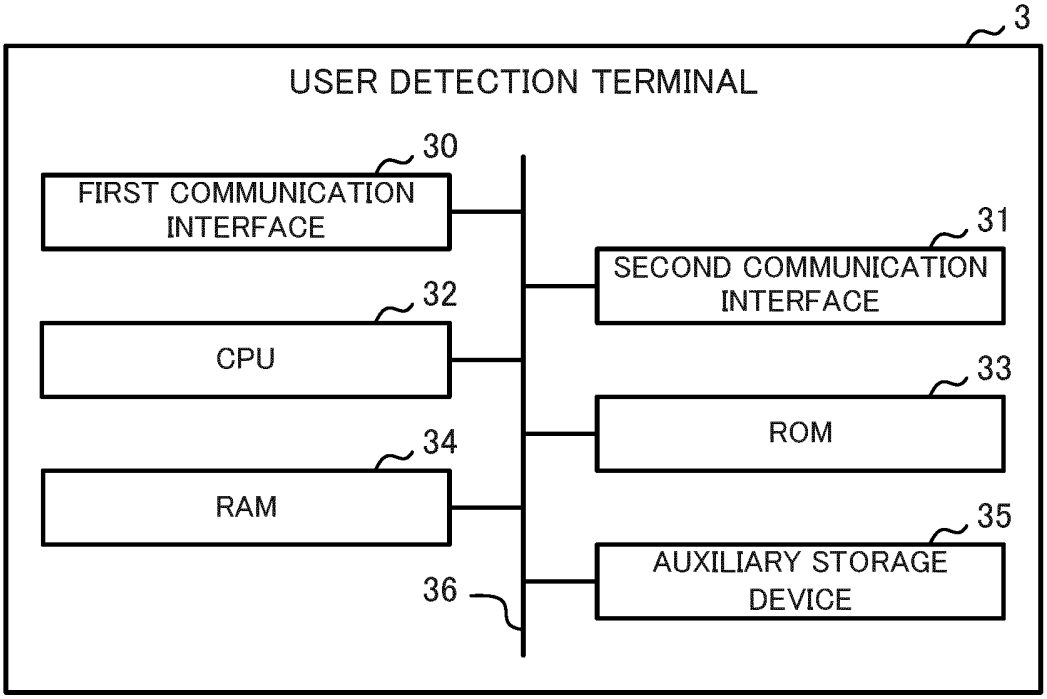

3
USER DETECTION TERMINAL
30
FIRST COMMUNICATION INTERFACE
31
SECOND COMMUNICATION INTERFACE
32
CPU
33
ROM
34
RAM
35
AUXILIARY STORAGE DEVICE
36

FIG.5

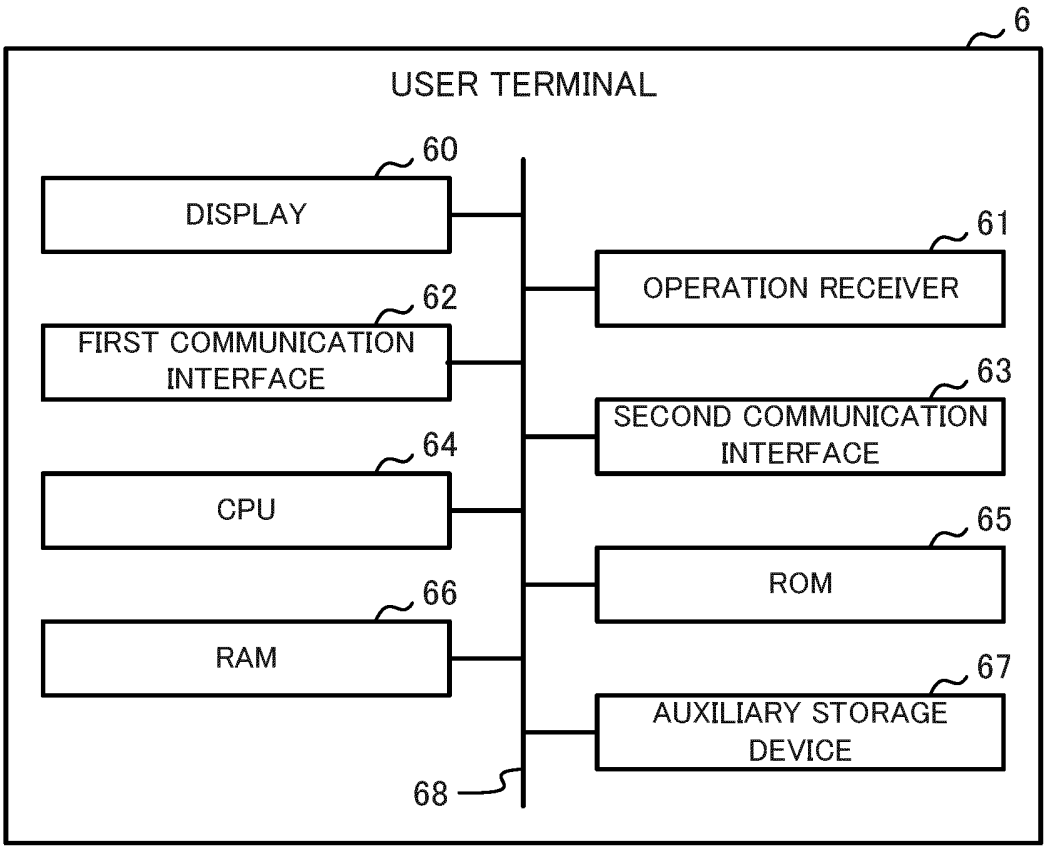

6
USER TERMINAL
60
DISPLAY
61
OPERATION RECEIVER
62
FIRST COMMUNICATION INTERFACE
63
SECOND COMMUNICATION INTERFACE
64
CPU
65
ROM
66
RAM
67
AUXILIARY STORAGE DEVICE
68

FIG.6

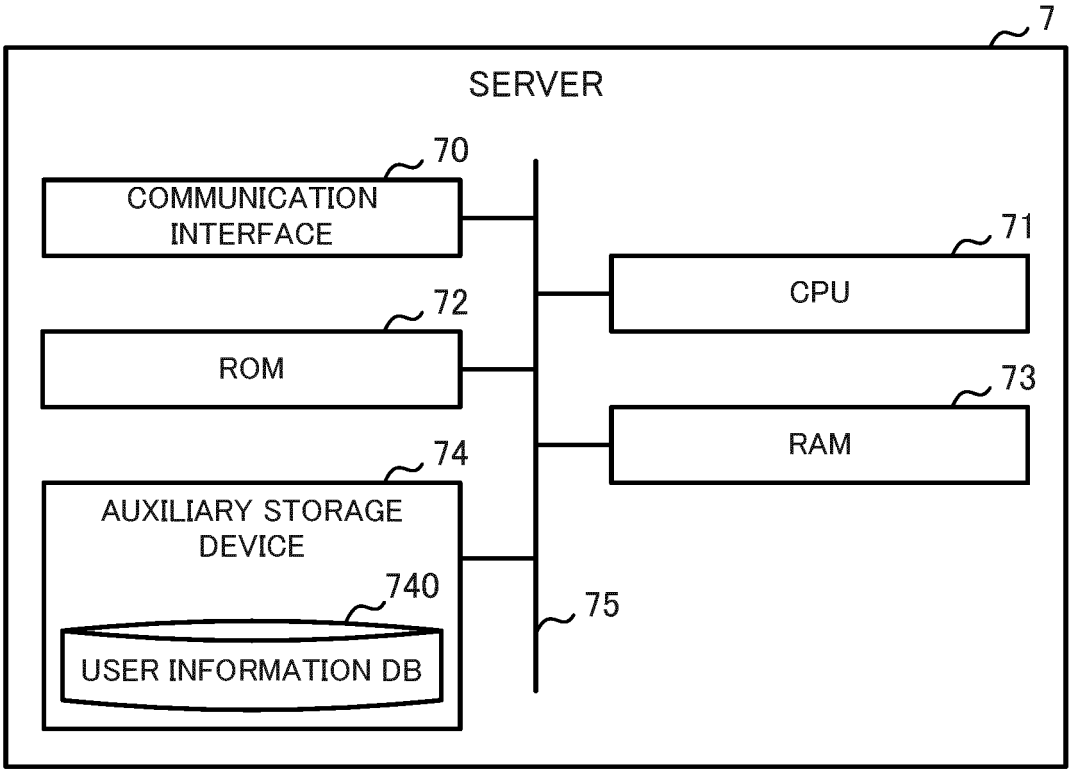


FIG.7

740

USER ID	PASSWORD	USER TERMINAL ID	PRE-COOLING/PRE-HEATING CONTROL INFORMATION		
			WORKROOM INFORMATION	SETTING TEMPERATURE (°C)	SPECIFIED OPERATION TIME (MIN)
...	...	...	...	...	...

FIG.8

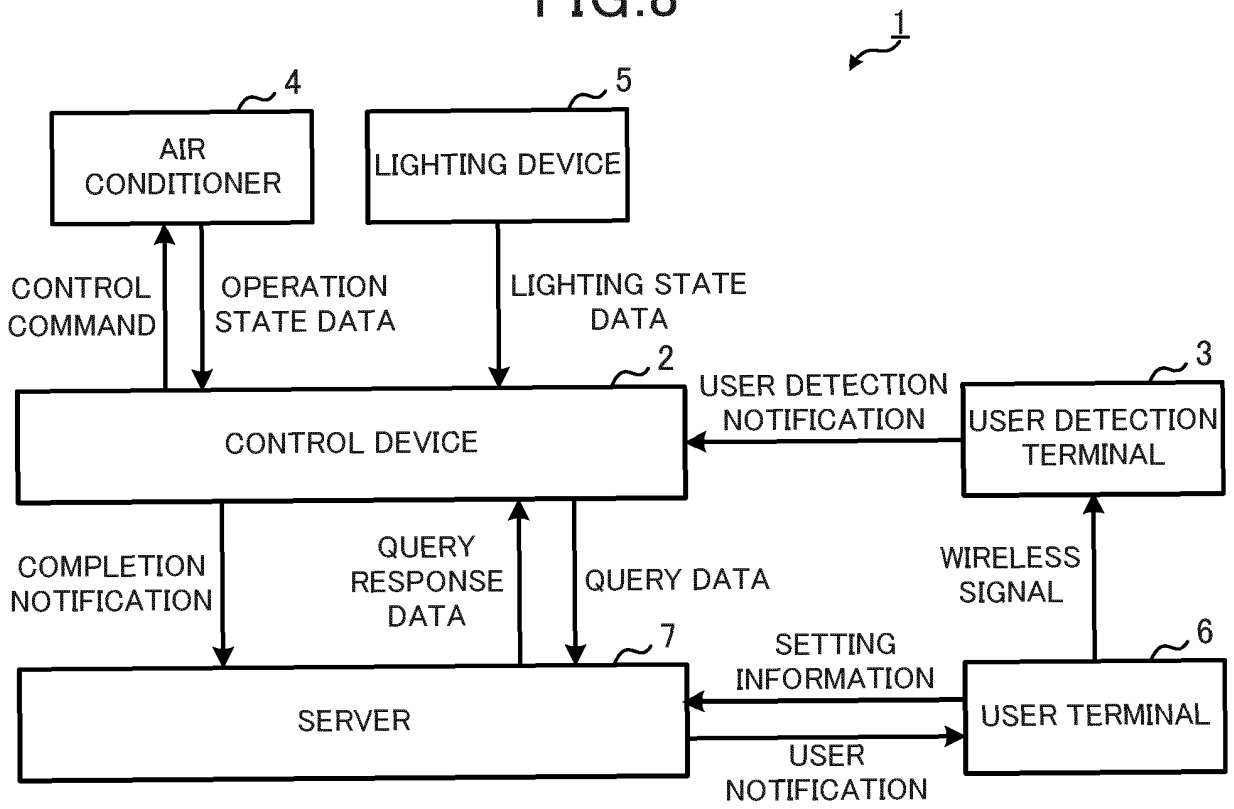

1
4
AIR CONDITIONER
5
LIGHTING DEVICE
CONTROL COMMAND
OPERATION STATE DATA
LIGHTING STATE DATA
2
CONTROL DEVICE
USER DETECTION NOTIFICATION
3
USER DETECTION TERMINAL
COMPLETION NOTIFICATION
QUERY RESPONSE DATA
QUERY DATA
WIRELESS SIGNAL
7
SERVER
SETTING INFORMATION
6
USER TERMINAL
USER NOTIFICATION

FIG.9

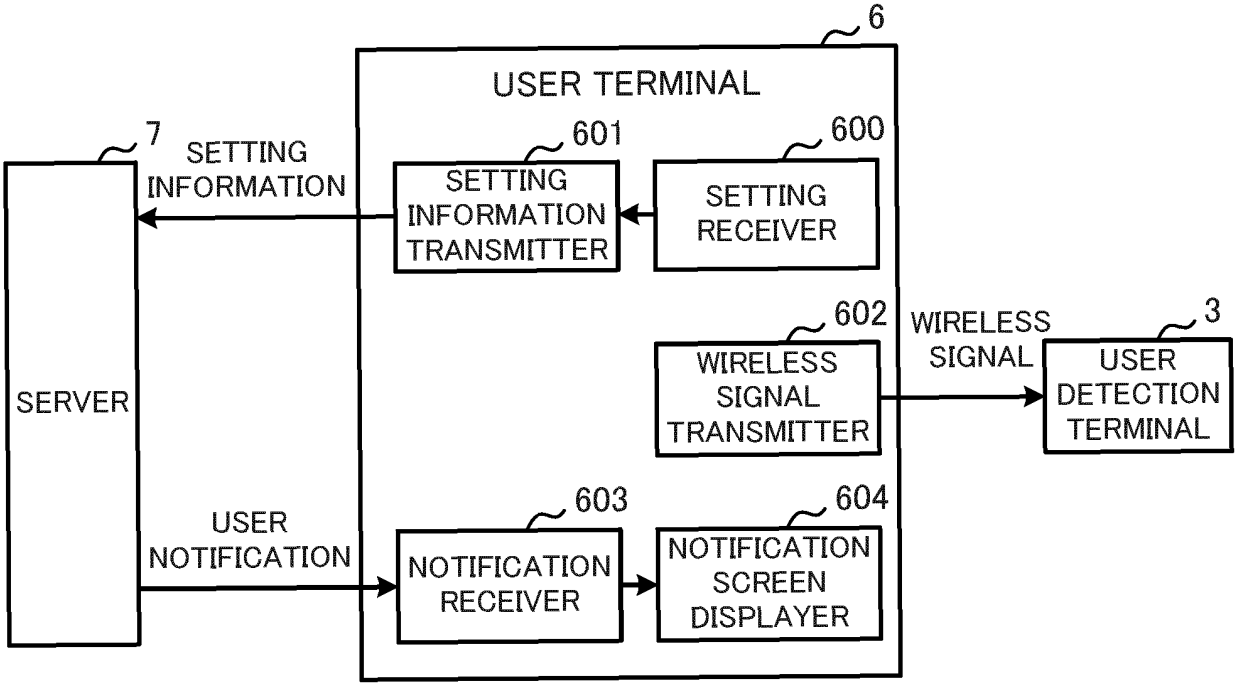

6
USER TERMINAL
7
SERVER
SETTING INFORMATION
601
SETTING INFORMATION TRANSMITTER
600
SETTING RECEIVER
602
WIRELESS SIGNAL TRANSMITTER
WIRELESS SIGNAL
3
USER DETECTION TERMINAL
USER NOTIFICATION
603
NOTIFICATION RECEIVER
604
NOTIFICATION SCREEN DISPLAYER

FIG.10

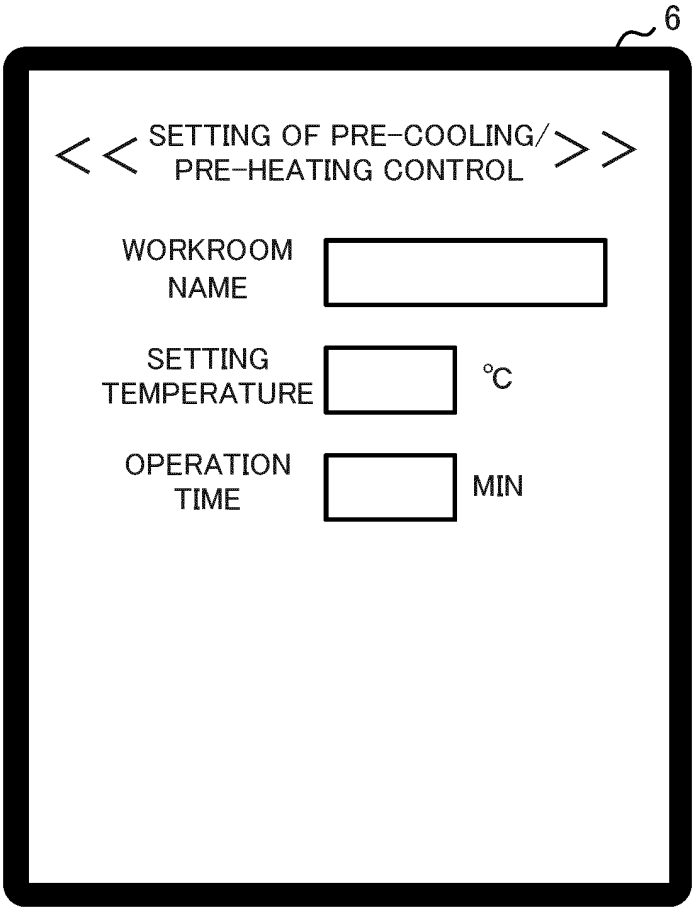

6
<< SETTING OF PRE-COOLING/ PRE-HEATING CONTROL >>
WORKROOM NAME
SETTING TEMPERATURE
℃
OPERATION TIME
MIN

FIG.11

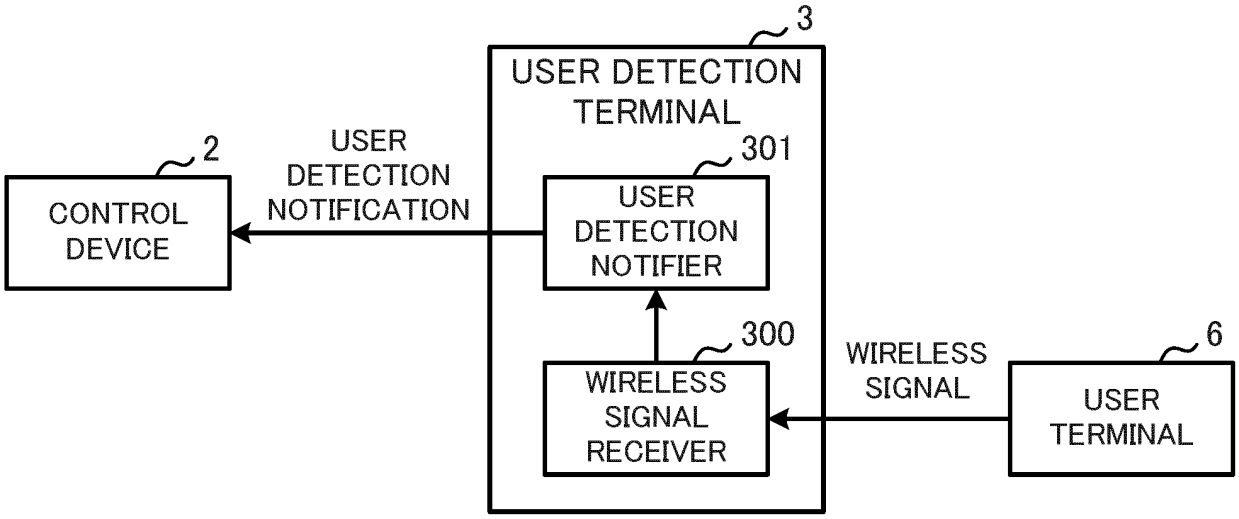

3
USER DETECTION TERMINAL
301
USER DETECTION NOTIFIER
300
WIRELESS SIGNAL RECEIVER
2
CONTROL DEVICE
USER DETECTION NOTIFICATION
WIRELESS SIGNAL
6
USER TERMINAL

FIG.12

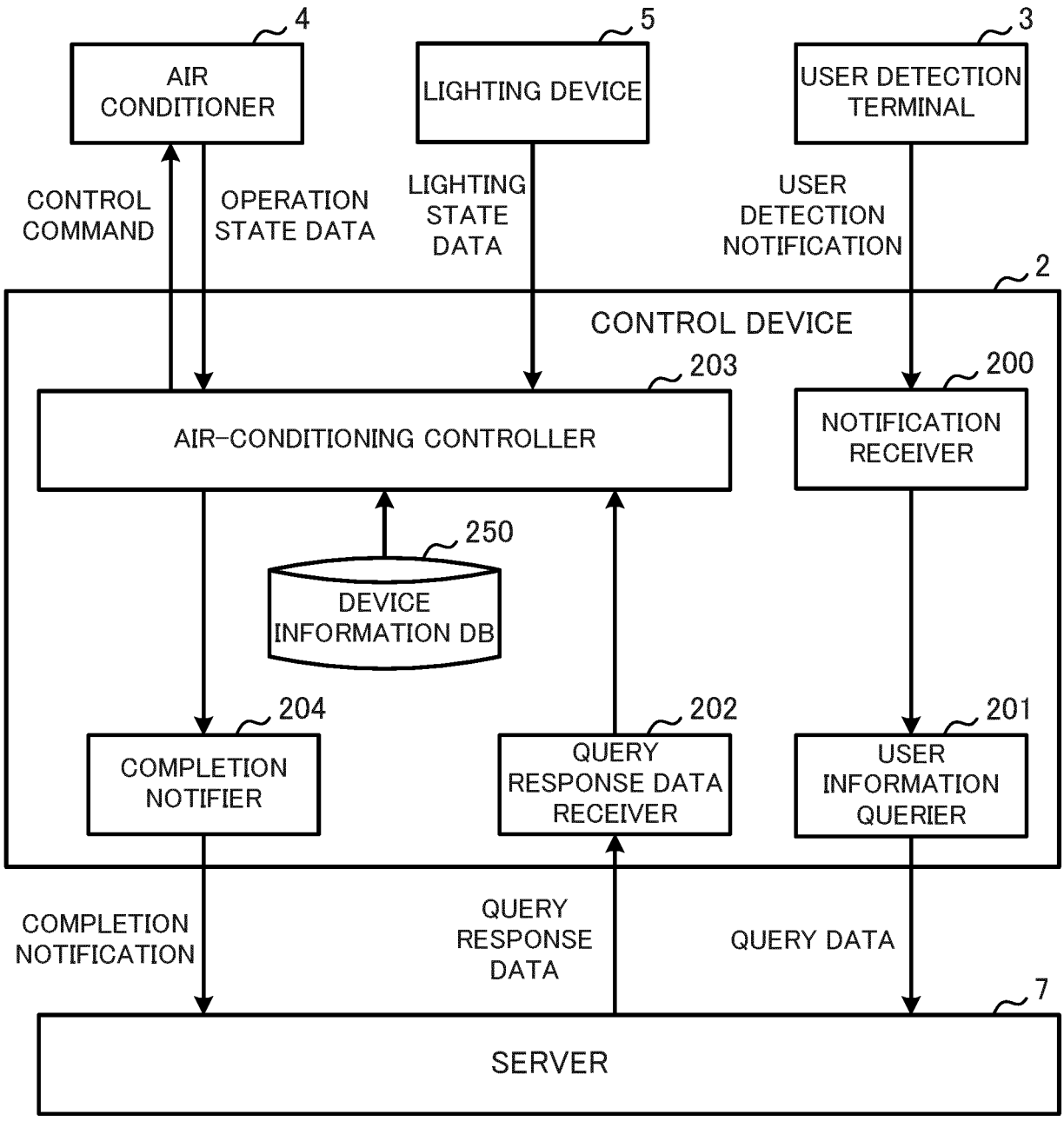

4
AIR CONDITIONER
5
LIGHTING DEVICE
3
USER DETECTION TERMINAL
CONTROL COMMAND
OPERATION STATE DATA
LIGHTING STATE DATA
USER DETECTION NOTIFICATION
2
CONTROL DEVICE
203
AIR-CONDITIONING CONTROLLER
200
NOTIFICATION RECEIVER
250
DEVICE INFORMATION DB
204
COMPLETION NOTIFIER
202
QUERY RESPONSE DATA RECEIVER
201
USER INFORMATION QUERIER
COMPLETION NOTIFICATION
QUERY RESPONSE DATA
QUERY DATA
7
SERVER

FIG.13

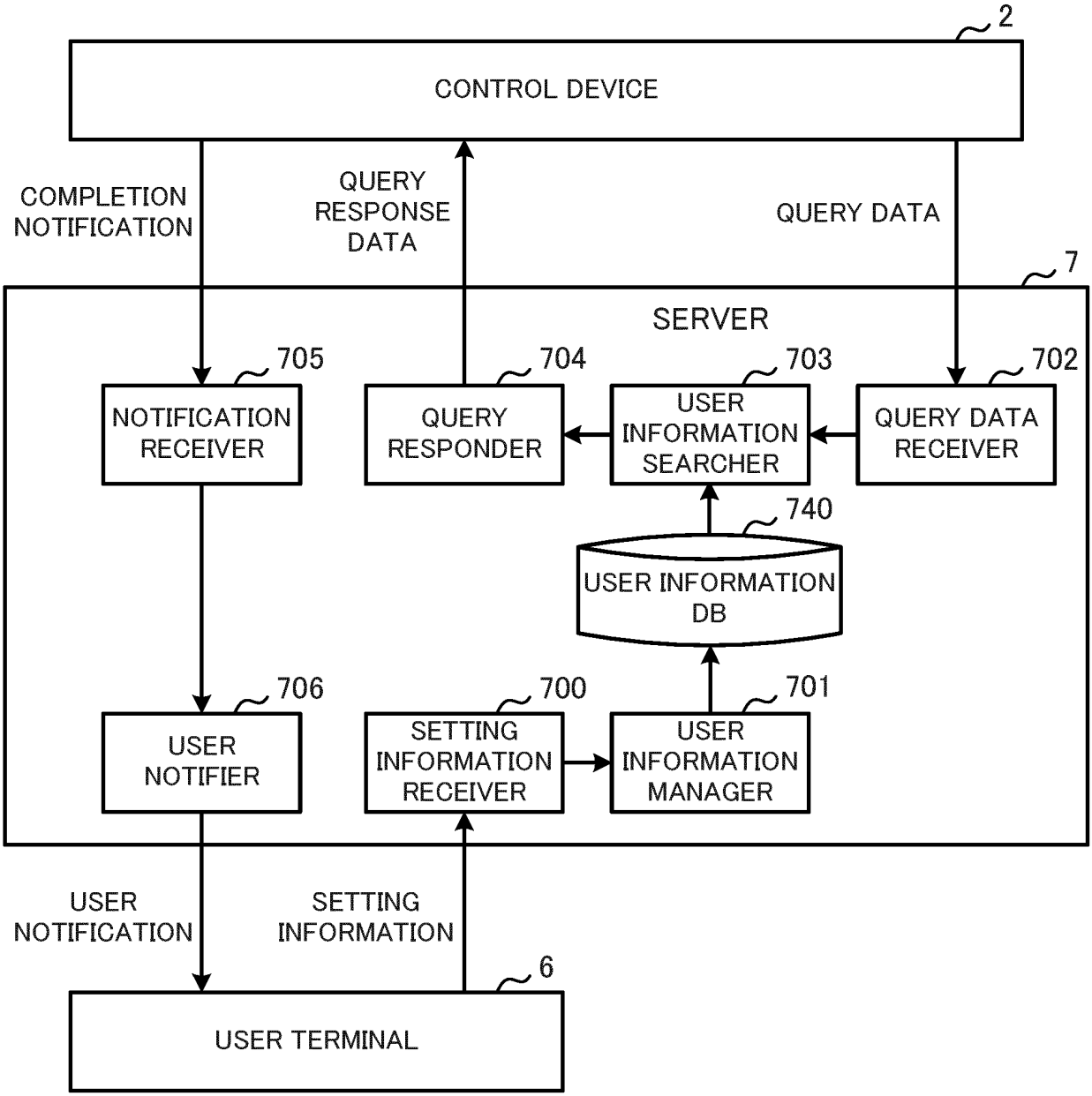

2
CONTROL DEVICE
COMPLETION NOTIFICATION
QUERY RESPONSE DATA
QUERY DATA
7
SERVER
705
NOTIFICATION RECEIVER
704
QUERY RESPONDER
703
USER INFORMATION SEARCHER
702
QUERY DATA RECEIVER
740
USER INFORMATION DB
706
USER NOTIFIER
700
SETTING INFORMATION RECEIVER
701
USER INFORMATION MANAGER
USER NOTIFICATION
SETTING INFORMATION
6
USER TERMINAL

FIG.14

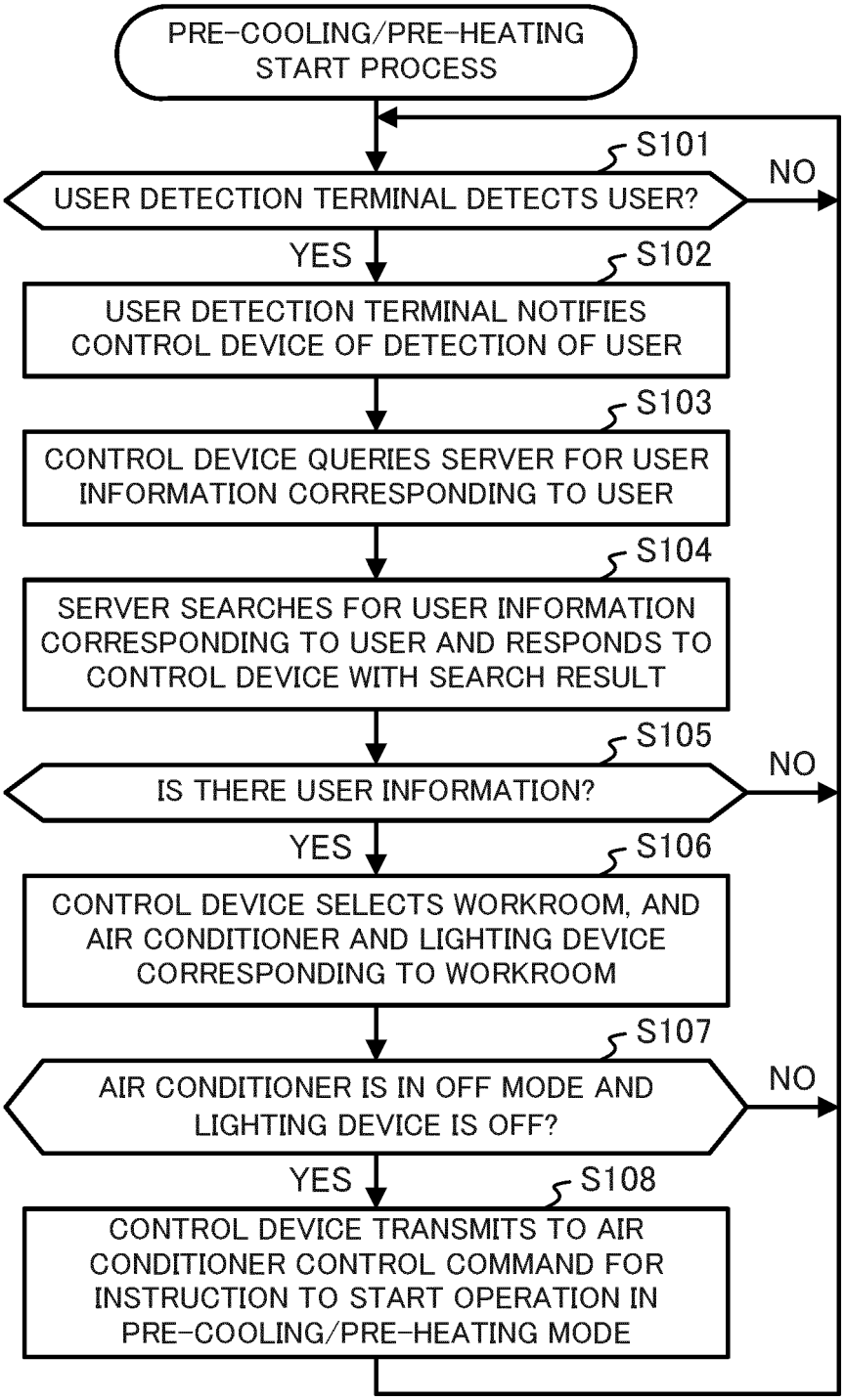

PRE-COOLING/PRE-HEATING START PROCESS
S101
USER DETECTION TERMINAL DETECTS USER?
NO
YES
S102
USER DETECTION TERMINAL NOTIFIES CONTROL DEVICE OF DETECTION OF USER
S103
CONTROL DEVICE QUERIES SERVER FOR USER INFORMATION CORRESPONDING TO USER
S104
SERVER SEARCHES FOR USER INFORMATION CORRESPONDING TO USER AND RESPONDS TO CONTROL DEVICE WITH SEARCH RESULT
S105
IS THERE USER INFORMATION?
NO
YES
S106
CONTROL DEVICE SELECTS WORKROOM, AND AIR CONDITIONER AND LIGHTING DEVICE CORRESPONDING TO WORKROOM
S107
AIR CONDITIONER IS IN OFF MODE AND LIGHTING DEVICE IS OFF?
NO
YES
S108
CONTROL DEVICE TRANSMITS TO AIR CONDITIONER CONTROL COMMAND FOR INSTRUCTION TO START OPERATION IN PRE-COOLING/PRE-HEATING MODE

FIG.15

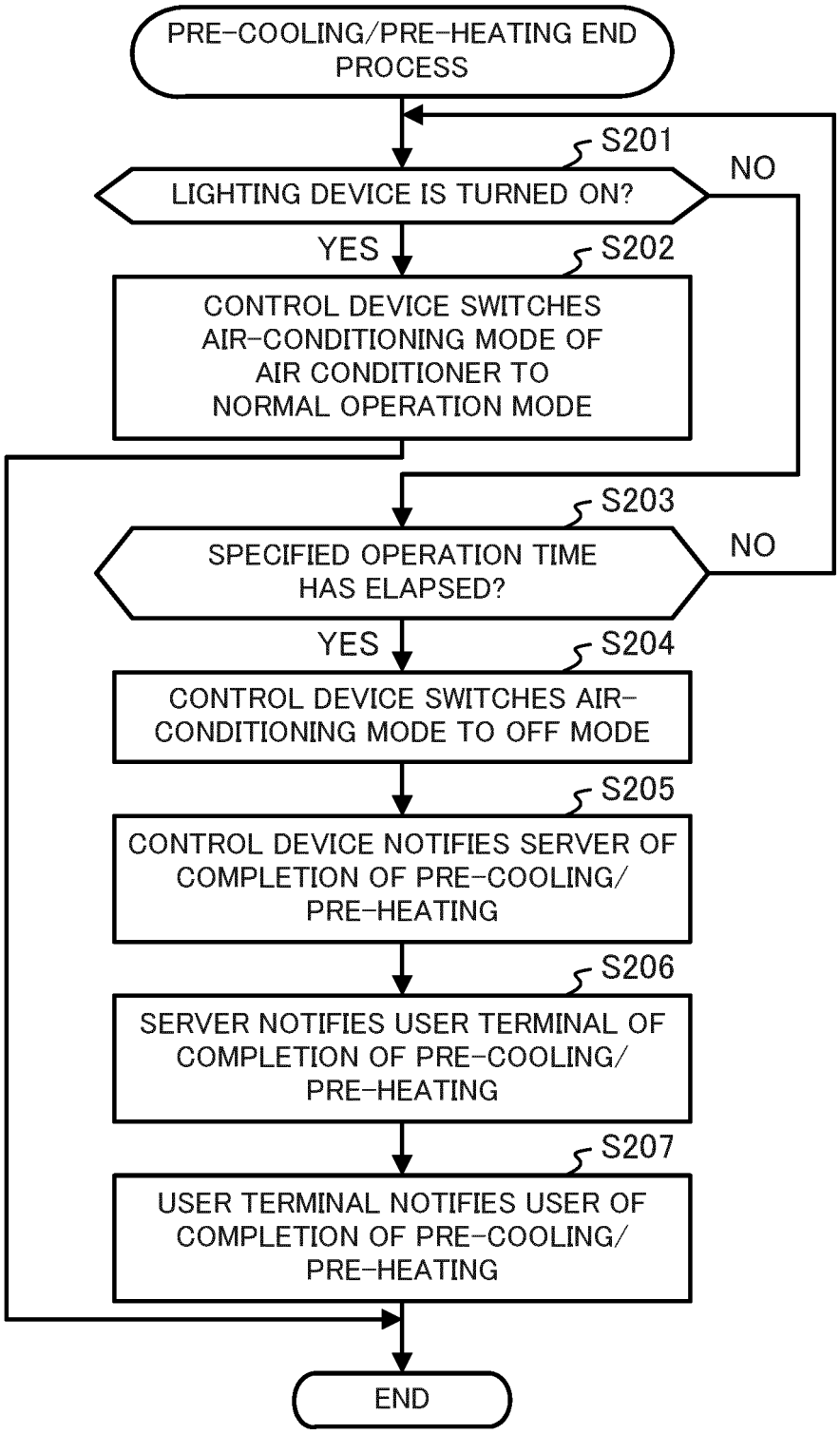

PRE-COOLING/PRE-HEATING END PROCESS
S201
LIGHTING DEVICE IS TURNED ON?
NO
YES
S202
CONTROL DEVICE SWITCHES AIR-CONDITIONING MODE OF AIR CONDITIONER TO NORMAL OPERATION MODE
S203
SPECIFIED OPERATION TIME HAS ELAPSED?
NO
YES
S204
CONTROL DEVICE SWITCHES AIR-CONDITIONING MODE TO OFF MODE
S205
CONTROL DEVICE NOTIFIES SERVER OF COMPLETION OF PRE-COOLING/ PRE-HEATING
S206
SERVER NOTIFIES USER TERMINAL OF COMPLETION OF PRE-COOLING/ PRE-HEATING
S207
USER TERMINAL NOTIFIES USER OF COMPLETION OF PRE-COOLING/ PRE-HEATING
END

FIG.16

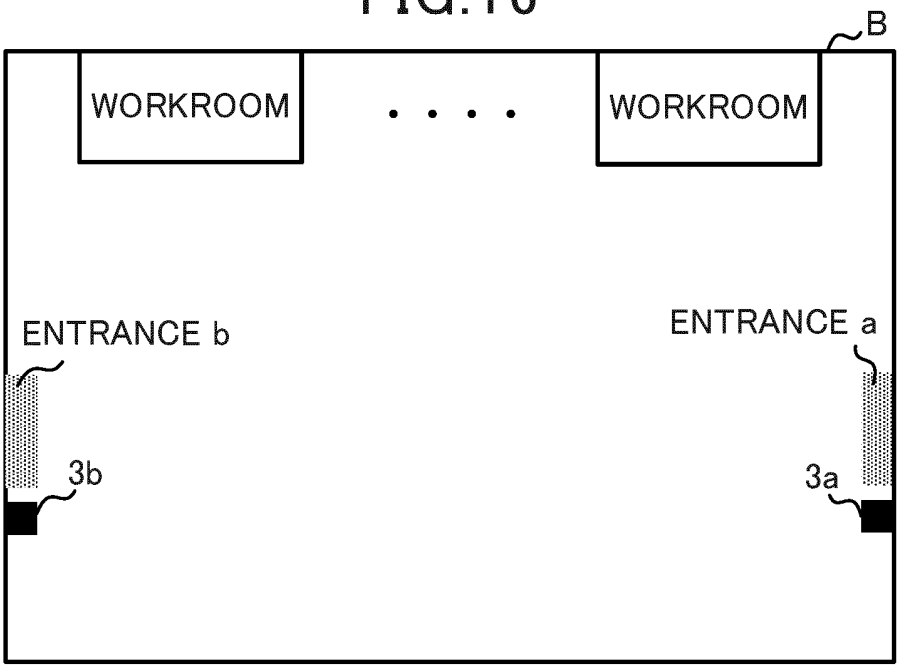
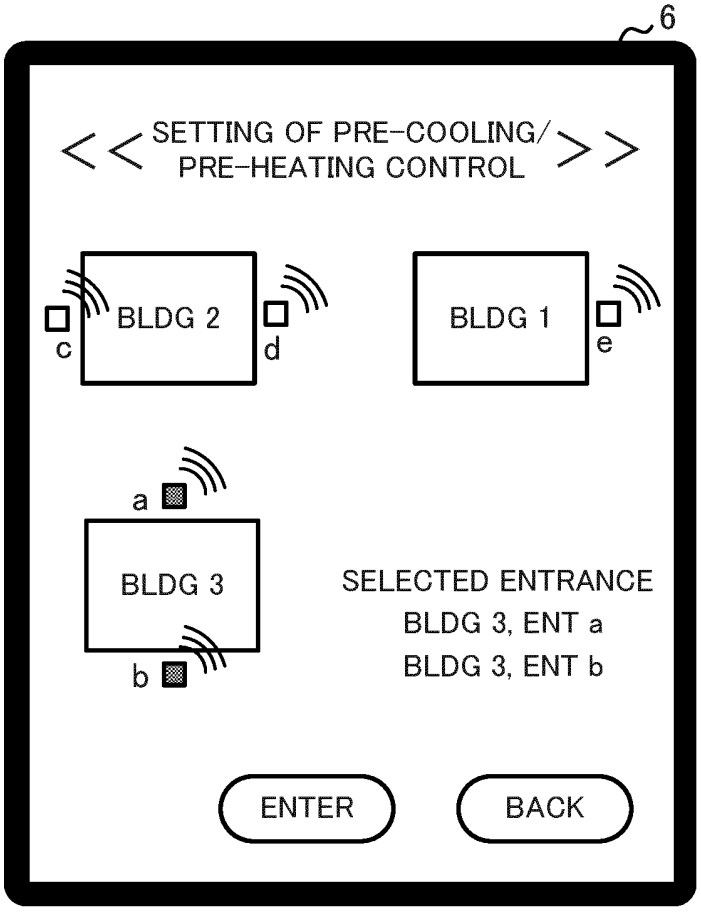

B
WORKROOM
. . . .
WORKROOM
ENTRANCE b
ENTRANCE a
3b
3a

FIG.17


6
<< SETTING OF PRE-COOLING/
PRE-HEATING CONTROL >>
BLDG 2
c
d
BLDG 1
e
a
BLDG 3
b
SELECTED ENTRANCE
BLDG 3, ENT a
BLDG 3, ENT b
ENTER
BACK

INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP2021/003500

A. CLASSIFICATION OF SUBJECT MATTER
F24F 11/48(2018.01)i; F24F 120/12(2018.01)n
FI: F24F11/48; F24F120:12

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
F24F11/48; F24F120/12

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Published examined utility model applications of Japan	1922-1996
Published unexamined utility model applications of Japan	1971-2021
Registered utility model specifications of Japan	1996-2021
Published registered utility model applications of Japan	1994-2021

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y A	WO 2017/208398 A1 (MITSUBISHI ELECTRIC CORP.) 07 December 2017 (2017-12-07) paragraphs [0010]-[0050], fig. 1-11	1-2, 5-10 3-4
Y	JP 2019-211320 A (RHYTHM WATCH CO., LTD.) 12 December 2019 (2019-12-12) paragraphs [0004]-[0061], fig. 1-5	1-2, 5-10
Y	WO 2015/159361 A1 (MITSUBISHI ELECTRIC CORP.) 22 October 2015 (2015-10-22) paragraphs [0014]-[0027], fig. 5	5-7
A	JP 2012-109680 A (SHIMIZU CORP.) 07 June 2012 (2012-06-07) entire text, all drawings	1-10
A	WO 2016/143830 A1 (DAIKIN INDUSTRIES, LTD.) 15 September 2016 (2016-09-15) entire text, all drawings	1-10

☐ Further documents are listed in the continuation of Box C.

☒ See patent family annex.

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"O" document referring to an oral disclosure, use, exhibition or other means
"P" document published prior to the international filing date but later than the priority date claimed
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"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
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"&" document member of the same patent family

Date of the actual completion of the international search 08 April 2021 (08.04.2021)	Date of mailing of the international search report 20 April 2021 (20.04.2021)
Name and mailing address of the ISA/ Japan Patent Office 3-4-3, Kasumigaseki, Chiyoda-ku, Tokyo 100-8915, Japan	Authorized officer Telephone No.

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INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.
PCT/JP2021/003500

Patent Documents referred in the Report	Publication Date	Patent Family	Publication Date
WO 2017/208398 A1	07 Dec. 2017	(Family: none)	
JP 2019-211320 A	12 Dec. 2019	(Family: none)	
WO 2015/159361 A1	22 Oct. 2015	(Family: none)	
JP 2012-109680 A	07 Jun. 2012	(Family: none)	
WO 2016/143830 A1	15 Sep. 2016	US 2018/0045474 A1 entire text, all drawings EP 3270072 A1 CN 107429932 A	

Form PCT/ISA/210 (patent family annex) (January 2015)

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Patent documents cited in the description

- JP 2004101048 A **[0003]**