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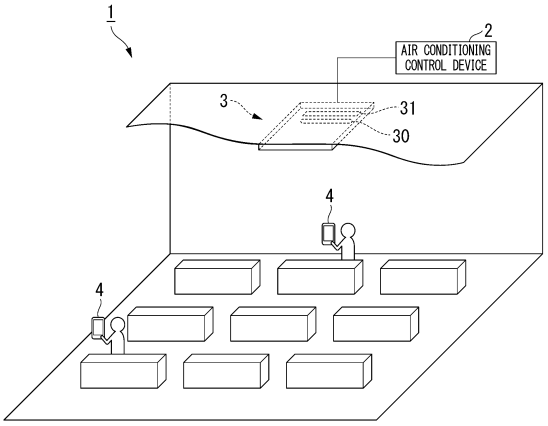
(54) AIR CONDITIONING CONTROL DEVICE, AIR CONDITIONING SYSTEM, AIR CONDITIONING CONTROL METHOD, AND PROGRAM

(57) An air conditioning control device (2) controls an indoor unit (3) for air conditioning in accordance with a requested environment setting requested by a user and a user position at which the user is located. The air conditioning control device (2) includes: a position acquisition unit (201) configured to acquire the user position; a personal information acquisition unit (202) configured to acquire personal information of the user; a recommended environment providing unit (203) configured to provide a recommended environment setting recommended for the user according to the personal information; a requested environment acquisition unit (204) configured to acquire the requested environment setting of the user; and an indoor unit control unit (206) configured to control the indoor unit (3) according to the user position and the requested environment setting.

FIG. 1



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Description

[Technical Field]

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

[0002] Priority is claimed on Japanese Patent Application No. 2017-143483, filed July 25, 2017, the content of which is incorporated herein by reference.

[Background Art]

[0003] Air conditioning systems of the related art have functions of specifying positions of a plurality of users operating terminal devices (remote controllers or the like) of the air conditioning systems in spaces in which the users are located and performing control such that air conditioning requests of the users are satisfied as much as possible (for example, see Patent Document 1).

[Citation List]

[Patent Literature]

[0004] [Patent Document 1]
Japanese Patent No. 4737037

[Summary of Invention]

[Technical Problem]

[0005] In the technologies of the related start, users have to operate the terminal devices to perform environment settings for satisfying individual air conditioning requests. Therefore, functions of estimating the air conditioning requests in accordance with characteristics (for example, sex, age, and the like) of the users and proposing environment settings recommended for each user in the air conditioning systems have been required.

[0006] The present invention was devised in view of the foregoing problems and provides an air conditioning control device, an air conditioning system, an air conditioning control method, and a program capable of proposing an environment setting recommended in accordance with characteristics of users.

[Solution to Problem]

[0007] To solve the foregoing problems, the present invention adopts the following means.

[0008] According to a first aspect of the present invention, an air conditioning control device controlling an indoor unit for air conditioning in accordance with a requested environment setting requested by a user and a user position at which the user is located includes: a position acquisition unit configured to acquire the user position; a personal information acquisition unit configured to acquire personal information of the user; a recommended environment providing unit configured to provide a recommended environment setting recommended for the user according to the personal information; a requested environment acquisition unit configured to acquire the requested environment setting of the user; and an indoor unit control unit configured to control the indoor unit for air conditioning according to the user position and the requested environment setting.

[0009] In this way, the air conditioning control device can save the user the time and effort of performing the environment setting and can estimate an appropriate air conditioning request in accordance with personal information of the user to provide the air conditioning request as the recommended environment setting.

[0010] According to a second aspect of the present invention, the air conditioning control device according to the above-described first aspect may further include a learning unit configured to learn the recommended environment setting for an individual user according to the personal information and the requested environment setting.

[0011] In this way, the learning unit can learn a relation between the personal information of the user and the requested environment setting actually set by the user. Thus, the air conditioning control device can improve precision of the recommended environment setting supplied to the user.

[0012] According to a third aspect of the present invention, in the air conditioning control device according to the above-described first or second aspect, the position acquisition unit may acquire the user position from an environment setting terminal receiving an operation of the user.

[0013] In this way, since the process in the air conditioning control device of estimating the position of each of a plurality of users can be omitted, it is possible to reduce a load of the air conditioning control device.

[0014] According to a fourth aspect of the present invention, in the air conditioning control device according to the above-described first or second aspect, the requested environment acquisition unit may acquire the requested environment setting from the environment setting terminal receiving an operation of the user.

[0015] In this way, the requested environment acquisition unit can correctly recognize an environment setting desired by the user and control the indoor unit for air conditioning when the user desires an environment setting different from the recommended environment setting.

[0016] According to a fifth aspect of the present invention, in the air conditioning control device according to any one of the above-described first to third aspects, the requested environment acquisition unit may acquire the recommended environment setting supplied by the recommended environment providing unit as the requested environment setting.

[0017] In this way, the air conditioning control device can control the indoor unit for air conditioning according to the recommended environment setting recommended for each of the users. Thus, the air conditioning control device can save the user the time and effort of performing the environment setting.

[0018] According to a sixth aspect of the present invention, in the air conditioning control device according to the above-described fifth aspect, the requested environment acquisition unit may acquire the recommended environment setting as the requested environment setting when the user adopts the recommended environment setting.

[0019] In this way, the air conditioning control device can acquire the requested environment setting for controlling the indoor unit for air conditioning according to whether the user adopts the recommended environment setting. Thus, when the user does not like the recommended environment setting, the indoor unit for air conditioning can be controlled according to the requested environment setting received from the user. Therefore, it is possible to provide air conditioning more appropriate for the request from the user.

[0020] According to a seventh aspect of the present invention, an air conditioning system includes an indoor unit for air conditioning and the air conditioning control device according to any one of the above-described first to sixth aspects,

[0021] According to an eight aspect of the present invention, there is provided an air conditioning control method of controlling an indoor unit for air conditioning in accordance with a requested environment setting requested by a user and a user position at which the user is located. The air conditioning control method includes: a position acquisition step of acquiring the user position; a personal information acquisition step of acquiring personal information of the user; a recommended environment providing step of providing a recommended environment setting recommended for the user according to the personal information; a requested environment acquisition step of acquiring the requested environment setting of the user; and an indoor unit control step of controlling the indoor unit for air conditioning according to the user position and the requested environment setting.

[0022] According to a ninth aspect of the present invention, there is provided a program causing a computer to function as an air conditioning control device controlling an indoor unit for air conditioning in accordance with a requested environment setting requested by a user and a user position at which the user is located. The program causes a computer to perform: a position acquisition step of acquiring the user position; a personal information acquisition step of acquiring personal information of the user; a recommended environment providing step of providing a recommended environment setting recommended for the user according to the personal information; a requested environment acquisition step of acquiring the requested environment setting of the user; and an indoor unit control step of controlling the indoor unit for air conditioning according to the user position and the requested environment setting.

[Advantageous Effects of Invention]

[0023] The air conditioning control device, the air conditioning system, the air conditioning control method, and the program according to the above-described aspects can propose an environment setting recommended in accordance with characteristics of users.

[Brief Description of Drawings]

[0024]

Fig. 1 is a diagram showing an example of an overall configuration of an air conditioning system according to a first embodiment.

Fig. 2 is a diagram showing an example of a functional configuration of the air conditioning system according to the first embodiment.

Fig. 3 is a sequence diagram showing an example of a check-in process of the air conditioning system according to the first embodiment.

Fig. 4 is a diagram showing an example of check-in information according to the first embodiment.

Fig. 5 is a diagram showing an example of user registration information according to the first embodiment.
Fig. 6 is a sequence diagram showing an example of an air conditioning control process of the air conditioning system according to the first embodiment.
Fig. 7 is a diagram showing an example of transmission information according to the first embodiment.
Fig. 8 is a diagram showing an example of information on individual users according to the first embodiment.
Fig. 9 is a diagram showing an example of requested environment history information according to the first embodiment.
Fig. 10 is a flowchart showing an example of an air conditioning control process of an air conditioning control device according to the first embodiment.
Fig. 11 is a sequence diagram showing an example of an action quantity information collecting process of the air conditioning system according to the first embodiment.
Fig. 12 is a diagram showing an example of action quantity information according to the first embodiment.
Fig. 13 is a diagram showing an example of action history information according to the first embodiment.
Fig. 14 is a flowchart showing an example of a learning process of the air conditioning control device according to the first embodiment.
Fig. 15 is a diagram showing an example of a recommended environment model according to the first embodiment.
Fig. 16 is a first sequence diagram showing an example of an air conditioning proposing process of the air conditioning system according to the first embodiment.
Fig. 17 is a second sequence diagram showing an example of an air conditioning proposing process of the air conditioning system according to the first embodiment.
Fig. 18 is a diagram showing a function of a recommended environment providing unit according to a first modification example.
Fig. 19 is a diagram showing a function of a recommended environment providing unit according to a second modification example.
Fig. 20 is a first diagram showing a function of a recommended environment providing unit according to a third modification example.
Fig. 21 is a second diagram showing the function of the recommended environment providing unit according to the third modification example.
Fig. 22 is a diagram showing an example of a functional configuration of an air conditioning system according to a second embodiment.
Fig. 23 is a sequence diagram showing an example of a check-in process of the air conditioning system according to the second embodiment.

[Description of Embodiments]

<First embodiment>

[0025] Hereinafter, an air conditioning system 1 according to a first embodiment of the present invention will be described with reference to Figs. 1 to 17.

(Overall configuration)

[0026] Fig. 1 is a diagram showing an example of an overall configuration of the air conditioning system according to the first embodiment.

[0027] As shown in Fig. 1, the air conditioning system 1 according to the embodiment is assumed to be used in, for example, an environment in which a plurality of users are in a large space such as an office, a warehouse, or a factory.

[0028] In another embodiment, the present invention is not limited to the above-described environment. For example, the air conditioning system may be used in a space smaller than an office such as a home living room.

[0029] The air conditioning system 1 includes an air conditioning control device 2, an indoor unit 3 for air conditioning, and smartphones (environment setting terminals) 4.

[0030] The air conditioning control device 2 performs control of the indoor unit 3 in accordance with a requested environment setting requested by the users and user positions at which the users are located.

[0031] The requested environment setting is information (a setting value) indicating an environment (temperature, humidity, air volume, and the like) in a space requested by the users. The air conditioning control device 2 receives another requested environment setting from each of the plurality of users in the space and controls the indoor unit 3 such that the requested environment setting can be satisfied as much as possible.

[0032] The indoor unit 3 is installed on the ceiling of the space in which the users are located and performs various operations of adjusting the environment in the space in accordance with control signals of the air conditioning control

device 2.

[0033] For example, as shown in Fig. 1, the indoor unit 3 includes a fan 30 capable of adjusting air volume and a louver 31 capable of adjusting an air direction. Fig. 1 shows an example in which the indoor unit 3 includes one fan 30 and one louver 31, but the present invention is not limited thereto. In another embodiment, the indoor unit 3 may include a plurality of fans 30 and a plurality of louvers 31.

[0034] Fig. 1 shows an example in which the air conditioning system 1 includes one indoor unit 3, but the present invention is not limited thereto. In another embodiment, the air conditioning system 1 may include a plurality of indoor units 3.

[0035] The smartphones 4 are carried by each of the plurality of users and function as environment setting terminals (remote controllers of the air conditioner) that transmit requests of each user to the air conditioning control device 2.

[0036] The smartphones 4 operate in accordance with a dedicated program (application) to transmit information with which certain user positions of the users can be specified (localization information) and air conditioning requests received from the users (requested environment settings) to the air conditioning control device 2.

[0037] In the embodiment, an aspect in which the smartphones 4 are portable terminals such as smartphones or tablets will be described as an example, but the present invention is not limited thereto. In another embodiment, the smartphones 4 may be a dedicated remote controller.

(Functional configuration of air conditioning control device)

[0038] Fig. 2 is a diagram showing an example of a functional configuration of the air conditioning system according to the first embodiment.

[0039] Hereinafter, a functional configuration of the air conditioning control device 2 according to the embodiment will be described with reference to Fig. 2.

[0040] As shown in Fig. 2, the air conditioning control device 2 includes a CPU 20, a communication interface (I/F) 21, a sensor 22, and a storage unit 23.

[0041] The communication I/F 21 transmits and receives various kinds of information and control signals to and from the indoor unit 3 through wireless communication or wired communication. The communication I/F 21 transmits and receives various kinds of information to and from the smartphones 4 which are within a predetermined communication area using a wireless communication technology such as Bluetooth (registered trademark) or Wi-Fi. The predetermined communication area is, for example, a space in which the air conditioning system 1 is installed.

[0042] The sensor 22 detects a temperature (air temperature), humidity, and the like of the space in which the air conditioning system 1 is installed.

[0043] The CPU 20 is a processor (microcomputer) that controls the entire air conditioning control device 2.

[0044] The CPU 20 operates in accordance with a prepared program and functions as a position estimation unit 200, a position acquisition unit 201, a personal information acquisition unit 202, a recommended environment providing unit 203, a requested environment acquisition unit 204, a learning unit 205, and an indoor unit control unit 206.

[0045] The position estimation unit 200 estimates a position of a user based on localization information acquired from a smartphone 4. The details of the localization information will be described below.

[0046] The position acquisition unit 201 acquires the user position.

[0047] In the embodiment, the position acquisition unit 201 acquires the user position estimated by the position estimation unit 200.

[0048] The personal information acquisition unit 202 acquires personal information of the user.

[0049] In the embodiment, the personal information includes information indicating characteristics (sex, age, occupation, height, weight, and the like) of the user and information indicating an action quantity of the user.

[0050] The action quantity is, for example, the number of steps of the user.

[0051] The recommended environment providing unit 203 performs an air conditioning proposal for the user by providing the recommended environment setting recommended for the individual user based on the personal information.

[0052] The recommended environment setting is information indicating an environment (temperature, humidity, air volume, and the like) in a space that the user is estimated to prefer. The recommended environment providing unit 203 supplies the personal information, the action quantity information, and the recommended environment setting of the individual user in accordance with a previously acquired requested environment setting or the like. A process in which the recommended environment providing unit 203 supplies the recommended environment setting will be described later.

[0053] The requested environment acquisition unit 204 acquires the requested environment settings of each of the plurality of users.

[0054] In the embodiment, the requested environment acquisition unit 204 may acquire the recommended environment setting supplied by the recommended environment providing unit 203 as a requested environment setting or may acquire a requested environment setting input by the user operating the smartphone 4.

[0055] The learning unit 205 learns a recommended environment setting for an individual user based on the requested

environment setting and the personal information of the user.
he air conditioning systemstructs a recommended environment model for estimating the estimating the recommended environment setting for the individual user by performing machine learning using the requested environment setting and the personal information of the user as supervised data. The recommended environment model constructed by the learning unit 205 is stored in the storage unit 23.

[0056] The indoor unit control unit 206 controls the indoor unit 3 (controls an operation amount of the fan 30 and an inclination angle or the like of the louver 31 of the indoor unit 3) based on the user position and the requested environment setting.

[0057] Information (the user position, the personal information, the recommended environment setting, the requested environment setting, the recommended environment model, and the like) acquired and generated at the time of processing of each functional unit of the CPU 20 is stored in the storage unit 23.

[0058] As shown in Fig. 2, the air conditioning control device 2 may be connected to the database (DB) 5 which is an external storage device through wired or wireless communication.

[0059] In the DB 5, the information (the user position, the personal information, the recommended environment setting, the requested environment setting, the recommended environment model, and the like) acquired and generated at the time of processing of each functional unit of the CPU 20 of the air conditioning control device 2 may be stored and shared by another air conditioning system.

(Functional configuration of smartphone)

[0060] Hereinafter, a functional configuration of the smartphone 4 according to the embodiment will be described with reference to Fig. 2.

[0061] As shown in Fig. 2, the smartphone 4 includes a CPU 40, an operation unit 41, a display unit 42, a camera 43, a communication interface (I/F) 44, and a storage unit 45.

[0062] The operation unit 41 is, for example, an input device such as a touch panel and receives an operation from the user carrying the smartphone 4.

[0063] The display unit 42 is, for example, a display device such as a liquid crystal display or an organic EL display and presents various kinds of information (a set value of a currently set temperature or the like, an entry form of a requested environment setting, or the like) regarding an operation of the air conditioning control device 2 to the user.

[0064] The camera 43 captures an image including an object in the space based on an operation performed by the user and outputs the captured image to the CPU 40.

[0065] For example, in the embodiment, a 2-dimensional code such as a QR code (registered trademark) is installed in advance at a predetermined position (for example, a seat or the like used by each of the users) in the space. The camera 43 captures an image including the 2-dimensional code based on an operation performed by the user and outputs the captured image to the CPU 40.

[0066] In the 2-dimensional code, localization information for localizing an installation position of the 2-dimensional code (for example, the position of a seat of each of the users) is recorded in advance. The localization information is, for example, an area ID assigned to each 2-dimensional code.

[0067] In the 2-dimensional code, a URL for accessing an entry form of the requested environment setting may be further recorded.

[0068] The communication I/F 44 transmits and receives various kinds of information to and from the air conditioning control device 2 through wireless communication.

[0069] The CPU 40 is a processor (microcomputer) that controls the entire smartphone 4.

[0070] The CPU 40 operates in accordance with a program prepared in advance and functions as a user registration unit 400, a requested environment setting reception unit 401, and an action quantity measurement unit 402.

[0071] The user registration unit 400 performs a check-in process of registering information indicating characteristics of the user (characteristic information) in the personal information of the user using the air conditioning system 1.

[0072] The check-in process is a process of registering characteristic information (sex, age, occupation, height, weight, and the like) and localization information (area ID) with which a user position can be localized in the air conditioning control device 2 so that the user can obtain a desired environment (temperature, humidity, air volume, and the like) in the space in which the air conditioning system 1 is installed.

[0073] The requested environment setting reception unit 401 receives an air conditioning request (a requested environment setting) input by the user through the operation unit 41 and transmits the air conditioning request to the air conditioning control device 2 via the communication I/F 44.

[0074] The action quantity measurement unit 402 transmits action quantity information (see Fig. 12) obtained by measuring an action quantity of the user per unit time (for example, 1 hour) to the air conditioning control device 2 via the communication I/F 44.

[0075] The action quantity measurement unit 402 functions as, for example, a pedometer that measures (counts) the

number of steps of the user per unit time as an action quantity. In another embodiment, the action quantity measurement unit 402 may measure a movement distance (km), an energy consumption amount (kcal), an action quantity level (levels 0 to 10) in accordance with the number of steps, and the like of the user per unit time.

[0076] The images captured by the camera 43 and various kinds of data (the characteristic information, the requested environment setting, the action quantity information, and the like) acquired and generated at the time of processing of each functional unit of the CPU 40 are stored in the storage unit 45.

(Check-in process in air conditioning system)

[0077] Fig. 3 is a sequence diagram showing an example of a check-in process of the air conditioning system according to the first embodiment.

[0078] Fig. 4 is a diagram showing an example of check-in information according to the first embodiment.

[0079] Fig. 5 is a diagram showing an example of user registration information according to the first embodiment.

[0080] Hereinafter, an example of a check-in process S10A in the air conditioning system 1 will be described with reference to Figs. 3 to 5.

[0081] In the embodiment, when the air conditioning system 1 is used for the first time, the user performs the check-in process S 10A of registering check-in information (see Fig. 4) including the localization information and the characteristic information of the user in the air conditioning control device 2 through the smartphone 4. A specific flow of the check-in process S10A is as follows.

[0082] As shown in Fig. 3, the user registration unit 400 of the smartphone 4 acquires the localization information with which a position of the user can be localized (step S100).

[0083] For example, in the embodiment, a 2-dimensional code is installed in advance in a predetermined position (for example, a seat or the like used by each of the users) in the space and the user operates the camera 43 of the smartphone 4 to capture an image including the 2-dimensional code. Then, the user registration unit 400 reads and acquires the localization information (the area ID) recorded in advance in the 2-dimensional code by performing known image processing on the captured image.

[0084] Subsequently, the user registration unit 400 of the smartphone 4 acquires the characteristic information of the user (step S101).

[0085] When a URL for accessing an entry form of the personal information is included in the 2-dimensional code, the user registration unit 400 displays the entry form on the display unit 42 based on the URL read from the 2-dimensional code. Then, the user registration unit 400 acquires the characteristic information input to the entry form via the operation unit 41 by the user.

[0086] The characteristic information of the user includes, for example, information such as a sex ("01 (male)"), an age ("30"), an occupation ("03"), a height ("170 cm"), and a weight ("75 kg") of the user, as shown in Fig. 4. The characteristic information of the user may be stored in advance in the storage unit 45. In this case, the user registration unit 400 reads and acquires the characteristic information from the storage unit 45. Thus, it is possible to save the user the time and effort of inputting the characteristic information with each check-in process.

[0087] Subsequently, the user registration unit 400 generates check-in information and transmits the check-in information to the air conditioning control device 2 (step S102).

[0088] As shown in Fig. 4, the check-in information includes the user ID ("0001") with which the user carrying the smartphone 4 can be identified, the localization information ("area ID: A01") acquired in step S100, and the characteristic information ("sex : 01," "age: 30," "occupation: 03," "height: 170 cm," "weight: 75 kg," and the like) acquired in step S101.

[0089] As the user ID, a unique user ID according to the smartphone 4 may be set in advance or a different user ID may be automatically assigned when communication between the smartphone 4 and the air conditioning control device 2 is started.

[0090] Subsequently, the position estimation unit 200 of the air conditioning control device 2 estimates a user position based on the localization information included in the check-in information received from the smartphone 4 (step S110).

[0091] For example, in the embodiment, a 2-dimensional code management table in which an area ID issued in advance to each 2-dimensional code and coordinate information indicating an installation position of each 2-dimensional code are associated is stored in advance in the storage unit 23 of the air conditioning control device 2. The position estimation unit 200 estimates coordinate information ("X1, Y1") corresponding to localization information ("area ID: A01") as the user position with reference to the 2-dimensional code management table.

[0092] Subsequently, the position acquisition unit 201 of the air conditioning control device 2 acquires the user position estimated in step S110 (step Sill).

[0093] Subsequently, the personal information acquisition unit 202 of the air conditioning control device 2 acquires the characteristic information (sex, age, occupation, height, weight, and the like) included in the check-in information (step S112).

[0094] Subsequently, the personal information acquisition unit 202 adds information in which the user ID included in

the check-in information, the user position acquired in step S111, and the characteristic information acquired in step S112 are associated as user registration information (see Fig. 5) and stores (registers) the information in the storage unit 23 (step S113).

[0095] As shown in Fig. 5, the user registration information is a table in which information in which the user ID ("0001") included in the check-in information, the user position ("X1, Y1"), and the characteristic information ("sex : 01," "age: 30," "occupation: 03," "height: 170 cm," "weight: 75 kg," and the like) are associated is stored for the individual user. The user registration information is an example of personal information in the embodiment.

[0096] In the embodiment, when the user uses the air conditioning system 1 installed in different places (different rooms or buildings), the above-described check-in process S10A is assumed to be performed at each place.

[0097] Even when the air conditioning system 1 which is the same as the air conditioning system 1 previously used by the user is used and the characteristic information has changed (the age, the occupation, the height, the weight, or the like has changed) or the position (seat) of the user has changed, the characteristic information and the user position registered in the user registration information may be updated by performing the above-described check-in process S10A again.

(Air conditioning control process in air conditioning system)

[0098] Fig. 6 is a sequence diagram showing an example of an air conditioning control process of the air conditioning system according to the first embodiment.

[0099] Fig. 7 is a diagram showing an example of transmission information according to the first embodiment.

[0100] Fig. 8 is a diagram showing an example of information on individual users according to the first embodiment.

[0101] Fig. 9 is a diagram showing an example of requested environment history information according to the first embodiment.

[0102] Fig. 10 is a flowchart showing an example of an air conditioning control process of an air conditioning control device according to the first embodiment.

[0103] When the above-described check-in process S10A (see Fig. 3) is completed, the user can operate the smartphone 4 to transmit an air conditioning request (requested environment setting) to the air conditioning control device 2.

[0104] Hereinafter, a flow of a process S20 in which the air conditioning system 1 receives the requested environment setting from the user and a process S25 in which the indoor unit 3 is controlled will be described with reference to Figs. 6 to 10.

[0105] As shown in Fig. 6, the requested environment setting reception unit 401 of the smartphone 4 receives the requested environment setting (set temperature, set humidity, set air volume, or the like) input by the user via the operation unit 41 (step S200).

[0106] Subsequently, the requested environment setting reception unit 401 transmits transmission information (see Fig. 7) including the user ID and the requested environment setting to the air conditioning control device 2 via the communication I/F 44 (step S201).

[0107] As shown in Fig. 7, the transmission information is information in which a user ID ("0001") with which the user carrying the smartphone 4 can be identified, the requested environment setting ("set temperature: 25 °C," "set humidity: 50%," "set air volume: large," and the like) acquired in step S200, and the like are associated.

[0108] For the user ID, the same value as the user ID included in the check-in information (see Fig. 4) is used.

[0109] Subsequently, the requested environment acquisition unit 204 of the air conditioning control device 2 acquires the user ID and the requested environment setting from the transmission information received via the communication I/F 21 from the smartphone 4 (step S210).

[0110] Subsequently, the requested environment acquisition unit 204 associates the user ID with the requested environment setting included in the transmission information and adds and stores the user ID and the requested environment setting as information on the individual user (see Fig. 8) in the storage unit 23 (step S211).

[0111] As shown in Fig. 8, the information on individual users is a table in which information in which the user ID ("0001") included in the transmission information and the requested environment setting ("set temperature: 25 °C," "set humidity: 50%," "set air volume: large," and the like) are associated is stored for each user.

[0112] The requested environment acquisition unit 204 adds the acquired requested environment setting to requested environment history information (see Fig. 9) accumulated in the storage unit 23 to store the requested environment setting (step S212).

[0113] As shown in Fig. 9, the requested environment history information is log data in which information in which the requested environment setting (set temperature, set humidity, a set air volume, and the like) and an acquisition date and time are associated is accumulated on individual users.

[0114] Subsequently, when the requested environment setting is received from at least one user, the air conditioning control device 2 performs a process S25 of controlling the indoor unit 3 such that a request from the user is satisfied as much as possible based on the requested environment setting of each of the users included in the information on

individual users (see Fig. 8) and the user position of each of the users included in the user registration information (see Fig. 5).

[0115] Specifically, the indoor unit control unit 206 of the air conditioning control device 2 performs the control process S25 shown in Fig. 10 as follows.

[0116] As shown in Fig. 10, the indoor unit control unit 206 of the air conditioning control device 2 identifies control parameters (a1, a2, a3, a4, and the like) for minimizing an objective function J (step S250). Here, the control parameters are direct instruction values for setting the indoor unit 3 to a desired state and are, for example, the number of rotations of the fan 30, an inclination angle of the louver 31, and the like.

[0117] The objective function J is regulated as in Formula (1), for example.

[0118] [Formula 1]

$$\left.\begin{aligned} \boldsymbol{x}(i) &= \left(x(i)_1, x(i)_2, \ldots, x(i)_M\right) = F(a1, a2, a3, a4, \ldots) \\ \boldsymbol{x}^*(i) &= \left(x^*(i)_1, x^*(i)_2, \ldots, x^*(i)_M\right) \\ J &= \sum_{i=1}^{N}\left[w_p(i)\sum_{k=1}^{M} w_d(i,k)\frac{\left|x(i)_k - x^*(i)_k\right|}{x^*(i)_k}\right] \end{aligned}\right\} \cdots (1)$$

[0119] A vector x(i) in Formula (1) is a vector quantity indicating an actual temperature, humidity, air volume, or the like at a position at which a user i (where i=1, 2, .., N) is located. The vector x(i) includes M elements ($x(i)_1$, $x(i)_2$, .., $x(i)_M$) and each element ($x(i)_1$, $x(i)_2$, .., $x(i)_M$) indicates a value (scalar quantity) such as an actual temperature, humidity, or air volume at the position at which the user i is located. As indicated in Formula (1), the vector x(i) is determined uniquely by a function F in which the control parameters (a1, a2, a3, a4, and the like) of the indoor unit 3 are input variables.

[0120] A vector x*(i) is a vector quantity indicating a temperature, humidity, air volume, or the like desired by the user i. The vector x*(i) includes M elements ($x^*(i)_1$, $x^*(i)_2$, .., $x^*(i)_M$) and each element ($x^*(i)_1$, $x^*(i)_2$, .., $x^*(i)_M$) indicates a temperature, humidity, or air volume at the position desired by the user i. More specifically, each element ($x^*(i)_1$, $x^*(i)_2$, .., $x^*(i)_M$) is the set temperature, set humidity, set air volume, and the like shown in the information on individual users (see Fig. 8).

[0121] As indicated by Formula (1), the objective function J obtains an error rate ($(x(i)_k-x^*(i)_k)/x^*(i)_k$) for each k-th element (where k=1, .., M) of the vector x(i) and sums up all the elements. The objective function J is derived by further adding a total sum of the error rates obtained for each user i for all the users.

[0122] "M" is the number of elements included in the vector x(i) and the vector x*(i) and is a total number of physical quantities such as temperature, humidity, and air volume which are targets to be set by the users.

[0123] "N" is the number of users who are in a space in which the indoor unit 3 is installed and is more specifically the number of smartphones 4 (the number of kinds of user IDs) detected through ultrasonic waves.

[0124] "Wd(i, k)" is a weighting coefficient separately regulated by element and is considered to always be "1" (equal value) in a general operation. However, for example, each user may set "Wd(i, k)" for each element (temperature, humidity, air volume, and the like) to reflect a preference indicating which physical quantity is weighted. In accordance with the weighting coefficient Wd(i, k), for example, it is possible to respond to a detailed request from the same person such as "A request for 'air volume' may be specially realized when a person has just returned from the hot outdoors" or "It is better to preferentially set 'humidity' to a value of preference in a rainy season."

[0125] "Wp(i)" is a weighting coefficient separately regulated on individual users and is considered to always be "1" (equal value) in a general operation. However, for example, when an operation in which a request from an elderly user or a user who is an executive is weighted is performed, the weighting coefficient for each user i may be changed.

[0126] A method of identifying a minimum value of the objective function J may be based on a well-known search algorithm. The function F may be based on, for example, a physical simulation of a temperature distribution, a humidity distribution, and an air volume distribution in a space based on an air flow or emission.

[0127] When control parameters for minimizing the objective function J are identified, the indoor unit control unit 206 transmits the identified control parameters as instruction values to the indoor unit 3 for control (step S251).

[0128] In this way, the air conditioning control device 2 repeatedly performs the above-described control process S25 whenever the transmission information is received from the smartphone 4.

(Process of collecting activity quantity information in air conditioning system)

[0129] Fig. 11 is a sequence diagram showing an example of an action quantity information collecting process of the air conditioning system according to the first embodiment.

[0130] Fig. 12 is a diagram showing an example of action quantity information according to the first embodiment.

[0131] Fig. 13 is a diagram showing an example of action history information according to the first embodiment.

[0132] Hereinafter, a flow of a process S30 of collecting action quantity information of each user in the air conditioning system 1 will be described with reference to Figs. 11 to 13.

[0133] As shown in Fig. 11, the action quantity measurement unit 402 of the smartphone 4 measures an action quantity of the user and stores the action quantity in the storage unit 45 (step S300).

[0134] In the embodiment, the action quantity measurement unit 402 measures the number of steps of the user as the action quantity.

[0135] Subsequently, the action quantity measurement unit 402 determines whether a unit time (for example, 1 hour) has passed (step S301).

[0136] When the unit time has not passed (NO in step S301), the action quantity measurement unit 402 returns the process to step S300 and continues to measure the action quantity.

[0137] Conversely, when the unit time has passed (YES in step S301), the action quantity measurement unit 402 transmits action quantity information (see Fig. 12) including the action quantity stored in the storage unit 45 to the air conditioning control device 2 via the communication I/F 44 (step S302).

[0138] As shown in Fig. 12, the action quantity information is information in which the user ID ("0001"), a measurement period of the action quantity ("10:00 to 11:00, 01 May 2017"), and an action quantity ("number of steps: 850") are associated.

[0139] The action quantity measurement unit 402 repeatedly performs steps S300 to S302 described above and transmits the action quantity information of the user to the air conditioning control device 2 whenever the unit time passes.

[0140] When the communication between the smartphone 4 and the air conditioning control device 2 may not be performed due to a case in which the user is not located in the space in which the air conditioning system 1 is installed, the action quantity measurement unit 402 may skip the transmission of the action quantity information (step S302). In this case, when the communication between the smartphone 4 and the air conditioning control device 2 may not be performed, the action quantity measurement unit 402 may transmit the action quantity information of non-transmission.

[0141] The personal information acquisition unit 202 of the air conditioning control device 2 acquires the action quantity information transmitted from the smartphone 4 (step S310).

[0142] Then, the personal information acquisition unit 202 cumulates the action quantity information collected from the plurality of users and stores the action quantity information as action history information in the storage unit 23 (step S311).

[0143] As shown in Fig. 13, the action history information includes "action quantity on individual users" in which the action quantity information collected from the plurality of users is accumulated for each user.

[0144] The personal information acquisition unit 202 may generate statistical data indicating a trend of the action quantity ("action pattern") at each date and time (year, month, week, time, season, and the like) in accordance with the characteristics of the user (sex, age, occupation, height, weight, and the like) by statistically processing the plurality of pieces of action quantity information and include the statistical data in the action history information.

[0145] The action quantity information and the action history information are examples of the personal information in the embodiment.

[0146] In Fig. 11, the example in which the action quantity measurement unit 402 of the smartphone 4 transmits the action quantity information whenever the unit time passes has been described, but the present invention is not limited thereto. In another embodiment, the action quantity measurement unit 402 may transmit the action quantity information at each time set in advance (for example, every hour on the hour).

(Learning process in air conditioning control device)

[0147] Fig. 14 is a flowchart showing an example of a learning process of the air conditioning control device according to the first embodiment.

[0148] Fig. 15 is a diagram showing an example of a recommended environment model according to the first embodiment.

[0149] Hereinafter, a flow of a learning process S40 in the air conditioning control device 2 will be described with reference to Figs. 14 and 15.

[0150] 22 detects a temperature (air temperature), humidity, and the like of the space in which s the personal information on individual users and the requested environment history information (see Fig. 9) from the storage unit 23 and acquires the personal information on individual users and the requested environment history information as learning data (step

S400).

[0151] The personal information on individual users includes the characteristic information of the user registration information (see Fig. 5) and the action history information (see Fig. 13).

[0152] Subsequently, the learning unit 205 constructs a recommended environment model by performing machine learning using the learning data acquired in step S400 (step S401).

[0153] In the embodiment, as shown in Fig. 15, the learning unit 205 constructs the recommended environment model using a neural network method. Specifically, the learning unit 205 learns a relation among the characteristic information (sex, age, occupation, height, weight, and the like) of the user, the action quantity (the action history information), common information (a date and time, an installation environment of the air conditioning system 1, and the like), and the requested environment setting (the set temperature, the set humidity, the set air volume, and the like) received from the users. The common information is information that does not depend on the users and is, for example, a date and time (month, date, and time) and an installation environment of the air conditioning system 1. The installation environment of the air conditioning system 1 is information indicating an installation place (latitude, longitude, and altitude) of the air conditioning system 1, an area, a surrounding environment, and the like and is stored in advance in the storage unit 23.

[0154] Thus, the learning unit 205 constructs a recommended environment model in which the characteristic information of the user, the action history information, and the common information are input values and set values estimated to be liked by the users are output values (a recommended environment setting).

[0155] The learning unit 205 may construct the recommended environment model further using personal information and requested environment history information of another air conditioning system accumulated in the DB 5. In this way, even when the accumulated learning data in the air conditioning system 1 is insufficient, the amount of the learning data can be increased using data of the other air conditioning system. Thus, it is possible to improve the precision of the recommended environment model. The plurality of air conditioning systems may share the recommended environment model in the DB 5.

[0156] The learning unit 205 repeatedly performs the above-described learning process S40 at a predetermined timing. The predetermined timing may be any time (for example, 00:00 of each day) or may be a timing at which a given amount of learning data is accumulated.

[0157] (Air conditioning proposing process in air conditioning system)

[0158] Fig. 16 is a first sequence diagram showing an example of an air conditioning proposing process of the air conditioning system according to the first embodiment.

[0159] Hereinafter, a flow of an air conditioning proposing process S50A in the air conditioning system 1 will be described with reference to Fig. 16.

[0160] As shown in Fig. 16, the recommended environment providing unit 203 of the air conditioning control device 2 determines whether the users are detected in the space in which the air conditioning system 1 is installed (step S510).

[0161] For example, the communication I/F 21 of the air conditioning control device 2 automatically performs communication connection when there is the smartphone 4 that has a user ID registered in the user registration information in a predetermined communication area. Then, when there is the smartphone 4 of which communication is established, the recommended environment providing unit 203 determines that the user (the user ID) associated with the smartphone 4 is detected (YES in S510) and the process proceeds to step S511.

[0162] When the smartphone 4 with which communication can be made is not in the space, that is, the user is not detected (NO in step S510), the recommended environment providing unit 203 waits until the user is detected.

[0163] Subsequently, the recommended environment providing unit 203 acquires the characteristic information (sex, age, occupation, height, weight, and the like) of the user from the user registration information (see Fig. 5) of the storage unit 23 based on the user ID of the user detected in step S510 (step S511).

[0164] Subsequently, the recommended environment providing unit 203 acquires the action quantity of the user from the action history information (see Fig. 13) of the storage unit 23 based on the user ID of the user detected in step S510 (step S512).

[0165] At this time, the recommended environment providing unit 203 may acquire a current action quantity of the user by acquiring a latest action quantity from "action quantity on individual users" accumulated in the action history information. The recommended environment providing unit 203 may estimate an action quantity of the user from an action pattern (statistical data) corresponding to characteristics of the user and a current date and time with reference to "action pattern" accumulated in the action history information.

[0166] Subsequently, the recommended environment providing unit 203 acquires the common information (step S513).

[0167] Specifically, the recommended environment providing unit 203 acquires a current date and time (year, month, date, and time) and acquires the installation environment of the air conditioning system 1 stored in advance in the storage unit 23.

[0168] Subsequently, the recommended environment providing unit 203 performs an air conditioning proposal using the recommended environment model (see Fig. 15) (step S514).

[0169] Specifically, the recommended environment providing unit 203 inputs the characteristic information, the action

quantity, and the common information of the user acquired in steps S511 to S513 as input values to the recommended environment model. Then, the air conditioning proposal is performed for the user by transmitting the output values (the set temperature, the set humidity, the set air volume, and the like) from the recommended environment model as the recommended environment setting to the smartphone 4.

[0170] Thus, the recommended environment providing unit 203 can estimate set values (set temperature, set humidity, a set air volume, and the like) liked by the user from the characteristic information (sex, age, occupation, height, weight, and the like) and the action pattern (action quantity) of the user and provide the set values as the recommended environment setting to the user. For example, when the air conditioning system 1 is installed in a hospital, doctors, nurses, and the like walk in spaces, and thus action quantities are considerable. Patients remain at the same positions (chairs and beds), and thus action quantities are considered to be small. In this case, the recommended environment providing unit 203 can perform an air conditioning proposal estimated to be preferable in accordance with the personal information (an action quantity, an occupation, and the like) of the user by providing a recommended environment setting including "set air volume: large" to doctors and the like and providing a recommended environment setting including "set air volume: small" to patients.

[0171] The recommended environment providing unit 203 may perform an air conditioning proposal using the recommended environment model of another air conditioning system accumulated in the DB 5. For example, the recommended environment providing unit 203 may use a recommended environment model of another air conditioning system that has a similar installation environment.

[0172] In this way, when accumulated data in the air conditioning system 1 is insufficient and when the recommended environment model is not constructed or the precision of the recommended environment model is low, the recommended environment providing unit 203 can provide the recommended environment setting suitable for each user using the recommended environment model of another air conditioning system.

[0173] Subsequently, the requested environment setting reception unit 401 of the smartphone 4 acquires the recommended environment setting transmitted from the air conditioning control device 2 via the communication I/F 44 (step S501).

[0174] The requested environment setting reception unit 401 displays the acquired recommended environment setting on the display unit 42 to propose the recommended environment setting to the user and receives an input of the requested environment setting from the user (step S502).

[0175] When the user performs an operation of adopting the recommended environment setting via the operation unit 41, the requested environment setting reception unit 401 receives the recommended environment setting as a requested environment setting. When the user does not adopt the recommended environment setting, the requested environment setting reception unit 401 receives the requested environment setting (the set temperature, the set humidity, the set air volume, and the like) input via the operation unit 41 by the user.

[0176] Subsequently, the requested environment setting reception unit 401 transmits the transmission information (see Fig. 7) including the user ID and the requested environment setting to the air conditioning control device 2 via the communication I/F 44 (step S503).

[0177] Subsequently, the requested environment acquisition unit 204 of the air conditioning control device 2 acquires the user ID and the requested environment setting from the transmission information received via the communication I/F 21 from the smartphone 4 (step S515).

[0178] Subsequently, the requested environment acquisition unit 204 associates the user ID with the requested environment setting included in the transmission information to add and store the user ID and the requested environment setting as information on individual users (see Fig. 8) in the storage unit 23 (step S516).

[0179] The requested environment acquisition unit 204 adds the acquired requested environment setting to requested environment history information (see Fig. 9) accumulated in the storage unit 23 to store the requested environment setting (step S517).

[0180] The requested environment setting added to the requested environment history information is used as new learning data in the above-described learning process S40. Thus, as the requested environment history information increases, the precision of the recommended environment model constructed by the learning unit 205 is improved. Therefore, a moderate air conditioning proposal (providing of the recommended environment setting) optimized for each user in the recommended environment providing unit 203 can be performed.

[0181] The indoor unit control unit 206 of the air conditioning control device 2 performs the process S25 (see Fig. 10) of controlling the indoor unit 3 when the information on individual users is updated. Since this process is the same as that described above, description thereof will be omitted.

[0182] The air conditioning control device 2 performs the above-described air conditioning proposing process S50A every predetermined time (for example, 1 hour) and performs the air conditioning proposal to the user in the space. The air conditioning control device 2 may perform the above-described air conditioning proposing process S50A at a timing at which communication with the smartphone 4 is established.

[0183] Fig. 17 is a second sequence diagram showing an example of an air conditioning proposing process of the air

conditioning system according to the first embodiment.

[0184] In Fig. 16, the example in which the air conditioning proposal is performed (the recommended environment setting is supplied) when the air conditioning control device 2 detects the user has been described, but the present invention is not limited thereto.

[0185] As shown in Fig. 17, the air conditioning control device 2 may perform an air conditioning proposing process S50B when the requested environment setting is received from the user.

[0186] As shown in Fig. 17, the requested environment setting reception unit 401 of the smartphone 4 receives the requested environment setting (the set temperature, the set humidity, the set air volume, and the like) input via the operation unit 41 by the user (step S520).

[0187] Subsequently, the requested environment setting reception unit 401 transmits the transmission information (see Fig. 7) including the user ID and the requested environment setting to the air conditioning control device 2 via the communication I/F 44 (step S521).

[0188] When the transmission information is received from the smartphone 4, the recommended environment providing unit 203 of the air conditioning control device 2 acquires the characteristic information, the action quantity, and the shared information of the user from the storage unit 23 based on the user ID included in the transmission information (steps S531 to S533). These processes are similar to steps S511 to S513 of Fig. 16.

[0189] Subsequently, the recommended environment providing unit 203 performs an air conditioning proposal using the recommended environment model (see Fig. 15) (step S534). This process is similar to step S514 of Fig. 16.

[0190] Subsequently, when the requested environment setting reception unit 401 of the smartphone 4 acquires the recommended environment setting acquired from the air conditioning control device 2 (step S522), the requested environment setting reception unit 401 displays the acquired recommended environment setting on the display unit 42 to propose the recommended environment setting to the user and receives an input of the requested environment setting from the user (step S523).

[0191] When the user performs an operation of adopting the recommended environment setting via the operation unit 41, the requested environment setting reception unit 401 receives the recommended environment setting as a requested environment setting. When the user does not adopt the recommended environment setting and the user performs an operation of maintaining the requested environment setting input in step S520, the requested environment setting reception unit 401 may omit the input by the user.

[0192] Subsequently, the requested environment setting reception unit 401 transmits the transmission information (see Fig. 7) including the user ID and the requested environment setting to the air conditioning control device 2 via the communication I/F 44 (step S524).

[0193] Subsequently, when the requested environment acquisition unit 204 of the air conditioning control device 2 acquires the user ID and the requested environment setting from the transmission information received via the communication I/F 21 from the smartphone 4 (step S535), the requested environment acquisition unit 204 associates the user ID with the requested environment setting to add and store the user ID and the requested environment setting as information on individual users (see Fig. 8) in the storage unit 23 (step S536).

[0194] The requested environment acquisition unit 204 adds the acquired requested environment setting to requested environment history information (see Fig. 9) accumulated in the storage unit 23 to store the requested environment setting (step S537).

[0195] When the transmission information is received from the smartphone 4, the air conditioning control device 2 performs the above-described air conditioning proposing process S50B. Thus, when there is a setting (a recommended environment setting) estimated to be more preferable than the requested environment setting input by the user, it is possible to perform the air conditioning proposal appropriate for the user. For example, when it is estimated that the action quantity of the user is larger than the action history information (see Fig. 13) of the user after the current use, the recommended environment providing unit 203 can perform an air conditioning proposal estimated to be preferable in accordance with the personal information (the action quantity) of the user by providing the recommended environment setting including the set temperature lower than the set temperature input by the user.

(Operation and effects)

[0196] As described above, the air conditioning control device 2 according to the embodiment includes: the position acquisition unit 201 that acquires the user position; the personal information acquisition unit 202 that acquires the personal information of the user; the recommended environment providing unit 203 that supplies the recommended environment setting recommended for the user based on the personal information; the requested environment acquisition unit 204 that acquires the requested environment setting of the user; and the indoor unit control unit 206 that controls the indoor unit 3 based on the user position and the requested environment setting.

[0197] In this way, air conditioning control device 2 can save the user the time and effort of performing the environment setting and can estimate an appropriate air conditioning request in accordance with personal information of the user to

provide the air conditioning request as the recommended environment setting.

[0198] For example, when the air conditioning system 1 is used for the first time, the user may be likely not to know the air conditioning desired by the user when certain values are set the environment setting. In such a case, since the air conditioning control device 2 supplies the recommended environment setting in accordance with the personal information of the user, the user can easily obtain comfortable air conditioning.

[0199] The personal information acquisition unit 202 acquires the information indicating characteristics of the user (sex, age, occupation, height, weight, and the like) and the information indicating the action quantity of the user (the action history information) as the personal information.

[0200] Thus, the recommended environment providing unit 203 can provide the recommended environment setting in accordance with the action quantity and the characteristics of the user. As a result, it is possible to improve precision of the recommended environment setting supplied to each user.

[0201] The air conditioning control device 2 further includes the learning unit 205 that learns the recommended environment setting on individual users based on the personal information and the requested environment setting.

[0202] In this way, the learning unit 205 can learn a relation between the personal information of the user and the requested environment setting actually set by the user. Thus, the air conditioning control device 2 can improve precision of the recommended environment setting supplied to the user.

[0203] The requested environment acquisition unit 204 acquires the requested environment setting from an environment setting terminal 4 receiving an operation of the user.

[0204] In this way, the requested environment acquisition unit 204 can correctly recognize an environment setting desired by the user and control the indoor unit 3 when the user desires an environment setting different from the recommended environment setting.

[0205] The requested environment setting acquired by the requested environment acquisition unit 204 is added to the requested environment history information accumulated in the storage unit 23 to be used as new learning data by the learning unit 205. Thus, as the requested environment history information increases, the precision of the recommended environment model constructed by the learning unit 205 is improved. Therefore, a moderate air conditioning proposal (providing of the recommended environment setting) optimized for each user in the recommended environment providing unit 203 can be performed.

[0206] The requested environment acquisition unit 204 acquires the recommended environment setting as the requested environment setting when the user adopts the recommended environment setting.

[0207] In this way, the air conditioning control device 2 can acquire the requested environment setting for controlling the indoor unit 3 based on whether the user adopts the recommended environment setting. Thus, when the user does not like the recommended environment setting, the indoor unit 3 can be controlled based on the requested environment setting received from the user. Therefore, it is possible to provide air conditioning more appropriate for the request from the user.

[0208] The requested environment setting acquired by the requested environment acquisition unit 204 is added to the requested environment history information accumulated in the storage unit 23 to be used as new learning data by the learning unit 205. Thus, as the requested environment history information increases, the precision of the recommended environment model constructed by the learning unit 205 is improved. Therefore, a moderate air conditioning proposal (providing of the recommended environment setting) optimized for each user in the recommended environment providing unit 203 can be performed.

[0209] In the embodiment, the example in which the area ID recorded in advance in the 2-dimensional code is used as the localization information has been described, but the present invention is not limited thereto.

[0210] In another embodiment, the user registration unit 400 may acquire a 2-dimensional code imaged by the camera 43 of the smartphone 4 or an image including a landmark of the indoor unit 3 or the like as the localization information. In this case, the position estimation unit 200 may analyze the size and the inclination of the landmark included in the image, and estimate a position at which the user images the landmark (the user position).

[0211] At the position of the user (the seat or the like), a transmitter of Bluetooth (registered trademark), a Wi-Fi, a beacon, or the like may be provided instead of the 2-dimensional code. In this case, the user registration unit 400 acquires a device ID with which the transmitter can be identified and information with which a relative distance (a distance, an angle, or the like) to the transmitter can be detected as the localization information from the signal received from the transmitter.

[0212] Further, an application that displays a map of a space in which the air conditioning system 1 is installed may be installed in advance in the smartphone 4 and the position of the user may be designated from the map through the operation unit 41 by the user. In this case, the user registration unit 400 may acquire the localization information (the area ID) indicating the user position on the map based on the operation performed by the user.

[0213] In the above-described embodiment, the example in which the position estimation unit 200 of the air conditioning control device 2 estimates the user position based on the localization information included in the check-in information has been described, but the present invention is not limited thereto.

[0214] For example, the position estimation unit 200 of the air conditioning control device 2 may be omitted and the user registration unit 400 of the smartphone 4 may estimate the user position based on the localization information.

[0215] In this case, the user registration unit 400 of the smartphone 4 estimates the user position of the user by performing the process (step S 110) of estimating the user position (coordinate information indicating the position of the user in the space) as in the position estimation unit 200 of the air conditioning control device 2 according to the first embodiment in the check-in process S10A (see Fig. 3).

[0216] That is, a 2-dimensional code management table in which an area ID issued in advance to each 2-dimensional code and coordinate information indicating an installation position of each 2-dimensional code are associated is stored in advance in the storage unit 45 of the smartphone 4. The user registration unit 400 estimates the coordinate information ("X1, Y1") corresponding to the localization information read from the 2-dimensional code as the user position with reference to the 2-dimensional code management table.

[0217] Then, the user registration unit 400 of the smartphone 4 generates check-in information including the user ID, the user position, and the characteristic information and transmits the check-in information to the air conditioning control device 2.

[0218] In this way, since the position acquisition unit acquires the user position in accordance with a place in which the user is located from the environment setting terminal, the place in which each user is located can be recognized with high precision. Therefore, since the process of estimating the position of each of the plurality of users in the air conditioning control device 2 can be omitted, it is possible to reduce a load of the air conditioning control device 2.

<First modification example>

[0219] Next, the air conditioning system 1 according to a first modification example of the present invention will be described with reference to Fig. 18.

[0220] The same reference signs are given to common constituent elements to the above-described embodiment and detailed description will be omitted.

[0221] Fig. 18 is a diagram showing a function of a recommended environment providing unit according to a first modification example.

[0222] For example, in an office or the like, the user is considered to be located at pre-decided position (a seat assigned to each user) in many cases.

[0223] Therefore, the recommended environment providing unit 203 generates an achievement map (see Fig. 18) indicating in which zone the user who likes certain air conditioning (a requested environment setting) is highly likely to be located in a space by performing statistical processing on the user position of each user (the user position included in the user registration information (see Fig. 5)) and a requested environment setting previously accumulated in the requested environment history information (see Fig. 9).

[0224] For example, as shown in Fig. 18, the recommended environment providing unit 203 generates an achievement map indicating a distribution of users who like "set air volume: large," users who like "set air volume: small," and the like by zones in the space. The recommended environment providing unit 203 may generate the achievement map by period of time, day of week, and month.

[0225] The recommended environment providing unit 203 estimates a zone the user is located in the space and air conditioning the user likes from the achievement map of Fig. 18. A recommended environment setting is proposed to the user located in each zone so that air volume stronger than in the zone in which the user who likes "set air volume: small" is given to the zone in which the users who like "set air volume: large."

[0226] In this way, the recommended environment providing unit 203 can provide the appropriate recommended environment setting in accordance with the previous requested environment setting of the user.

[0227] The recommended environment providing unit 203 estimates a distribution of the users by period of time based on the achievement map and provide a different recommended environment setting by period of time. For example, in a period of time in which the user who likes "set air volume: large" is absent in many cases, it is possible to provide a recommended environment setting in which the set air volume of the zone in which the user is located is small and suppress power consumption of the air conditioning system 1. As a result, the recommended environment providing unit 203 can provide an optimum plan (a recommended environment setting by period of time) for further decreasing power consumption of the air conditioning system 1.

<Second modification example>

[0228] Next, the air conditioning system 1 according to a second modification example of the present invention will be described with reference to Fig. 19.

[0229] The same reference signs are given to common constituent elements to the above-described embodiment and detailed description will be omitted.

[0230] Fig. 19 is a diagram showing a function of a recommended environment providing unit according to a second modification example.

[0231] In the modification example, the recommended environment providing unit 203 updates an achievement map based on a temperature of a space measured by the sensor 22.

[0232] Specifically, the recommended environment providing unit 203 generates a distribution map (achievement map) of temperature by zone in the space, as shown in Fig. 19. In Fig. 19, an example in which a space is partitioned into four zones (Z1 to Z4) will be described, but the present invention is not limited thereto. In another embodiment, the number of zones may be at least two or the zone may be partitioned into three or less zones or five or more zones.

[0233] The recommended environment providing unit 203 acquires an average temperature by zone in the space every unit time (for example, hourly) and generates a unit time map M2 indicating a distribution of temperature in unit time. Fig. 19 shows an example in which the unit time map M2 (T2) is generated in unit time T2.

[0234] Then, the recommended environment providing unit 203 calculates a distribution map M3 after updating indicating a distribution of temperature in measurement time T_1+T_2 based on a distribution M1 (a distribution map before updating) indicating a distribution of temperature in a past measurement time (cumulative time T_1) and the unit time map M2. The recommended environment providing unit 203 weights the distribution map M1 before updating and the unit time map M2 when the recommended environment providing unit 203 calculates the distribution map M3 after the updating. In the weighting, for example, a measurement time is used.

[0235] Specifically, the recommended environment providing unit 203 calculates the distribution map M3 after updating using Formula (2) below.

[0236] [Formula 2]

$$M3 = \frac{T_1 \times M1 + T_2 \times M2}{T_1 + T_2} \quad \cdots(2)$$

[0237] The recommended environment providing unit 203 can know an environment (temperature) which has been adjusted so far in each zone (Z1 to Z4) in the space from the distribution map M3 (see Fig. 19) after updating. That is, the recommended environment providing unit 203 can know a tendency of an environment liked by the user in each zone in the space.

[0238] Thus, the recommended environment providing unit 203 can propose a recommended environment setting in accordance with a past environment to the user located in each zone (Z1 to Z4) based on the temperature by zone indicated by the distribution map M3.

[0239] For example, when the requested environment setting received from the user considerably deviates from an environment indicated by the distribution map M3, a recommended environment setting in accordance with the past environment can be proposed to the user. Thus, the air conditioning control device 2 can save the user a time and effort of frequently changing the requested environment setting.

<Third modification example>

[0240] Next, the air conditioning system 1 according to a third modification example of the present invention will be described with reference to Figs. 20 and 21.

[0241] Fig. 20 is a first diagram showing a function of a recommended environment providing unit according to a third modification example.

[0242] In the modification example, it is assumed that a transmitter of Bluetooth (registered trademark), a Wi-Fi, a beacon, or the like is provided in a space in which the air conditioning system 1 is installed and performs wireless communication with the smartphone 4 carried by the user. The position estimation unit 200 of the air conditioning control device 2 estimates the position of the smartphone 4, that is, the user position, periodically (for example, every second) based on radio waves (localization information) received from the smartphone 4 by the transmitter. Specifically, the position estimation unit 200 estimates the user position using a three-point measurement technology based on, for example, a radio wave strength of the radio waves received from the smartphone 4, a radio wave arrival speed, and the like. The position estimation unit 200 stores and cumulates a position history on individual users (see Fig. 20) in which a date and time at which the radio waves are received is associated with the estimated user position in the storage unit 23.

[0243] Then, the recommended environment providing unit 203 of the air conditioning control device 2 generates an achievement map (see Fig. 20) indicating a position at which each user is located in the space and a time in which the user stays based on the position history on individual users accumulated in the storage unit 23 and proposes the

recommended environment setting based on the achievement map.

[0244] Specifically, the recommended environment providing unit 203 is assumed to have a map in which the space is partitioned into a plurality of cells and coordinates (i, j, k) of each cell are associated in advance. Then, the recommended environment providing unit 203 records an "action pattern on individual users" including a history of a position at which the user stays in the space (coordinates of a cell), a date and time, a stay time, a movement path (a path indicating from which cell the user moves to which cell), and the like based on the user position of each user, as shown in Fig. 20.

[0245] In the example of Fig. 20, for example, an action pattern in which a certain user moves to and stays at a position A (for example, a desk of a user), a position B (for example, a trash can), a position C (for example, a copy machine), a position D (for example, an entrance), and a position E (for example, a seat of a superior) is recorded as an action pattern of the user for a day. Then, the recommended environment providing unit 203 generates a table in which stay times in which the user stays at positions (cells) are arranged in the descending order ("stay time ranking") on individual users based on the action pattern. Further, as shown in Fig. 20, the recommended environment providing unit 203 generates an achievement map on individual users indicating whether there is a tendency to stay longer in a certain position (cell) in the space based on the stay time ranking.

[0246] As shown in Fig. 20, according to the "stay time ranking," a position (cell) at which the stay time of the user is the longest has coordinates (i, j, k)=(4, 8, 1). Therefore, the recommended environment providing unit 203 estimates that the position at which the stay time is the longest is a position at which the user is normally located (one's seat).

[0247] In this way, the air conditioning control device 2 can save the user the time and effort of registering the user position in the check-in process.

[0248] When the user exits to the outside (out of a detected area of the user position), the user position of the user is not detected (communication with the smartphone 4 is disconnected). For example, it is assumed that the position estimation unit 200 may not detect the user position of the user at a subsequent timing after the user position of the user at coordinates (i, j, k)=(3, 1, 1), that is, the position D, is detected. In this case, the recommended environment providing unit 203 estimates that the user exits to the outside since an entrance is at the position D.

[0249] Further, the recommended environment providing unit 203 may identify positions of all the users in the space staying and cells on movement paths based on the action patterns of the plurality of users (paint colors in the cells on the achievement map) and identify cells in which the users do not stay and pass. Then, the recommended environment providing unit 203 can estimate that obstacles such as a desk, a copy machine, and a bookshelf are at positions at which the users do not stay and pass (for example, the positions A, B, and C in Fig. 20).

[0250] In this way, the recommended environment providing unit 203 can automatically perform mapping in the space so that the users do not take a time and effort to designate installation positions of obstacles and the entrance in the space and generate the map.

[0251] The recommended environment providing unit 203 performs an air conditioning proposal in accordance with the positions of the users and the obstacles in the space based on the achievement map in which the one's seats of the users, the entrance, the obstacles, and the like estimated in this way are mapped.

[0252] Specifically, for example, a user is assumed to be located at his or her seat for a long time. Therefore, the recommended environment providing unit 203 proposes a recommended environment setting in which mild and slow air is ventilated in an area including the one's seat of the user based on the achievement map on individual users. On the other hand, when the user moves away from his or her seat, the recommended environment providing unit 203 may propose a recommended environment setting in which strong air is ventilated. Thus, the recommended environment providing unit 203 can propose an appropriate recommended environment setting in accordance with an action pattern of the user.

[0253] For example, it is assumed that air flows considerably near an entrance. Therefore, the recommended environment providing unit 203 can suppress degradation of air conditioning efficiency by proposing a recommended environment setting in which ventilation is restrained near an entrance (the position D in Fig. 20) based on the achievement map in which the entrance is mapped.

[0254] Further, the recommended environment providing unit 203 may propose a recommended environment setting in which ventilation comes avoiding an obstacle. When the user desires to direct air in a direction in which no user is located, the recommended environment providing unit 203 may propose a recommended environment setting in which ventilation is directed to an obstacle conversely.

[0255] For example, when the air conditioning system 1 is activated, a recommended environment setting in which ventilation is directed to an obstacle may be proposed so that the air in the space reaches a target temperature fast. In this way, the recommended environment providing unit 203 can promote heat transmission by applying air to an obstacle and producing air turbulence. As a result, the air conditioning control device 2 can improve air conditioning efficiency at the time of activating of the air conditioning system 1 and provide comfortable air conditioning to the user quickly.

[0256] Fig. 21 is a second diagram showing the function of the recommended environment providing unit according to the third modification example.

[0257] Until the indoor unit control unit 206 of the air conditioning control device 2 transmits an instruction value to the

indoor unit 3 and a temperature or the like of an actually desired spot changes, delay occurs. When a user does not move from the same position (for example, his or her seat), no problem occurs despite the delay of the air conditioning. However, when a user is moving, the user position of the user is acquired, and then an instruction value is transmitted to the indoor unit 3, there is a possibility of a temperature or the like of the position of a movement destination of the user not being appropriately adjusted due to delay of air conditioning.

[0258] When the indoor unit 3 is controlled by tracking the movement of the user, it is necessary to minutely operate the louver 31 and a servomotor (an actuator) (not shown) that operates the louver 31. In this case, when a load change increases in the servomotor, there is a possibility of power consumption of the indoor unit 3 increasing.

[0259] Therefore, as shown in Fig. 21, the recommended environment providing unit 203 predicts a route using a mobile vector of the user and proposes a recommended environment setting so that an appropriate environment setting (temperature, humidity, and air volume) is reflected at the time of arrival of the user at the position of the movement destination.

[0260] Specifically, the recommended environment providing unit 203 considers a movement speed of the user and a change of a movement direction (azimuth) as a stochastic process and obtains a probability distribution from a cumulative frequency of past movement amounts. For example, as shown in Fig. 21, the recommended environment providing unit 203 obtains a probability distribution such as "a frequency distribution of a speech change" or "a frequency distribution of an azimuth change" from a mobile vector (v^n) of the user at a certain time point to a mobile vector (v^{n+1}) at a subsequent time point based on the position history on individual users and the action pattern on individual users (see Fig. 20).

[0261] Then, the recommended environment providing unit 203 generates a "probability map" (see Fig. 21) indicating a probability at which a user moves from a current user position (R) to each position (cell) after T seconds based on the probability distribution (see Fig. 21) and the position history on individual users (see Fig. 20). The recommended environment providing unit 203 may reflect installation positions of obstacles estimated in the above-described manner in the probability map. Thus, the recommended environment providing unit 203 can improve precision of the probability map.

[0262] The recommended environment providing unit 203 may generate the probability map in advance from a position history on individual users or the like accumulated previously and stores the probability map in the storage unit 23. Then, the recommended environment providing unit 203 may update the probability map periodically (for example, every day).

[0263] The recommended environment providing unit 203 proposes a recommended environment setting so that air conditioning of a position (cell) with a highest probability is optimized after T seconds from a current user position (R) based on the probability map generated in this way. In the modification example, the indoor unit control unit 206 is assumed to control the indoor unit 3 automatically based on the recommended environment setting proposed by the recommended environment providing unit 203.

[0264] Thus, the air conditioning control device 2 can estimate a movement destination of the user and transmit an instruction value with which air conditioning of the movement destination can be optimized in advance to the indoor unit 3. As a result, the air conditioning control device 2 can provide comfortable air conditioning even when the user is moving and curb an increase in power consumption of the indoor unit 3.

<Second embodiment>

[0265] Next, the air conditioning system 1 according to a second modification example of the second embodiment of the present invention will be described with reference to Figs. 22 and 23.

[0266] The same reference signs are given to common constituent elements to the above-described embodiment and detailed description will be omitted.

[0267] Fig. 22 is a diagram showing an example of a functional configuration of an air conditioning system according to a second embodiment.

[0268] As shown in Fig. 22, the air conditioning system 1 according to the embodiment is different from that of the first embodiment in that an air conditioning IC 46 and a reading device 6 are further included.

[0269] The air conditioning IC 46 is an IC card or an RF tag carried by each user.

[0270] In the air conditioning IC 46, a user ID, characteristic information (sex, age, occupation, height, weight, and the like) of the user, and localization information with which a user position can be identified are stored in advance.

[0271] The reading device 6 reads the user ID, the characteristic information of the user, and the localization information stored in the air conditioning IC 46.

[0272] Fig. 23 is a sequence diagram showing an example of a check-in process of the air conditioning system according to the second embodiment.

[0273] Hereinafter, an example of a check-in process S10B according to the embodiment will be described with reference to Fig. 23.

[0274] In the embodiment, when the user uses the air conditioning system 1 for the first time, the user performs the check-in process S10B of registering the check-in information (see Fig. 4) including the characteristic information of the user and the localization information in the air conditioning control device 2 by holding up the air conditioning IC to the

reading device 6. A flow of the specific check-in process S10B is as follows.

[0275] As shown in Fig. 23, when the user holds up the air conditioning IC 46 to the reading device 6, the reading device 6 acquires the user ID, the characteristic information of the user, and the localization information stored in advance in the air conditioning IC 46 (step S 120).

[0276] Subsequently, the reading device 6 generates check-in information including the user ID, the characteristic information of the user, and the localization information and transmits the check-in information to the air conditioning control device 2 (step S102).

[0277] When the air conditioning control device 2 receives the check-in information from the reading device 6, the air conditioning control device 2 performs each of the processes of estimating the user position (step S 130), acquiring the user position (step S 131), acquiring the characteristic information (step S 132), and storing the information on individual users (step S133). These processes are similar to the processes (step S110 to S113) of the check-in process S10A (see Fig. 3) in the first embodiment.

[0278] In this configuration, the user can complete the check-in process S10B by merely performing a simple operation of holding up the air conditioning IC 46 to the reading device 6. Thus, the air conditioning system 1 can save the user the time and effort of inputting the characteristic information through the smartphone 4 and the user the time and effort of imaging a 2-dimensional code and acquiring the localization information.

[0279] In the above-described embodiments, the course of the above-described various processes of the air conditioning control device 2 and the smartphone 4 are stored in a computer-readable recording medium in a program format. A computer performs the foregoing various processes by reading and executing the program. The computer-readable recording medium is a magnetic disk, a magneto-optical disc, a CD-ROM, a DVD-ROM, a semiconductor memory, or the like. The computer program may be delivered to a computer via a communication line and the computer to which the program is delivered may execute the program.

[0280] The program may realize some of the above-described functions. Further, the program may be a file, a so-called differential file (differential program), which can realize the above-described functions by combining a program previously recorded in the computer system. Further, the air conditioning control device 2 and the smartphone 4 may be configured by one computer in another embodiment or may be configured by a plurality of computers connected to be communicable.

[0281] Several embodiments of the present invention have been described above, but the embodiments are exemplary and are not intended to limit the scope of the present invention. The embodiments can be realized in other various forms and various omissions, substitutions, and changes may be made within the scope of the present invention without departing from the gist of the present invention. The embodiments and the modifications are included in the equivalent scope of the present invention described in the claims as long as the embodiments and the modifications are included in the scope or the gist of the present invention.

[0282] For example, in the above-described embodiments, the example in which the recommended environment providing unit 203 of the air conditioning control device 2 transmits the recommended environment setting to the smartphone 4 and the smartphone 4 accepts adoption or non-adoption of the recommended environment setting from the user has been described, but the present invention is not limited thereto.

[0283] For example, by changing the setting of the air conditioning control device 2 or the setting of the smartphone 4, the recommended environment setting may not be transmitted. In this case, the requested environment acquisition unit 204 automatically acquires the recommended environment setting supplied by the recommended environment providing unit 203 as a requested environment setting. Then, the indoor unit control unit 206 may automatically control the indoor unit 3 based on the recommended environment setting.

[0284] In this way, since the air conditioning control device 2 can omit the operation of selecting adaptation or non-adaptation of the recommended environment setting by the user, it is possible to further save the user the time and effort.

[0285] In the air conditioning control device 2 according to the above-described embodiments and modification examples, the elements used for control are "temperature," "humidity," "air volume," and the like, as described above, but other embodiments are not limited to this aspect. The air conditioning control device 2 according to the other embodiments may realize any aspect as long as elements such as "illumination," "aroma," temperature of hot water," and "cleaning strength of toilet seat" are amounts related to comfort of people in addition to the above-described elements of the air conditioning. In the cases of the above-described embodiments, the air conditioning control device 2 according to the other embodiments may realize aspects for setting an illumination device, an aroma instrument, a water heater, and a toilet seat device as control targets as well as the indoor unit 3.

[Industrial Applicability]

[0286] The air conditioning control device, the air conditioning system, the air conditioning control method, and the program described above can propose an environment setting recommended in accordance with characteristics of users.

[Reference Signs List]

[0287]

1	Air conditioning system
2	Air conditioning control device
20	CPU
200	Position estimation unit
201	Position acquisition unit
202	Personal information acquisition unit
203	Recommended environment providing unit
204	Requested environment acquisition unit
205	Learning unit
206	Indoor unit control unit
21	Communication I/F
22	Sensor
23	Storage unit
3	Indoor unit for air conditioning
30	Fan
31	Louver
4	Smartphone (environment setting terminal)
40	CPU
400	User registration unit
401	Requested environment setting reception unit
402	Action quantity measurement unit
41	Operation unit
42	Display unit
43	Camera
44	Communication I/F
45	Storage unit
5	Database (DB)
6	Reading device

Claims

1. An air conditioning control device controlling an indoor unit for air conditioning in accordance with a requested environment setting requested by a user and a user position at which the user is located, the air conditioning control device comprising:

a position acquisition unit configured to acquire the user position;
a personal information acquisition unit configured to acquire personal information of the user;
a recommended environment providing unit configured to provide a recommended environment setting recommended for the user according to the personal information;
a requested environment acquisition unit configured to acquire the requested environment setting of the user; and
an indoor unit control unit configured to control the indoor unit according to the user position and the requested environment setting.

2. The air conditioning control device according to claim 1, further comprising:
a learning unit configured to learn the recommended environment setting for an individual user according to the personal information and the requested environment setting.

3. The air conditioning control device according to claim 1 or 2, wherein the position acquisition unit is configured to acquire the user position from an environment setting terminal receiving an operation of the user.

4. The air conditioning control device according to claim 1 or 2, wherein the requested environment acquisition unit is configured to acquire the requested environment setting from the environment setting terminal receiving an operation of the user.

5. The air conditioning control device according to any one of claims 1 to 3, wherein the requested environment acquisition unit is configured to acquire the recommended environment setting supplied by the recommended environment providing unit as the requested environment setting.

6. The air conditioning control device according to claim 5, wherein the requested environment acquisition unit is configured to acquire the recommended environment setting as the requested environment setting when the user adopts the recommended environment setting.

7. An air conditioning system comprising:

an indoor unit for air conditioning; and
the air conditioning control device according to any one of claims 1 to 6 controlling the indoor unit.

8. An air conditioning control method of controlling an indoor unit for air conditioning in accordance with a requested environment setting requested by a user and a user position at which the user is located, the air conditioning control method comprising:

a position acquisition step of acquiring the user position;
a personal information acquisition step of acquiring personal information of the user;
a recommended environment providing step of providing a recommended environment setting recommended for the user according to the personal information;
a requested environment acquisition step of acquiring the requested environment setting of the user; and
an indoor unit control step of controlling the indoor unit according to the user position and the requested environment setting.

9. A program causing a computer to function as an air conditioning control device controlling an indoor unit for air conditioning in accordance with a requested environment setting requested by a user and a user position at which the user is located, the program causing the computer to perform:

a position acquisition step of acquiring the user position;
a personal information acquisition step of acquiring personal information of the user;
a recommended environment providing step of providing a recommended environment setting recommended for the user according to the personal information;
a requested environment acquisition step of acquiring the requested environment setting of the user; and
an indoor unit control step of controlling the indoor unit according to the user position and the requested environment setting.

FIG. 1

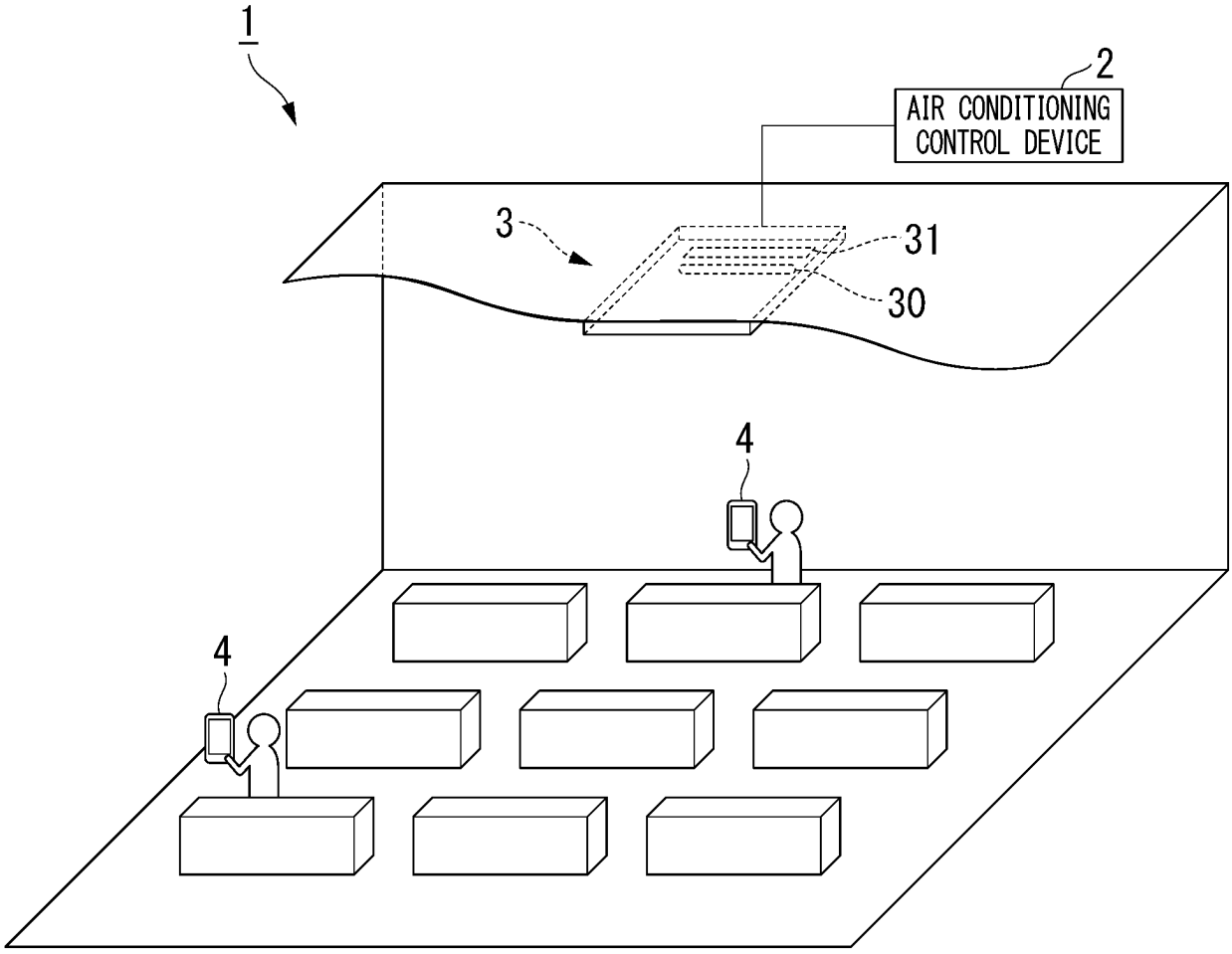


FIG. 2

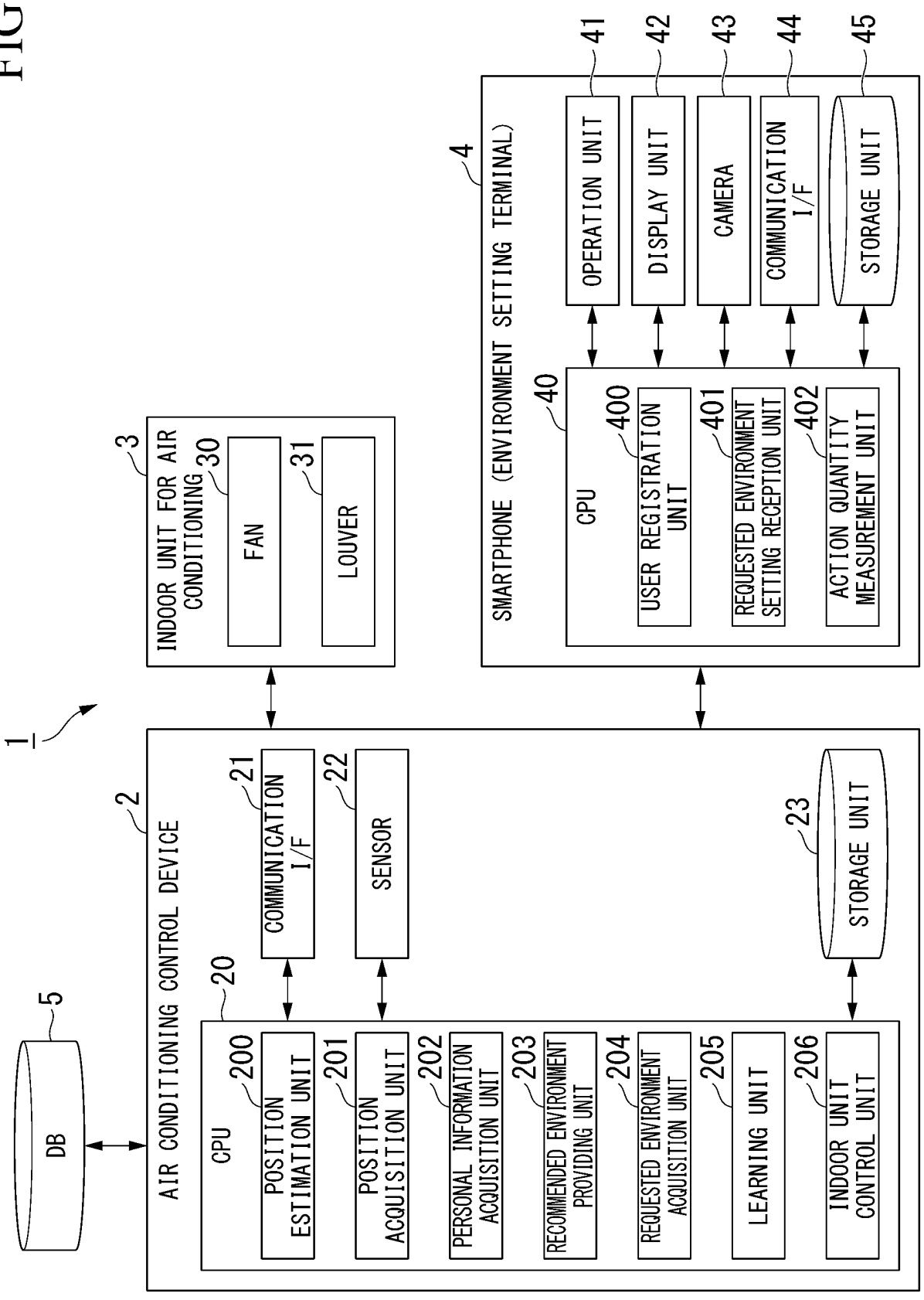

1
2
AIR CONDITIONING CONTROL DEVICE
20
CPU
200
POSITION ESTIMATION UNIT
201
POSITION ACQUISITION UNIT
202
PERSONAL INFORMATION ACQUISITION UNIT
203
RECOMMENDED ENVIRONMENT PROVIDING UNIT
204
REQUESTED ENVIRONMENT ACQUISITION UNIT
205
LEARNING UNIT
206
INDOOR UNIT CONTROL UNIT
21
COMMUNICATION I/F
22
SENSOR
23
STORAGE UNIT
5
DB
3
INDOOR UNIT FOR AIR CONDITIONING
30
FAN
31
LOUVER
4
SMARTPHONE (ENVIRONMENT SETTING TERMINAL)
40
CPU
400
USER REGISTRATION UNIT
401
REQUESTED ENVIRONMENT SETTING RECEPTION UNIT
402
ACTION QUANTITY MEASUREMENT UNIT
41
OPERATION UNIT
42
DISPLAY UNIT
43
CAMERA
44
COMMUNICATION I/F
45
STORAGE UNIT

FIG. 3

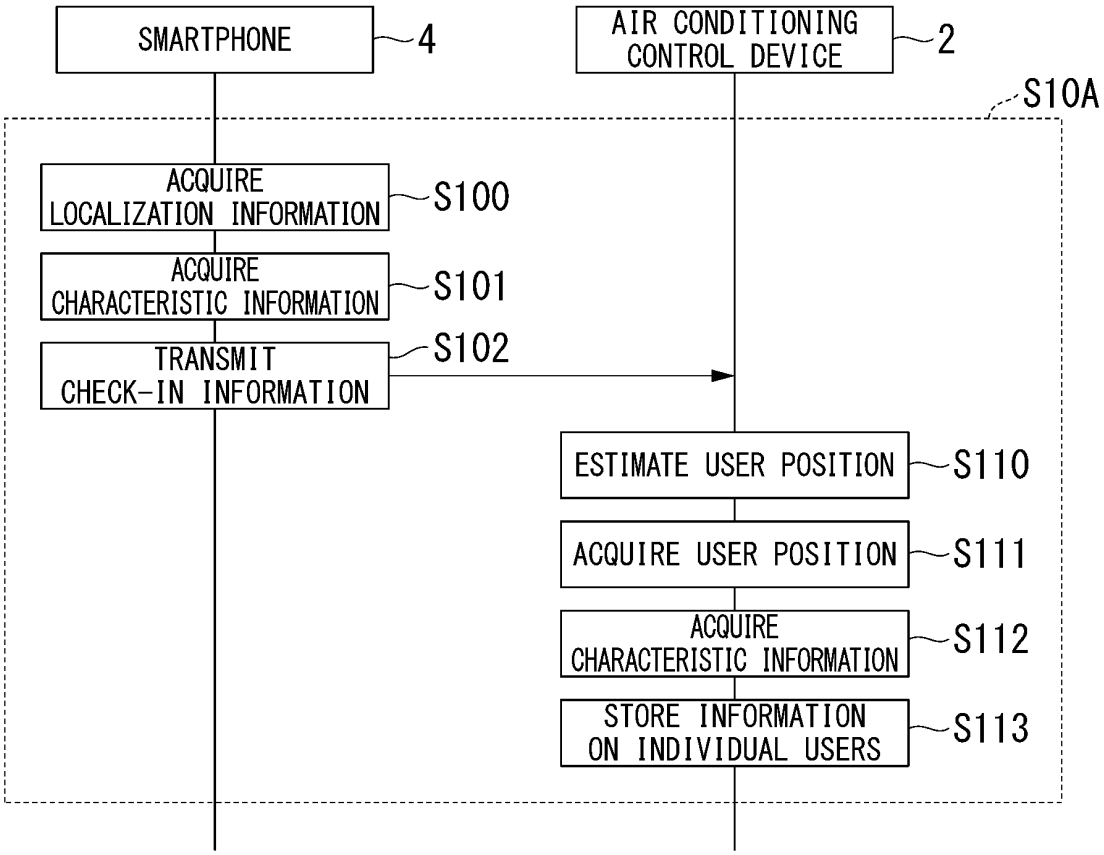


FIG. 4

<CHECK-IN INFORMATION>

USER ID	SEX	AGE	JOB	HEIGHT (cm)	WEIGHT (kg)	...	LOCALIZATION INFORMATION (AREA ID)
0001	01	30	03	170	75	...	A01

FIG. 5

<USER REGISTRATION INFORMATION>

USER ID	USER POSITION	SEX	AGE	JOB	HEIGHT(cm)	WEIGHT(kg)	···
0001	X1, Y1	01	30	03	170	75	···
0002	X2, Y2	02	25	10	160	55	···
···	···	···	···	···	···	···	···

FIG. 6

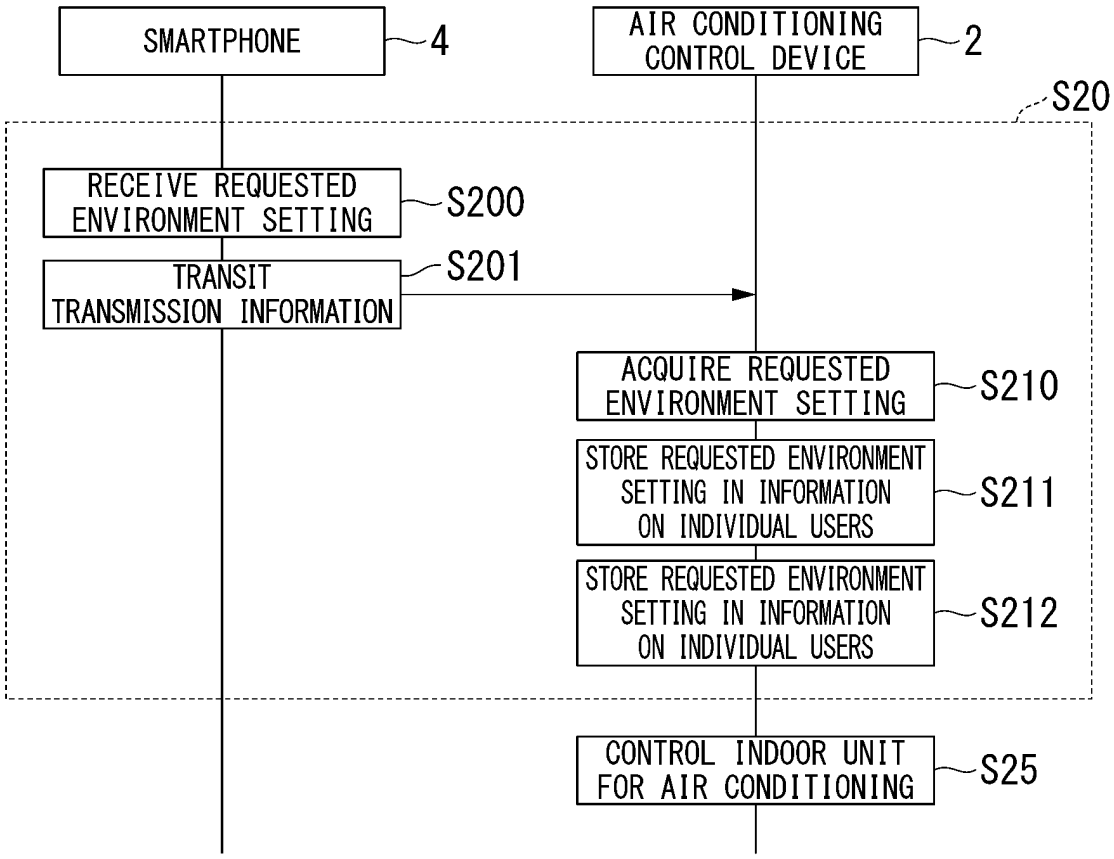


FIG. 7

<TRANSMISSION INFORMATION>

USER ID	SET TEMPERATURE	SET HUMIDITY	SET AIR VOLUME	...
0001	25℃	50%	LARGE	...

FIG. 8

<INFORMATION ON INDIVIDUAL USERS>

USER ID	SET TEMPERATURE	SET HUMIDITY	SET AIR VOLUME	...
0001	25℃	50%	LARGE	...
0002	27℃	60%	SMALL	...
...	...	...	...	...

FIG. 9

<REQUESTED ENVIRONMENT HISTORY INFORMATION>

USER ID:0001				
ACQUISITION DATE AND TIME	SET TEMPERATURE	SET HUMIDITY	SET AIR VOLUME	...
10:00, 01 MAY 2017	25℃	50%	LARGE	...
11:05, 01 MAY 2017	24℃	50%	LARGE	...
...	...	...	...	...

...

FIG. 10

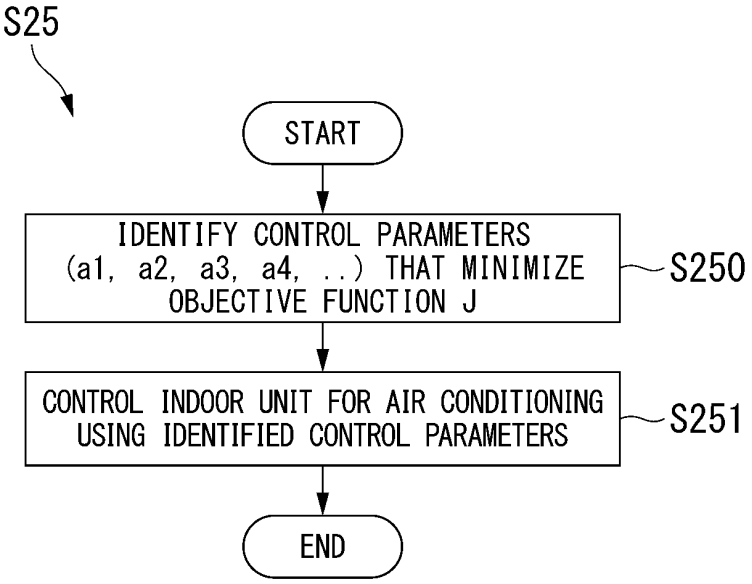

S25
START
IDENTIFY CONTROL PARAMETERS (a1, a2, a3, a4, ..) THAT MINIMIZE OBJECTIVE FUNCTION J
S250
CONTROL INDOOR UNIT FOR AIR CONDITIONING USING IDENTIFIED CONTROL PARAMETERS
S251
END

FIG. 11

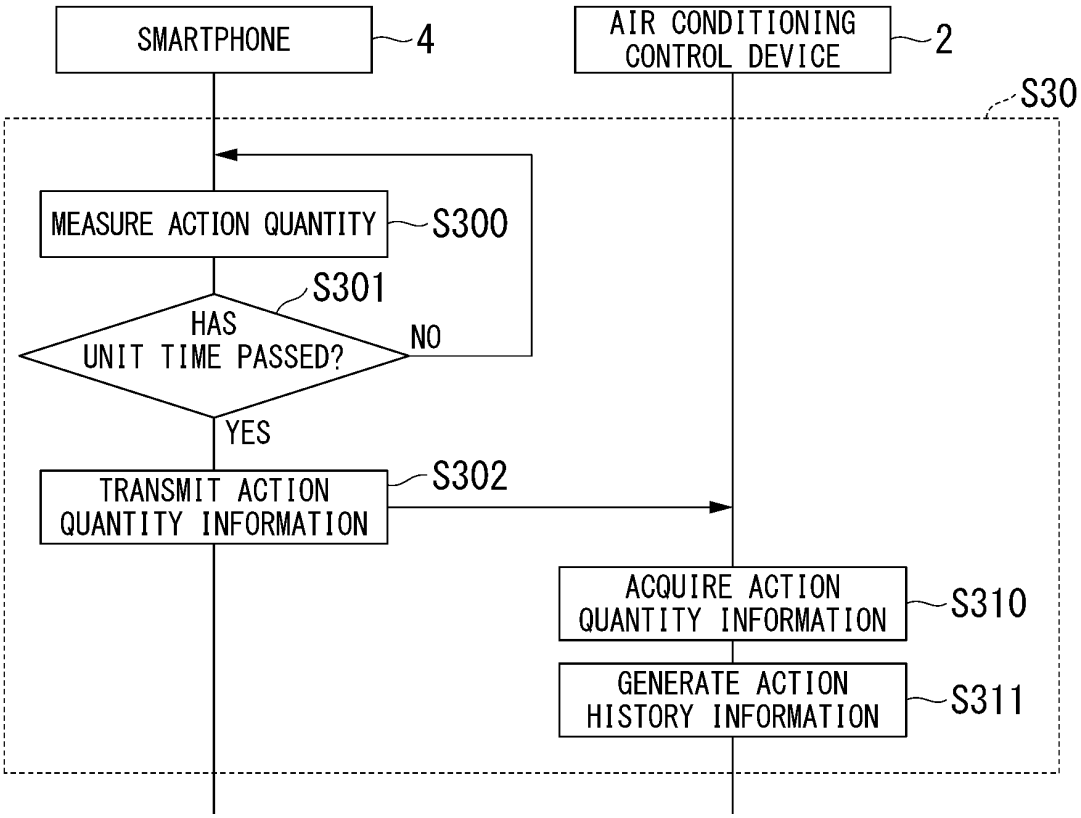

SMARTPHONE
4
AIR CONDITIONING CONTROL DEVICE
2
S30
MEASURE ACTION QUANTITY
S300
S301
HAS UNIT TIME PASSED?
NO
YES
TRANSMIT ACTION QUANTITY INFORMATION
S302
ACQUIRE ACTION QUANTITY INFORMATION
S310
GENERATE ACTION HISTORY INFORMATION
S311

FIG. 12

<ACTION QUANTITY INFORMATION>

USER ID	MEASUREMENT PERIOD	ACTION QUANTITY (NUMBER OF STEPS)
0001	10:00 TO 11:00, 01 MAY 2017	850

FIG. 13

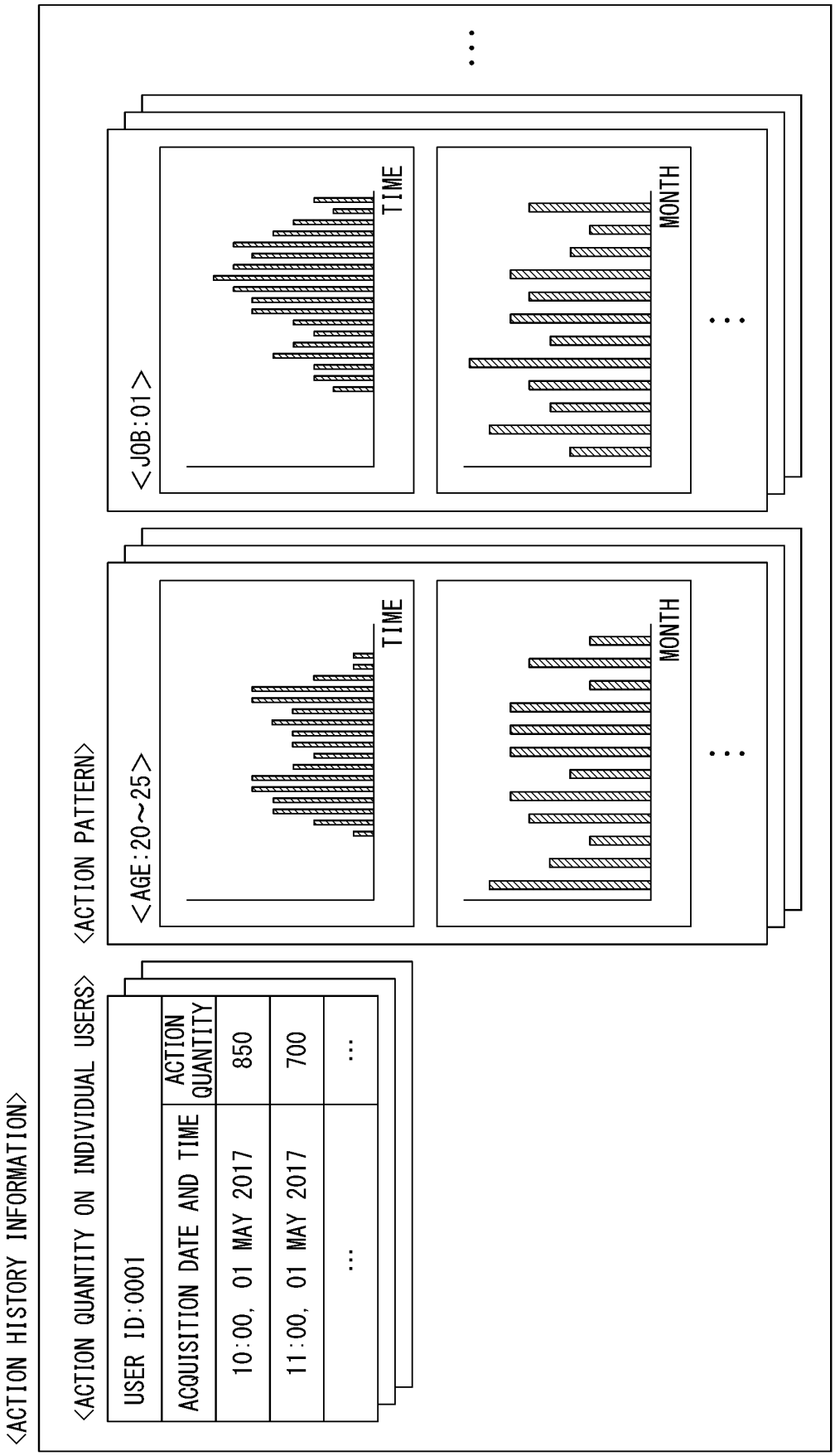

<ACTION HISTORY INFORMATION>
<ACTION QUANTITY ON INDIVIDUAL USERS>
USER ID:0001
ACQUISITION DATE AND TIME
ACTION QUANTITY
10:00, 01 MAY 2017
850
11:00, 01 MAY 2017
700
...
...
<ACTION PATTERN>
<AGE:20~25>
TIME
MONTH
<JOB:01>
TIME
MONTH

FIG. 14

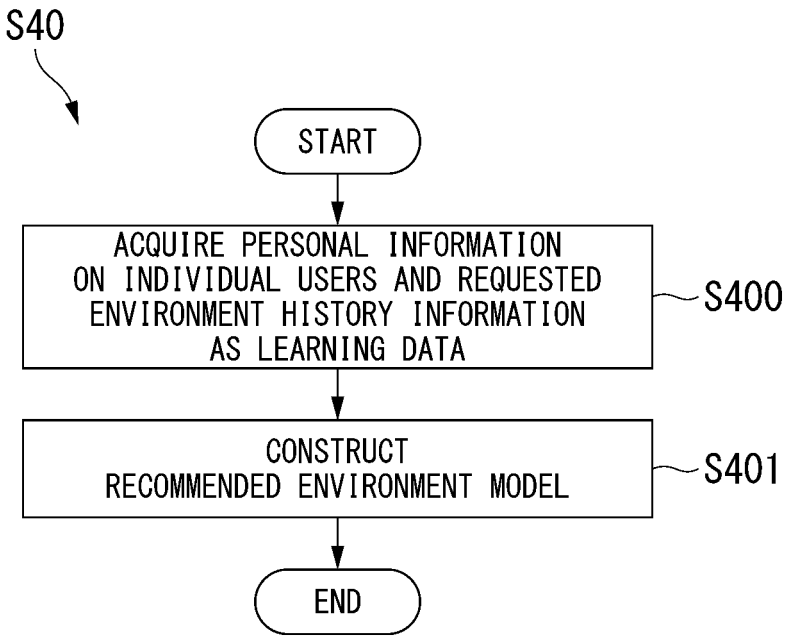

S40
START
ACQUIRE PERSONAL INFORMATION ON INDIVIDUAL USERS AND REQUESTED ENVIRONMENT HISTORY INFORMATION AS LEARNING DATA
S400
CONSTRUCT RECOMMENDED ENVIRONMENT MODEL
S401
END

FIG. 15

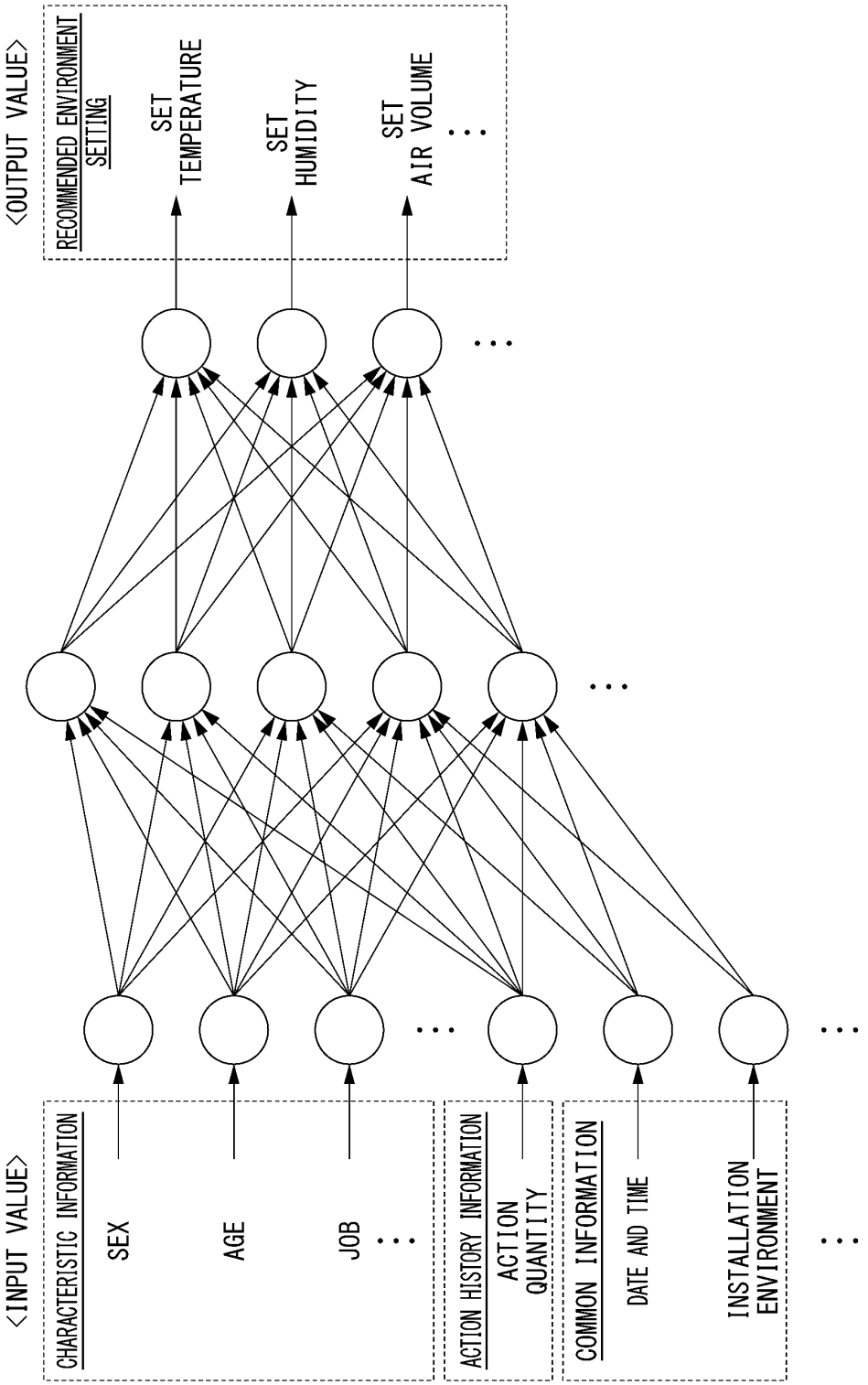

<INPUT VALUE>
CHARACTERISTIC INFORMATION
SEX
AGE
JOB
ACTION HISTORY INFORMATION
ACTION QUANTITY
COMMON INFORMATION
DATE AND TIME
INSTALLATION ENVIRONMENT
<OUTPUT VALUE>
RECOMMENDED ENVIRONMENT SETTING
SET TEMPERATURE
SET HUMIDITY
SET AIR VOLUME

FIG. 16

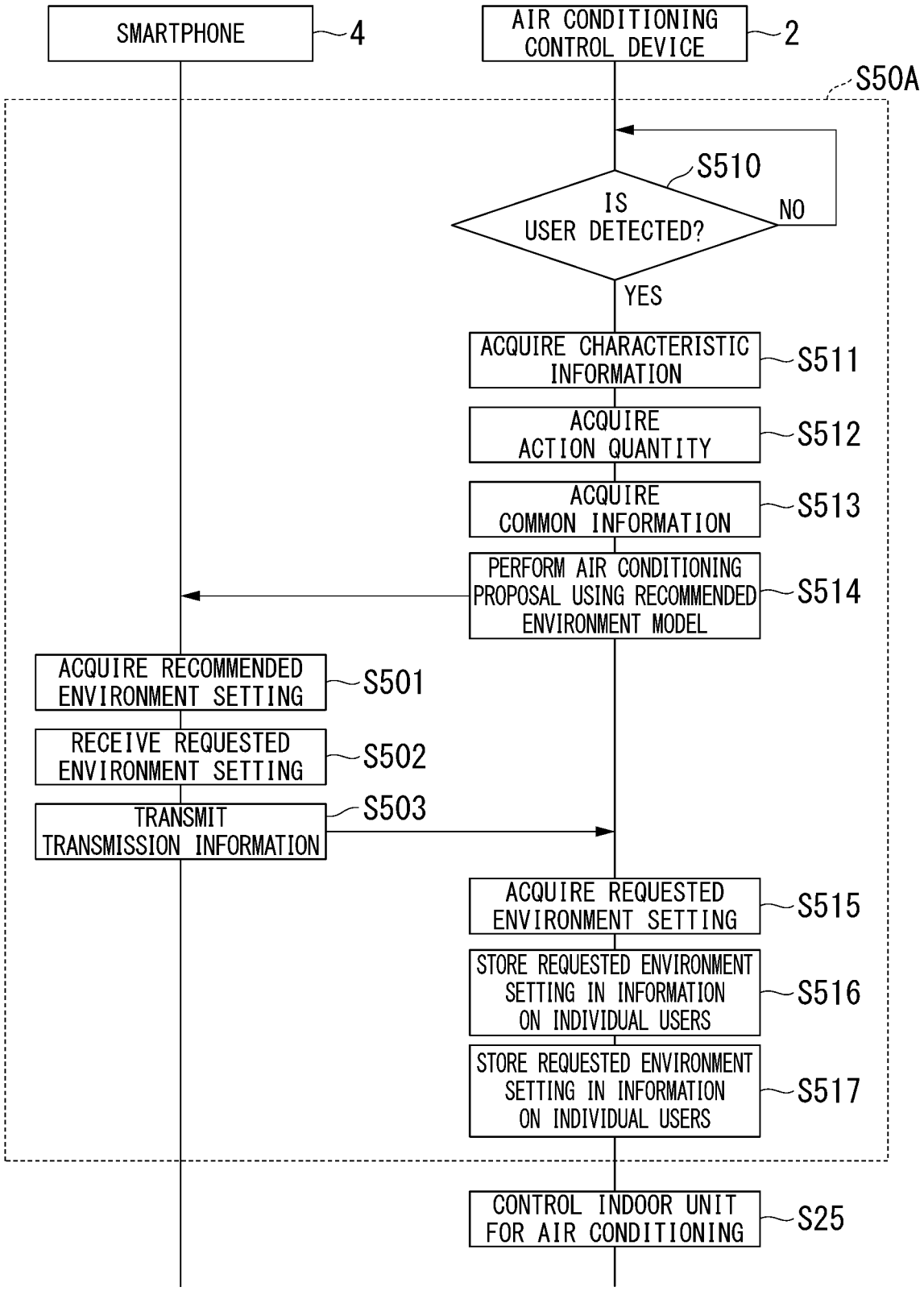

SMARTPHONE
4
AIR CONDITIONING CONTROL DEVICE
2
S50A
S510
IS USER DETECTED?
NO
YES
ACQUIRE CHARACTERISTIC INFORMATION
S511
ACQUIRE ACTION QUANTITY
S512
ACQUIRE COMMON INFORMATION
S513
PERFORM AIR CONDITIONING PROPOSAL USING RECOMMENDED ENVIRONMENT MODEL
S514
ACQUIRE RECOMMENDED ENVIRONMENT SETTING
S501
RECEIVE REQUESTED ENVIRONMENT SETTING
S502
TRANSMIT TRANSMISSION INFORMATION
S503
ACQUIRE REQUESTED ENVIRONMENT SETTING
S515
STORE REQUESTED ENVIRONMENT SETTING IN INFORMATION ON INDIVIDUAL USERS
S516
STORE REQUESTED ENVIRONMENT SETTING IN INFORMATION ON INDIVIDUAL USERS
S517
CONTROL INDOOR UNIT FOR AIR CONDITIONING
S25

FIG. 17

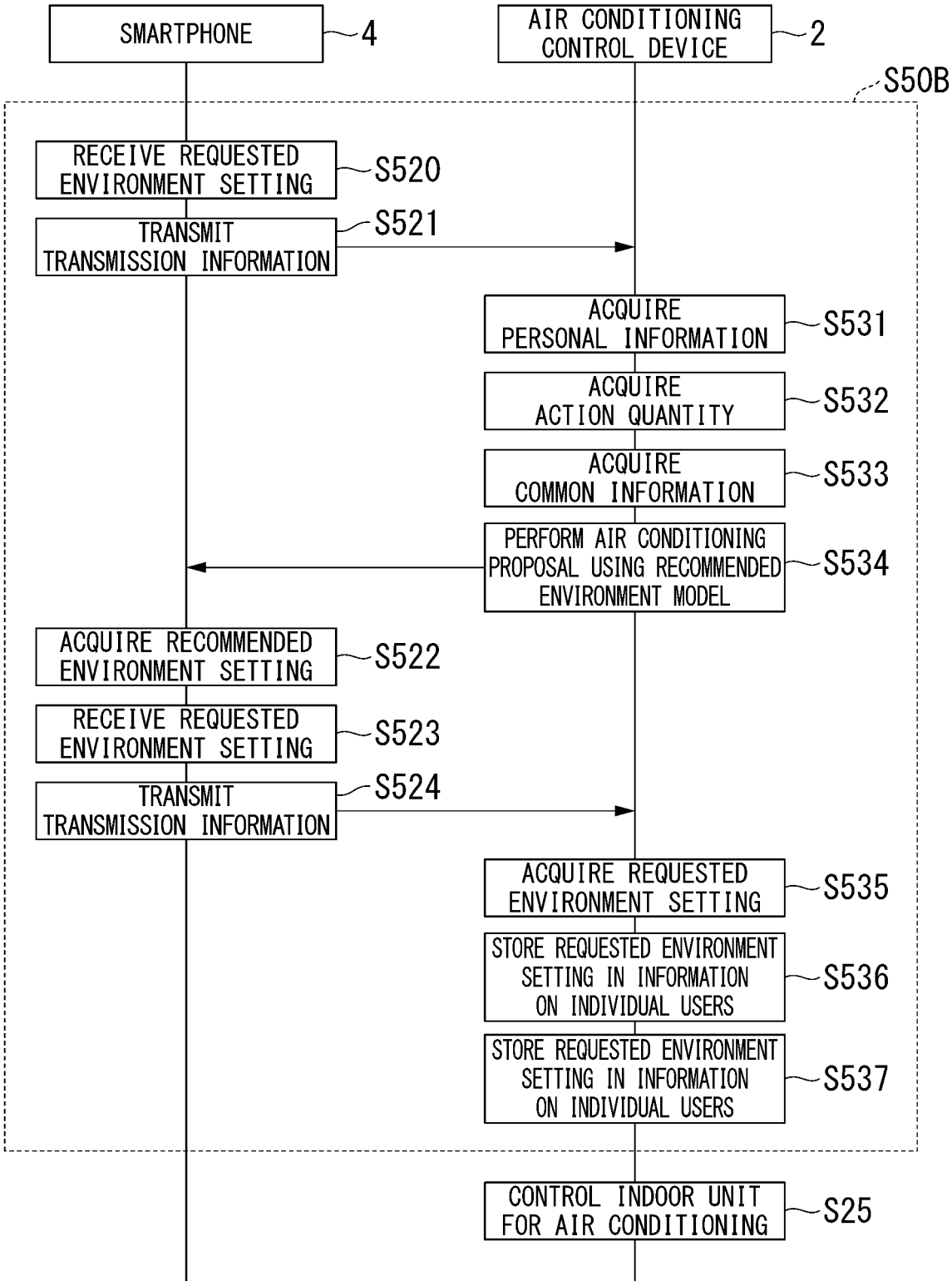

SMARTPHONE
4
AIR CONDITIONING CONTROL DEVICE
2
S50B
RECEIVE REQUESTED ENVIRONMENT SETTING
S520
TRANSMIT TRANSMISSION INFORMATION
S521
ACQUIRE PERSONAL INFORMATION
S531
ACQUIRE ACTION QUANTITY
S532
ACQUIRE COMMON INFORMATION
S533
PERFORM AIR CONDITIONING PROPOSAL USING RECOMMENDED ENVIRONMENT MODEL
S534
ACQUIRE RECOMMENDED ENVIRONMENT SETTING
S522
RECEIVE REQUESTED ENVIRONMENT SETTING
S523
TRANSMIT TRANSMISSION INFORMATION
S524
ACQUIRE REQUESTED ENVIRONMENT SETTING
S535
STORE REQUESTED ENVIRONMENT SETTING IN INFORMATION ON INDIVIDUAL USERS
S536
STORE REQUESTED ENVIRONMENT SETTING IN INFORMATION ON INDIVIDUAL USERS
S537
CONTROL INDOOR UNIT FOR AIR CONDITIONING
S25

FIG. 18

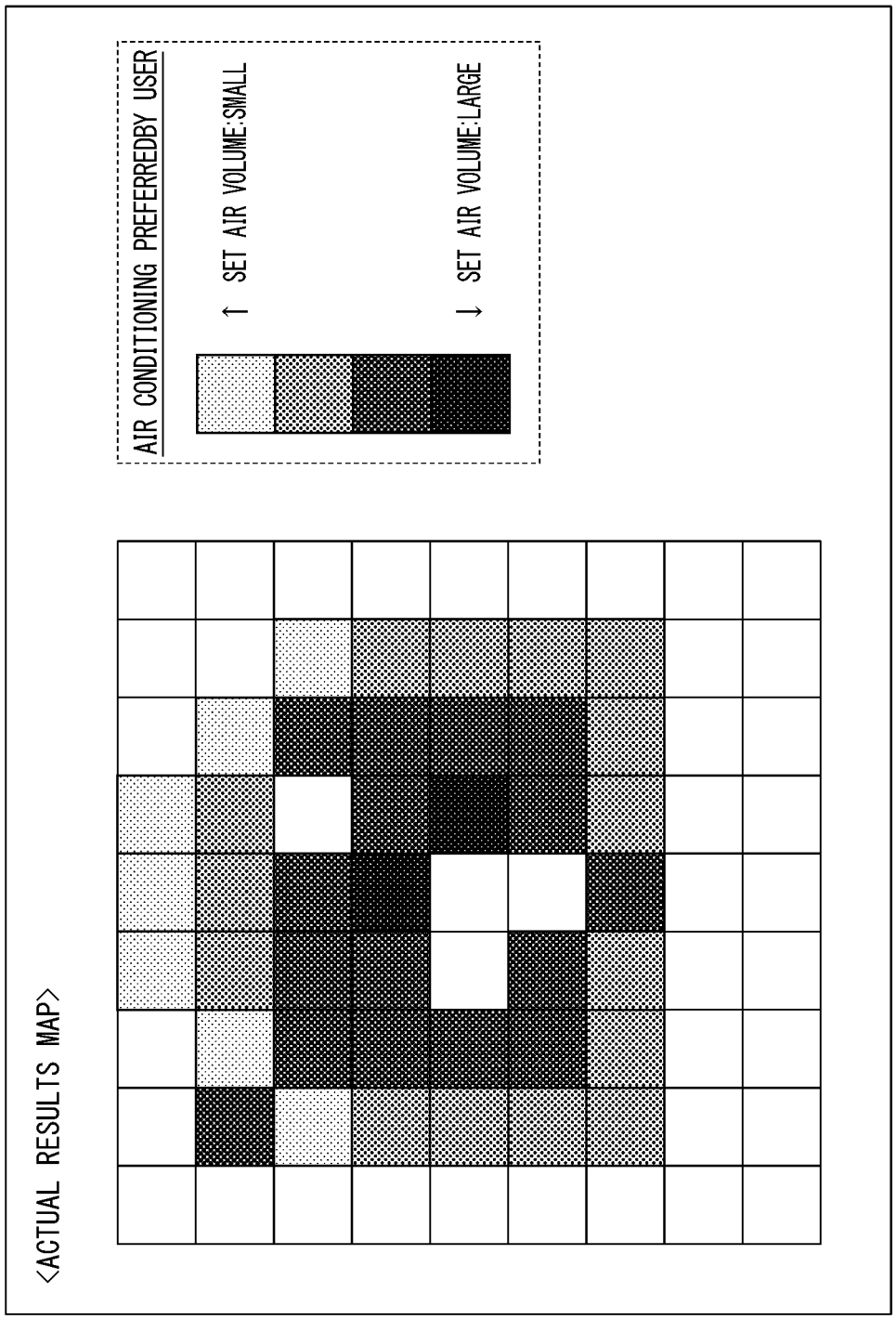

<ACTUAL RESULTS MAP>
AIR CONDITIONING PREFERREDBY USER
↑ SET AIR VOLUME:SMALL
↓ SET AIR VOLUME:LARGE

FIG. 19

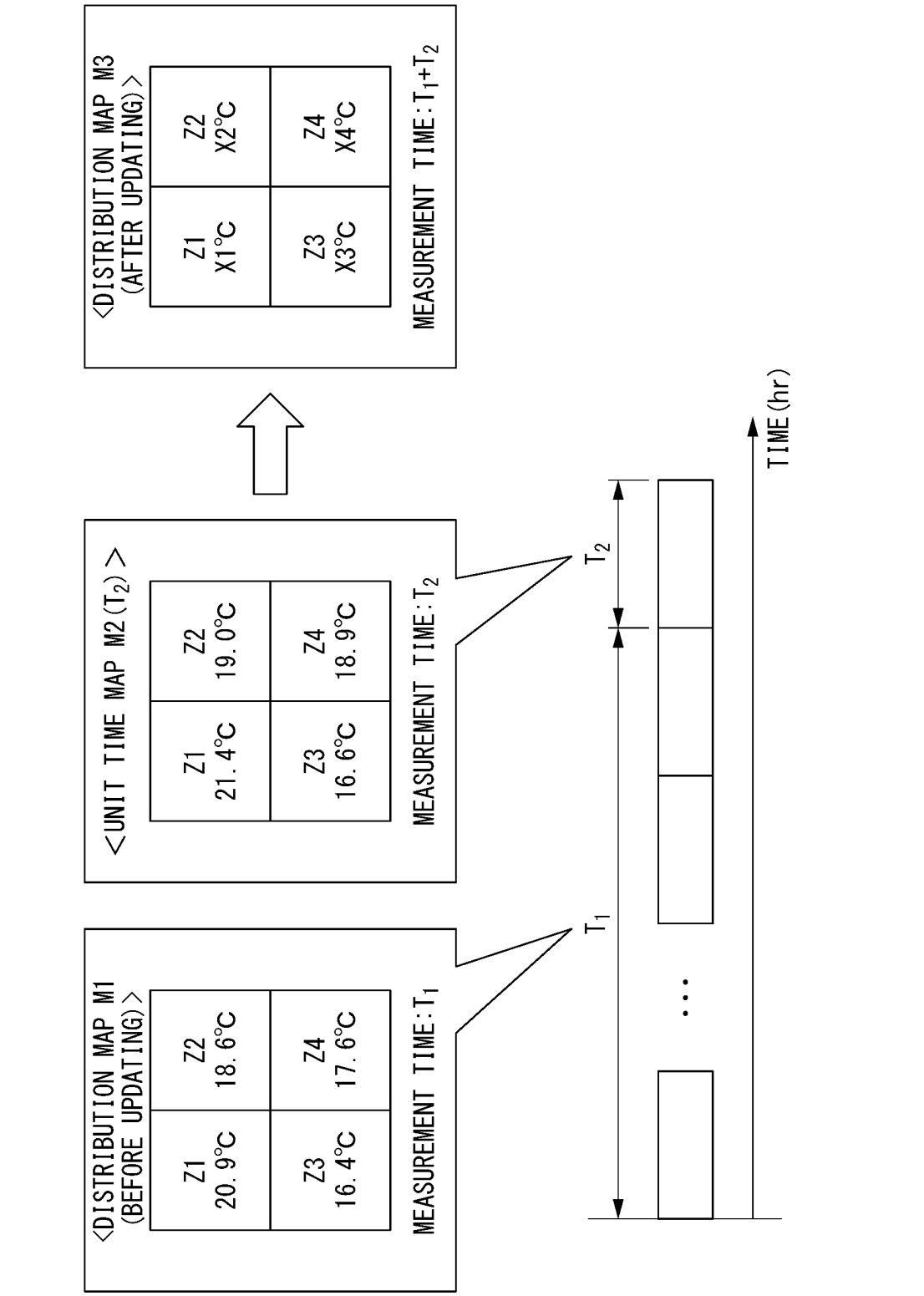

<DISTRIBUTION MAP M1 (BEFORE UPDATING)>
Z1 20.9°C
Z2 18.6°C
Z3 16.4°C
Z4 17.6°C
MEASUREMENT TIME:T1
<UNIT TIME MAP M2(T2)>
Z1 21.4°C
Z2 19.0°C
Z3 16.6°C
Z4 18.9°C
MEASUREMENT TIME:T2
<DISTRIBUTION MAP M3 (AFTER UPDATING)>
Z1 X1°C
Z2 X2°C
Z3 X3°C
Z4 X4°C
MEASUREMENT TIME:T1+T2
T1
T2
TIME(hr)

FIG. 20

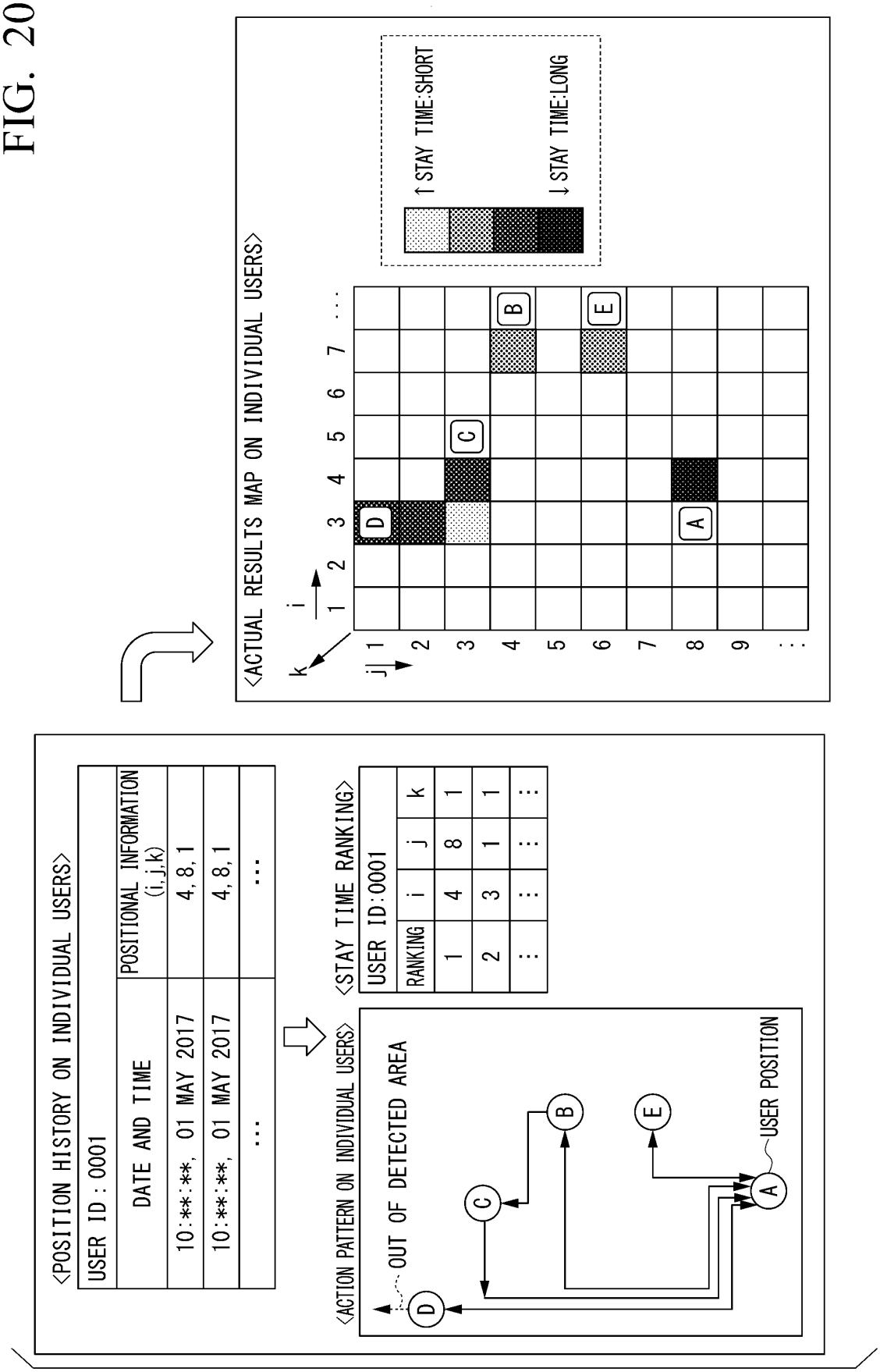

<POSITION HISTORY ON INDIVIDUAL USERS>
USER ID : 0001
DATE AND TIME
POSITIONAL INFORMATION (i,j,k)
10:**:**, 01 MAY 2017
4, 8, 1
10:**:**, 01 MAY 2017
4, 8, 1
...
...
<STAY TIME RANKING>
USER ID:0001
RANKING
i
j
k
1
4
8
1
2
3
1
1
<ACTION PATTERN ON INDIVIDUAL USERS>
OUT OF DETECTED AREA
USER POSITION
A
B
C
D
E
<ACTUAL RESULTS MAP ON INDIVIDUAL USERS>
↑ STAY TIME:SHORT
↓ STAY TIME:LONG
i
k
j

FIG. 21

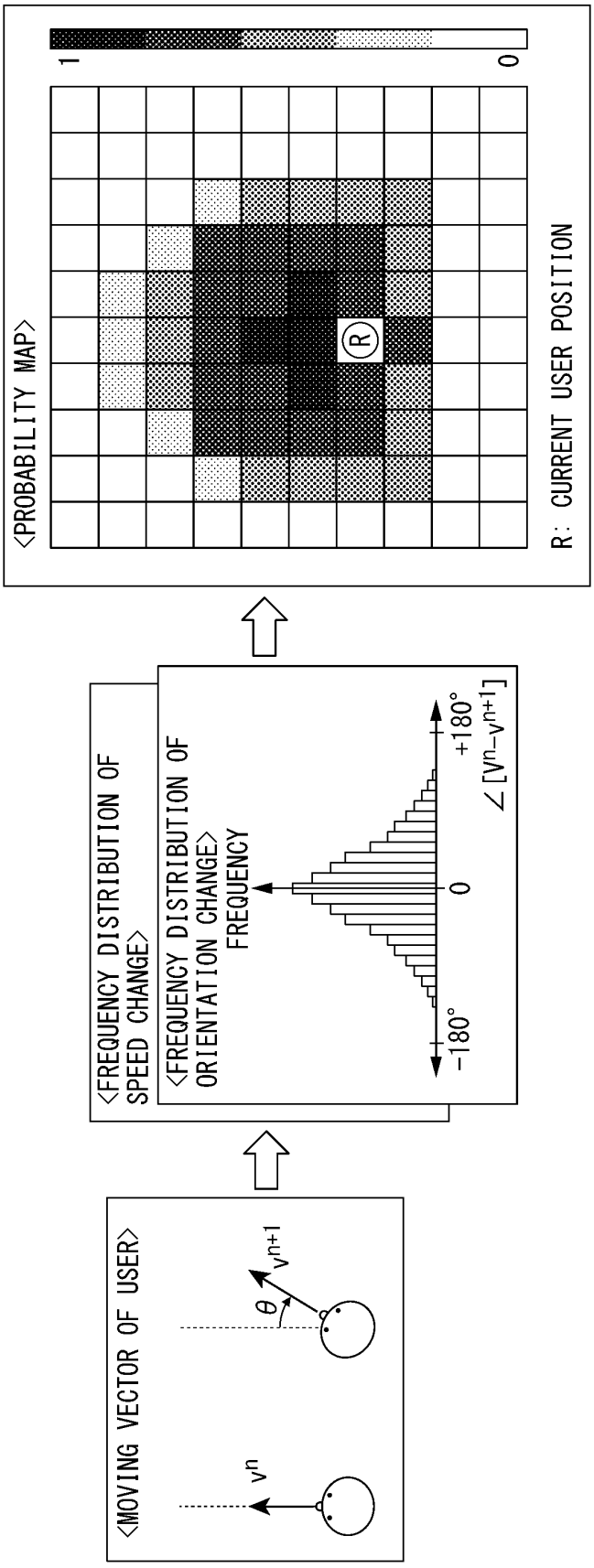

<MOVING VECTOR OF USER>
v^n
θ
v^{n+1}
<FREQUENCY DISTRIBUTION OF SPEED CHANGE>
<FREQUENCY DISTRIBUTION OF ORIENTATION CHANGE>
FREQUENCY
-180°
0
+180°
$\angle[V^n - V^{n+1}]$
<PROBABILITY MAP>
1
0
R
R: CURRENT USER POSITION

FIG. 22

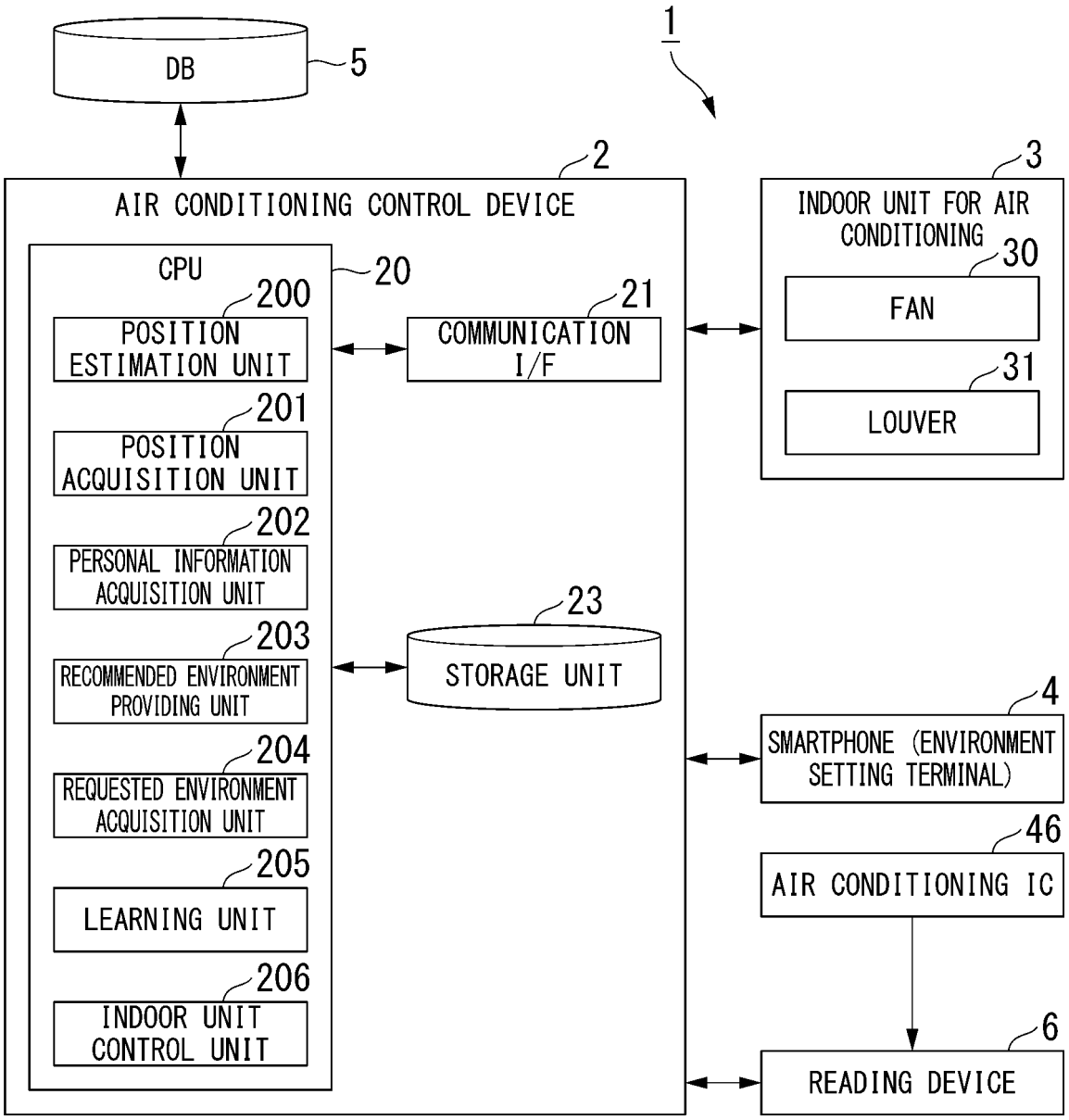
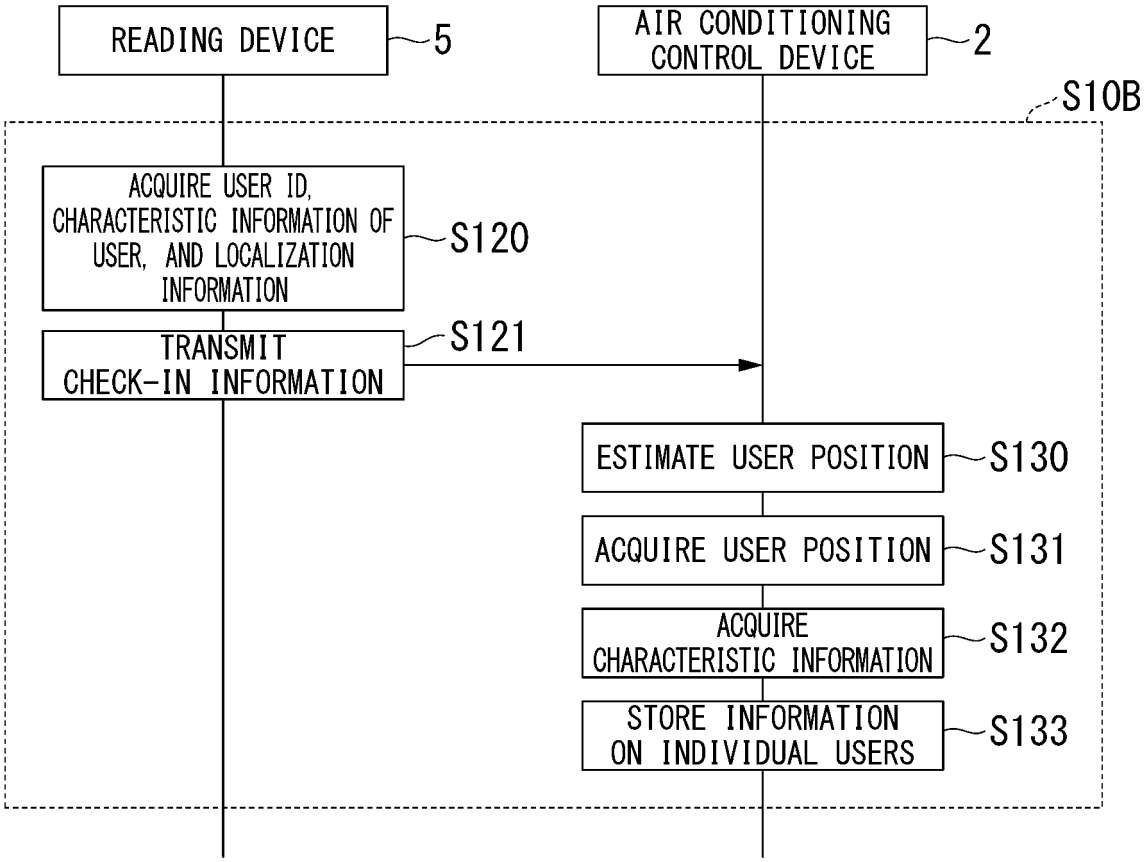

1
DB
5
2
AIR CONDITIONING CONTROL DEVICE
CPU
20
200
POSITION ESTIMATION UNIT
201
POSITION ACQUISITION UNIT
202
PERSONAL INFORMATION ACQUISITION UNIT
203
RECOMMENDED ENVIRONMENT PROVIDING UNIT
204
REQUESTED ENVIRONMENT ACQUISITION UNIT
205
LEARNING UNIT
206
INDOOR UNIT CONTROL UNIT
21
COMMUNICATION I/F
23
STORAGE UNIT
3
INDOOR UNIT FOR AIR CONDITIONING
30
FAN
31
LOUVER
4
SMARTPHONE (ENVIRONMENT SETTING TERMINAL)
46
AIR CONDITIONING IC
6
READING DEVICE

FIG. 23


READING DEVICE
5
AIR CONDITIONING CONTROL DEVICE
2
S10B
ACQUIRE USER ID, CHARACTERISTIC INFORMATION OF USER, AND LOCALIZATION INFORMATION
S120
TRANSMIT CHECK-IN INFORMATION
S121
ESTIMATE USER POSITION
S130
ACQUIRE USER POSITION
S131
ACQUIRE CHARACTERISTIC INFORMATION
S132
STORE INFORMATION ON INDIVIDUAL USERS
S133

INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP2018/022905

A. CLASSIFICATION OF SUBJECT MATTER
Int.Cl. F24F11/56(2018.01)i, F24F11/59(2018.01)i, F24F11/62(2018.01)i, F24F120/10(2018.01)n, F24F120/12(2018.01)n, F24F120/14(2018.01)n, F24F120/20(2018.01)n
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)
Int.Cl. F24F11/56, F24F11/59, F24F11/62, F24F120/10, F24F120/12, F24F120/14, F24F120/20

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	1971-2018
Registered utility model specifications of Japan	1996-2018
Published registered utility model applications of Japan	1994-2018

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	JP 2017-026283 A (SHIMIZU CORP.) 02 February 2017, paragraphs [0046]-[0134], fig. 1-12 (Family: none)	1-9
Y	JP 2013-124809 A (MITSUBISHI ELECTRIC BUILDING TECHNO-SERVICE CO., LTD.) 24 June 2013, paragraphs [0033]-[0133], fig. 1-12 (Family: none)	1-9
Y	JP 2010-091228 A (PANASONIC CORP.) 22 April 2010, paragraphs [0022]-[0046], fig. 1-7 (Family: none)	2-7
A	US 2017/0005982 A1 (K4CONNECT INC.) 05 January 2017, paragraphs [0194]-[0203], fig. 35-36 & WO 2017/004184 A1 & EP 3314338 A1	1-9

☐ Further documents are listed in the continuation of Box C.
☐ See patent family annex.

* Special categories of cited documents:
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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
"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
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"&" document member of the same patent family

Date of the actual completion of the international search 20 August 2018 (20.08.2018)	Date of mailing of the international search report 28 August 2018 (28.08.2018)
Name and mailing address of the ISA/ Japan Patent Office 3-4-3, Kasumigaseki, Chiyoda-ku, Tokyo 100-8915, Japan	Authorized officer Telephone No.

Form PCT/ISA/210 (second sheet) (January 2015)

REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- JP 2017143483 A **[0002]**
- JP 4737037 B **[0004]**