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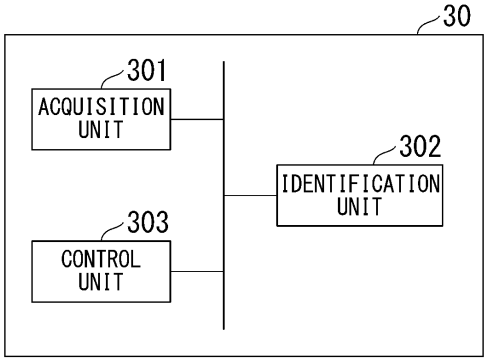
(54) AIR CONDITIONING CONTROL DEVICE, AIR CONDITIONING SYSTEM, CONTROL METHOD, AND PROGRAM

(57) An air conditioning control device includes a requested environment acquisition unit configured to acquire requested environment settings from each of a plurality of users, a position acquisition unit configured to acquire users' positions at which each of the plurality of users is present, an identification unit configured to identify actual environment settings which bring an environment at users' positions of the plurality of users who have set the requested environment settings closer to the requested environment settings on the basis of the requested environment settings and the users' positions, and a control unit configured to control an indoor unit for air conditioning on the basis of the identified actual environment settings.

FIG. 5



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Description

[Technical Field]

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

[0002] Priority is claimed on Japanese Patent Application No. 2017-128992, filed June 30, 2017, the content of which is incorporated herein by reference.

[Background Art]

[0003] There is an air conditioning system that acquires the positions of persons and changes settings. Patent Literature 1 discloses a technology that acquires position information set to correspond to ID information of a transmission device for transmitting a request of a user, acquires position information recognized by reading one-dimensional barcodes, or two-dimensional barcodes including unique position information affixed to fixed desks or chairs, and performs control on an air conditioner according to the requests.

[Citation List]

[Patent Literature]

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

[Summary of Invention]

[Technical Problem]

[0005] Incidentally, there is a demand for a technology which can realize air conditioning settings with a high degree of satisfaction for all users of an air conditioning system.

[0006] Therefore, there is a demand for a technology which can realize air conditioning settings with a high degree of satisfaction for all users inside a room where a plurality of users set air conditioning settings when the air conditioning settings are performed.

[0007] An object of the present invention is to provide an air conditioning control device, an air conditioning system, a control method, and a program which can solve the problems described above.

[Solution to Problem]

[0008] According to a first aspect of the present invention, an air conditioning control device includes a requested environment acquisition unit configured to acquire requested environment settings from each of a plurality of users, a position acquisition unit configured to acquire users' positions at which each of the plurality of users is present, an identification unit configured to identify actual environment settings which bring an environment at users' positions of the plurality of users who have set requested environment settings closer to the requested environment settings on the basis of the requested environment settings and the users' positions, and a control unit configured to control an indoor unit for air conditioning on the basis of the identified actual environment settings.

[0009] According to a second aspect of the present invention, in the air conditioning control device in the first aspect, the actual environment settings may be settings of at least one of a temperature, an air volume, a humidity, and an air direction.

[0010] According to a third aspect of the present invention, in the air conditioning control device in the first aspect or the second aspect, the requested environment acquisition unit may acquire the requested environment settings from environment setting terminals of each of the plurality of users.

[0011] According to a fourth aspect of the present invention, in the air conditioning control device in the third aspect, the position acquisition unit may acquire the users' positions from the environment setting terminal of each of the plurality of users.

[0012] According to a fifth aspect of the present invention, an air conditioning system includes the air conditioning control device described in any one of the first to fourth aspects, and the indoor unit for air conditioning configured to blow out air on the basis of control performed by the air conditioning control device.

[0013] According to a sixth aspect of the present invention, a control method includes the steps of: acquiring requested

environment settings from each of a plurality of users, acquiring users' positions at which each of the plurality of users is present, identifying actual environment settings which bring an environment at users' positions of the plurality of users who have set requested environment settings closer to the requested environment settings on the basis of the requested environment settings and the users' positions, and controlling an indoor unit for air conditioning on the basis of the identified actual environment settings.

[0014] According to a seventh aspect of the present invention, a program causes a computer to execute the steps of: acquiring requested environment settings from each of a plurality of users, acquiring users' positions at which each of the plurality of users is present, identifying actual environment settings which bring an environment at users' positions of the plurality of users who have set requested environment settings closer to the requested environment settings on the basis of the requested environment settings and the users' positions, and controlling an indoor unit for air conditioning on the basis of the identified actual environment settings.

[Advantageous Effects of Invention]

[0015] The air conditioning control device, the air conditioning system, the control method, and the program according to the embodiments of the present invention can realize air conditioning settings with a high degree of satisfaction for all users inside the room where the plurality of users set air conditioning settings when the air conditioning settings are performed.

[Brief Description of Drawings]

[0016]

FIG. 1 is a diagram which shows a configuration of an air conditioning system according to one embodiment of the present invention.
FIG. 2 is a diagram which shows a configuration of an indoor unit for air conditioning according to one embodiment of the present invention.
FIG. 3 is a diagram which shows a configuration of an environment setting terminal according to one embodiment of the present invention.
FIG. 4 is a diagram which shows a display example of a display unit according to one embodiment of the present invention.
FIG. 5 is a diagram which shows a configuration of an air conditioning control device according to one embodiment of the present invention.
FIG. 6 is a diagram which shows a processing flow of the air conditioning control device according to one embodiment of the present invention.
FIG. 7 is a diagram which shows an example of a map displayed by the display unit according to one embodiment of the present invention.
FIG. 8 is a schematic block diagram which shows a configuration of a computer according to at least one embodiment.

[Description of Embodiments]

<Embodiment>

[0017] Hereinafter, embodiments will be described in detail with reference to the drawings.

[0018] A configuration of an air conditioning system 1 according to one embodiment of the present invention will be described.

[0019] The air conditioning system 1 according to one embodiment of the present invention is a system that identifies actual environment settings on the basis of each requested environment setting requested by each of a plurality of users and each user's position where each of the plurality of users is present. Then, the air conditioning system 1 is a system that controls an indoor unit for air conditioning on the basis of the identified actual environment settings. The requested environment settings are setting values of an environment requested by a user to realize a desired environment at the user's position and are setting values including at least one of a temperature, an air volume, a humidity, and an air direction at the user's position. The actual environment settings are environment setting values actually set in the air conditioning system 1 such that degrees of satisfaction of all users who have set the setting values increase.

[0020] The air conditioning system 1 includes, as shown in FIG. 1, the indoor unit for air conditioning 10, environment setting terminals 20a1 to 20an, and an air conditioning control device 30. In the following description, the environment setting terminals 20a1 to 20an will be collectively referred to as environment setting terminals 20.

[0021] The indoor unit for air conditioning 10 sends out air to each user's position.

[0022] Each environment setting terminal 20 transmits requested environment settings at a user's position inside a room equipped with the indoor unit for air conditioning 10 to the air conditioning control device 30. Note that the user's position inside a room equipped with the indoor unit for air conditioning 10 is a user's position of a user who uses the environment setting terminal 20.

[0023] The air conditioning control device 30 controls the indoor unit for air conditioning 10 on the basis of actual environment settings.

[0024] The indoor unit for air conditioning 10 includes, as shown in FIG. 2, a communication unit 101 and an air blowing mechanism 102.

[0025] The communication unit 101 performs communication with the air conditioning control device 30. The communication unit 101 receives a control signal which realizes setting values indicated by the actual environment settings from the air conditioning control device 30.

[0026] The air blowing mechanism 102 blows out air according to the control signal received by the communication unit 101.

[0027] Each environment setting terminal 20 includes, as shown in FIG. 3, an output unit 201, a display unit 202, an input unit 203, and a storage unit 204. The environment setting terminal 20 is, for example, a smartphone.

[0028] The output unit 201 has a communication function and transmits requested environment settings to the air conditioning control device 30. The output unit 201 has a ultrasonic wave transducer and outputs ultrasonic waves. The output unit 201 transmits the requested environment settings to the air conditioning control device 30 by superimposing information of the requested environment settings on the ultrasonic waves. Note that an output unit 201 according to another embodiment of the present invention may transmit the requested environment settings to the air conditioning control device 30 using means other than ultrasonic waves (for example, radio waves).

[0029] The display unit 202 displays setting content of the requested environment settings transmitted to the air conditioning control device 30. Specifically, the display unit 202 displays, as shown in FIG. 4, the requested environment settings of a temperature, an air volume, a humidity, and an air direction.

[0030] The input unit 203 receives an input of the requested environment settings including at least one of the temperature, the air volume, the humidity, and the air direction designated by an operation of a user. The input unit 203 writes the received requested environment settings in the storage unit 204.

[0031] The storage unit 204 stores the requested environment settings of the user.

[0032] The air conditioning control device 30 includes, as shown in FIG. 5, an acquisition unit 301 (an example of a requested environment acquisition unit, an example of a position acquisition unit), an identification unit 302, and a control unit 303.

[0033] The acquisition unit 301 acquires each requested environment setting requested by each of a plurality of users. Specifically, the acquisition unit 301 acquires requested environment settings from each environment setting terminal 20.

[0034] In addition, the acquisition unit 301 acquires each user's position at which each of the plurality of users is present. Specifically, the acquisition unit 301 includes three or more ultrasonic wave receivers (for example, ultrasonic wave microphones), for example, on a ceiling of the room equipped with the indoor unit for air conditioning 10. The acquisition unit 301 detects ultrasonic waves from each environment setting terminal 20. The acquisition unit 301, with regard to ultrasonic waves of any one frequency, calculates a position of the environment setting terminal 20 that is a sound source of the ultrasonic waves, that is, a user's position, on the basis of a time difference in timing at which respective ultrasonic wave receivers detect the ultrasonic waves, positions at which respective ultrasonic wave receivers are installed, and speeds at which the ultrasonic waves are propagated in a space (mainly air) inside the room equipped with the indoor unit for air conditioning 10.

[0035] More specifically, the acquisition unit 301 extracts ultrasonic waves of a specific frequency among the ultrasonic waves detected by each ultrasonic wave receiver. The acquisition unit 301 identifies a phase of the extracted ultrasonic wave in each ultrasonic wave receiver, and calculates a phase difference between respective ultrasonic wave receivers, that is, an arrival time difference between ultrasonic waves. The acquisition unit 301 converts the phase difference between respective ultrasonic wave receivers into a difference in distance between respective ultrasonic wave receivers. The acquisition unit 301 estimates the user's position based on the difference in distance between respective ultrasonic wave receivers.

[0036] The acquisition unit 301 calculates the user's position for all of the ultrasonic waves of different frequencies.

[0037] Note that, when the acquisition unit 301 includes N ultrasonic wave receivers (N>3), it may estimate the user's position for each of all combinations of selecting three among N, and set an average value of these as the user's position. In this manner, the acquisition unit 301 can estimate the user's position with higher accuracy.

[0038] Note that, when the acquisition unit 301 has detected a plurality of ultrasonic waves of the same frequency at the same time, the acquisition unit 301 cannot identify a position of a sound source of the ultrasonic waves because the plurality of ultrasonic waves of the same frequency interfere with each other. For this reason, when the acquisition unit 301 has detected a plurality of ultrasonic waves of the same frequency at the same time, the acquisition unit 301 may attempt to detect ultrasonic waves again after a predetermined time elapses. In this case, a different frequency may be

assigned to each environment setting terminal 20 in advance such that respective ultrasonic waves have different frequencies and frequencies of ultrasonic waves output from each environment setting terminal 20 do not interfere with each other.

[0039] The identification unit 302 identifies actual environment settings that bring an environment at users' positions of a plurality of users (for example, all users) who have set requested environment settings closer to the requested environment settings on the basis of each requested environment setting and each user's position.

[0040] Specifically, the identification unit 302 sets a difference between each requested environment setting that is a target value and an actual environment at each user's position as a target function, and identifies actual environment settings in which a value of this target function is a small value.

[0041] More specifically, the identification unit 302 identifies actual environment settings in which a target function J shown in Equation (1) as follows is a small value.

[Equation 1]

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

[0042] The vector x(i) shown in Equation (1) is a vector indicating each requested environment setting such as an actual temperature, an actual humidity, an actual air volume, and an actual air direction at a position at which a user i (i=1, 2, .., or N) is present. The vector x(i) is made from M elements ($x(i)_1$, $x(i)_2$, .., and $x(i)_M$), and each element ($x(i)_1$, x(i)2, .., or $x(i)_M$) indicates actual values (a scalar amount) for temperature, humidity, air volume, and air direction at the position at which the user i is present. In addition, as shown in Equation (1), the vector x(i) is uniquely determined by a function F having the control parameters (a1, a2, a3, a4, .., and the like) of the indoor unit for air conditioning 10 as input variables. Note that in turning the air direction into numeric values, for example, when the air direction in a vertical direction is defined by n stages from an air direction toward the uppermost side to an air direction toward the lowermost side, the n stages from the air direction toward the uppermost side to the air direction toward the lowermost side may be turned into numeric values using integers from 1 to n. In addition, in turning the air direction into numeric values, for example, when the air direction in a horizontal direction is defined by m stages from an air direction toward the leftmost side to an air direction toward the rightmost side, the m stages from the air direction toward the leftmost side to the air direction toward the rightmost side may be designated by numeric values using integers from 1 to m. If the air direction is designated by numeric values in this manner, a difference between a numeric value indicating a target air direction and a numeric value indicating an actual air direction at the user's position can be expressed and can be calculated in the same manner as numeric values of a temperature, an air volume, and a humidity.

[0043] Moreover, a vector x*(i) is a vector indicating a temperature, a humidity, an air volume, an air direction, and the like desired by the user i. The vector x*(i) is made from M elements ($x^*(i)_1$, $x^*(i)_2$, .., and $x^*(i)_M$), and each element ($x^*(i)_1$, $x^*(i)_2$, .., or $x^*(i)_M$) indicates a temperature, a humidity, an air volume, an air direction, and the like desired by the user i.

[0044] As shown in Equation (1), an objective function J obtains an error rate ($(x(i)_k\text{-}x^*(i)_k/x^*(i)_k)$) for each k^{th} (k=1, .., M) element of the vector x(i), and adds the error rates of all elements together. Then, the objective function J is derived by further adding up a sum of the error rates obtained for each user i by all users.

[0045] "M" is the number of elements configuring the vector x(i) and the vector x*(i), and is the total number of physical quantities that may be set by a user, a temperature, a humidity, an air volume, an air direction, and the like.

[0046] "N" is the number of users present in a space equipped with the indoor unit for air conditioning 10, and, more specifically, the number of the environment setting terminals 20 detected through ultrasonic waves.

[0047] Each of "wd(i,k)" is a weighting coefficient separately defined for each element and "wd(i,k)" are all "1" (the same value) in general operations. However, for example, each user may set "wd(i,k)" for each element (temperature, humidity, air volume, air direction,.., and the like), and apply preferences indicating which physical quantities are considered to be important. Based on this weighting coefficient wd(i,k), for example, it is possible to respond to detailed requests by the same person such as "I particularly wish an "air volume" request to be performed after I have returned from the heat outdoors" or "I wish the "humidity" to be a preferred value during the rainy season."

[0048] Each of "wp(i)" is a weighting coefficient separately defined for each user, and "wp(i)" are all "1" (the same value) in general operations. However, for example, when special considerations are important, such as requests of users prone to heat strokes, aged users, executive users, or the like , the weighting coefficient for each user i may be changed.

[0049] In addition, settings of a temperature, an air volume, a humidity, an air direction, and the like may be normalized, and, for example, when the temperature is considered important among the setting items, a weighting coefficient wi of the temperature may be made larger than other weighting coefficients wi for the air volume, the humidity, the air direction, or the like other than the temperature.

[0050] In addition, when there are L air blowing-out ports (L> 1) in the room equipped with the indoor unit for air conditioning 10, actual environment settings of the temperature, air volume, humidity, air direction, and the like for each air blowing-out port may be set.

[0051] The identification unit 302 models an airflow and heat radiation inside the room equipped with the indoor unit for air conditioning 10, changes model parameters of this model, and calculates actual values of the temperature, air volume, humidity, air direction, and the like after a predetermined time at each user's position inside the room equipped with the indoor unit for air conditioning 10 using simulation. At this time, when there are L (L> 1) air blowing-out ports inside the room equipped with the indoor unit for air conditioning 10, combinations of actual environment settings such as the temperature, the air volume, the humidity, and the air direction for each air blowing-out port are variously changed. Note that modeling an airflow and heat radiation inside a room equipped with the indoor unit for air conditioning 10 may be modeled using model parameters derived from equations that have been confirmed to be theoretically correct, experiments performed in advance, or the like.

[0052] The identification unit 302 identifies actual environment settings in which the identified target function J is a small value for each setting item calculated by simulation for a combination of various actual environment settings that have been changed. Note that an algorithm used by the identification unit 302 at the time of identifying the actual environment settings in which the target function J is a small value is not limited as long as correct actual environment settings can be identified. The identification unit 302 may use a hill climbing method, a simulated annealing (SA method), a genetic algorithm (GA), a simultaneous perturbation probability approximation (SPSA) algorithm, or the like. The function F may be based on, for example, physical simulation of temperature distribution, humidity distribution, and air volume distribution in a space based on the airflow and the heat radiation.

[0053] The control unit 303 controls the indoor unit for air conditioning 10 on the basis of the actual environment settings identified by the identification unit 302.

[0054] Next, processing of the air conditioning system 1 according to one embodiment of the present invention will be described.

[0055] Here, a processing flow of the air conditioning control device 30 shown in FIG. 6 will be described.

[0056] The input unit 203 receives an input of requested environment settings including at least one of a temperature, an air volume, a humidity, and an air direction designated by an operation of a user. The input unit 203 writes the received requested environment settings in the storage unit 204.

[0057] The storage unit 204 stores the requested environment settings of the user.

[0058] The output unit 201 outputs ultrasonic waves on which information of the requested environment settings of the user is superimposed to the air conditioning control device 30.

[0059] The acquisition unit 301 acquires requested environment settings requested by each of the plurality of users (step S1). Specifically, the acquisition unit 301 detects ultrasonic waves from each environment setting terminal 20 and acquires requested environment settings included in the detected ultrasonic waves.

[0060] In addition, the acquisition unit 301 acquires each user's position at which each of the plurality of users is present (step S2).

[0061] Specifically, the acquisition unit 301 extracts ultrasonic waves of a specific frequency from the ultrasonic waves detected by each ultrasonic wave receiver. The acquisition unit 301 identifies a phase of the extracted ultrasonic wave in each ultrasonic wave receiver, and calculates a phase difference between respective ultrasonic wave receivers, that is, an arrival time difference between ultrasonic waves. The acquisition unit 301 converts the phase difference between respective ultrasonic wave receivers into a difference in distance between respective ultrasonic wave receivers. The acquisition unit 301 estimates the user's position on the basis of the difference in distance between respective ultrasonic wave receivers.

[0062] The acquisition unit 301 calculates the user's position for all of the ultrasonic waves of different frequencies.

[0063] The identification unit 302 identifies actual environment settings that bring environments at the user's positions of the plurality of users who have set requested environment settings closer to the requested environment settings on the basis of each requested environment setting and each user's position (step S3).

[0064] Specifically, the identification unit 302 sets a difference between each requested environment setting that is a target value and an actual environment at each user's position as a target function, and identifies actual environment settings in which a value of the target function is a small value.

[0065] More specifically, the identification unit 302 identifies actual environment settings in which the target function J shown in Equation (1) is a small value.

[0066] In addition, in the room equipped with the indoor unit for air conditioning 10, when there are L (L> 1) air blowing-out ports, the identification unit 302 sets actual environment settings such as the temperature, the air volume, the humidity, and the air direction for each air blowing-out port (step S4).

[0067] The identification unit 302 models an air flow and a heat radiation inside the room equipped with the indoor unit for air conditioning 10, calculates the function F by changing model parameters of this model, and calculates actual values of a temperature, an air volume, a humidity, an air direction, and the like after a predetermined time at each user's position inside the room equipped with the indoor unit for air conditioning 10 using simulation (step S5). At this time, when there are L (L> 1) air blowing-out ports in the room equipped with the indoor unit for air conditioning 10, combinations of actual environment settings such as the temperature, the air volume, the humidity, and the air direction for each air blowing-out port are variously changed (step S6).

[0068] The identification unit 302 identifies the actual environment settings in which the identified target function J is a small value for each setting item calculated using simulation for a combination of various actual environment settings which have been changed (step S7).

[0069] The control unit 303 controls the indoor unit for air conditioning 10 on the basis of the actual environment settings identified by the identification unit 302 (step S8).

[0070] As described above, the air conditioning system 1 according to one embodiment of the present invention has been described.

[0071] In the air conditioning system 1 according to one embodiment of the present invention, the air conditioning control device 30 acquires requested environment settings requested by each of the plurality of users and each user's position at which each of the plurality of users is present. The air conditioning control device 30 identifies actual environment settings which bring an environment at the users' positions of the plurality of users who have set requested environment settings closer to the requested environment settings on the basis of each requested environment setting and each user's position. The air conditioning control device 30 controls the indoor unit for air conditioning on the basis of the actual environment settings.

[0072] In this manner, the air conditioning control device 30 can realize air conditioning settings with a high degree of satisfaction for all users inside a room where a plurality of users set air conditioning settings when the air conditioning settings are performed.

[0073] Note that, it is described that the identification unit 302 sets a difference between each requested environment setting that is a target value and actual environment settings that are setting values to be actually set as a target function, and identifies actual environment settings in which a value of this target function is a small value in one embodiment of the present invention. However, the identification unit 302 according to another embodiment of the present invention may turn a degree of satisfaction of users into numeric values to set the degree of satisfaction as a target function, and identify actual environment settings in which the target function is a maximum value. For example, the degree of satisfaction of users turned into numeric values may be expressed as a reciprocal of the difference between each requested environment setting and that is a target value and actual environment settings that are setting values to be actually set.

[0074] Note that it is described that the acquisition unit 301 identifies the user's position on the basis of a difference in timing at which three or more ultrasonic wave receivers detect ultrasonic waves in one embodiment of the present invention. However, the user's position may also be identified using another method described below in other embodiments of the present invention.

[0075] For example, a user may perform an operation of designating the user's position with a number indicating an area on a map as shown in FIG. 7 displayed on the display unit 202 of the environment setting terminal 20. The environment setting terminal 20 transmits the user's position to the air conditioning control device 30 according to the operation of designating the user's position by the user. Then, the acquisition unit 301 acquires the user's position from the environment setting terminal 20. Note that an air blowing-out port F is shown in FIG. 7.

[0076] Moreover, for example, the environment setting terminal 20 may transmit a signal of communication using radio waves such as Bluetooth (registered trademark) Low Energy to the air conditioning control device 30. Then, the acquisition unit 301 identifies the user's position on the basis of a radio wave intensity of a signal received from the environment setting terminal 20.

[0077] In addition, for example, the air conditioning control device 30 may acquire and store information at each position in the room equipped with the indoor unit for air conditioning 10 in advance. Moreover, the air conditioning control device 30 may store each user and a face image thereof in association with each other in advance. The acquisition unit 301 has a face authentication function and identifies a position at which a user is authenticated by face in the room equipped with the indoor unit for air conditioning 10 as the user position of the user.

[0078] In addition, for example, the environment setting terminal 20 may have an imaging function and capture a predetermined mark (for example, a barcode). The environment setting terminal 20 transmits an image of the captured predetermined mark to the air conditioning control device 30. The acquisition unit 301 identifies a position at which the

environment setting terminal 20 has captured the predetermined mark and identifies the identified position as the user position on the basis of a deformation method of the predetermined mark in the image captured by the environment setting terminal 20 and a position of the predetermined mark in the room equipped with the indoor unit for air conditioning 10.

[0079] In this manner, the air conditioning system 1 does not need to use the specific method at the time of identifying the user's position, and can select a method according to a situation.

[0080] Note that processing of the air conditioning system 1 in the embodiments of the present invention may be switched in order of processing within a range in which appropriate processing is performed.

[0081] Each of the storage unit 204 and a storage device (including a register and a latch) in the embodiment of the present invention may be provided anywhere within a range in which appropriate information is transmitted and received. In addition, each of a plurality of storage units 204 and a plurality of the storage devices may be present to store a plurality of pieces of data in a distributed manner within a range in which the transmission and reception of the appropriate information is performed.

[0082] Although the embodiments of the present invention have been described, each of the indoor unit for air conditioning 10, the environment setting terminal 20, the air conditioning control device 30, and other control devices described above may have a computer system inside. In addition, a procedure of the process described above is stored in a form of a program in a computer-readable recording medium, and the process is performed by a computer reading and executing the program. A specific example of the computer is shown below.

[0083] FIG. 8 is a schematic block diagram showing a constitution of a computer according to at least one embodiment.

[0084] A computer 5 includes, as shown in FIG. 8, a CPU 6, a main memory 7, a storage 8, and an interface 9.

[0085] For example, each of the indoor unit for air conditioning 10, the environment setting terminal 20, the air conditioning control device 30, and other control devices is mounted on the computer 5. In addition, operations of each of the processing unit described above are stored in the storage 8 in a form of a program. The CPU 6 reads the program from the storage 8, develops the program in the main memory 7, and executes the process described above in accordance with the program. In addition, the CPU 6 secures a storage region corresponding to each storage unit described above in the main memory 7 in accordance with the program.

[0086] Examples of the storage 8 include a hard disk drive (HDD), a solid state drive (SSD), a magnetic disk, an optical magnetic disk, a compact disc read only memory (CD-ROM), a digital versatile disc read only memory (DVD-ROM), a semiconductor memory, and the like. The storage 8 may be internal media that is directly connected to a bus of the computer 5 or may be external media connected to the computer 5 through an interface 9 or a communication line. In addition, in a case in which the program is distributed to the computer 5 via the communication line, the computer 5 that has received the distribution may develop the program in the main memory 7 and execute the process described above. In at least one embodiment, the storage 8 is a non-transitory tangible storage medium.

[0087] In addition, the above-described program may realize part of the functions described above. Furthermore, the above-described program may be a file capable of realizing the function described above in combination with a program that is already recorded in a computer system, a so-called differential file (differential program).

[0088] Although some embodiments of the present invention have been described, these embodiments are examples and do not limit the scope of the invention. In these embodiments, various additions, various omissions, and various replacements, and various changes may be made in a range not departing from the gist of the invention.

[Industrial Applicability]

[0089] According to the air conditioning control device, the air conditioning system, the control method, and the program according to the embodiments of the present invention, it is possible to realize air conditioning settings with a high degree of satisfaction for all users in a room where the plurality of users set air conditioning settings when the air conditioning settings are performed.

[Reference Signs List]

[0090]

1 Air conditioning system
5 Computer
6 CPU
7 Main memory
8 Storage
9 Interface
10 Indoor unit for air conditioning

20 20a1, 20a2, 20an Environment setting terminal
30 Air conditioning control device
101 Communication unit
102 Air blowing mechanism
201 Output unit
202 Display unit
203 Input unit
204 Storage unit
301 Acquisition unit
302 Identification unit
303 Control unit

Claims

1. An air conditioning control device comprising:

a requested environment acquisition unit configured to acquire requested environment settings from each of a plurality of users;
a position acquisition unit configured to acquire users' positions at which each of the plurality of users is present;
an identification unit configured to identify actual environment settings which bring an environment at users' positions of the plurality of users who have set requested environment settings closer to the requested environment settings on the basis of the requested environment settings and the users' positions; and
a control unit configured to control an indoor unit for air conditioning on the basis of the identified actual environment settings.

2. The air conditioning control device according to claim 1,
wherein the actual environment settings are settings of at least one of a temperature, an air volume, a humidity, and an air direction.

3. The air conditioning control device according to claim 1 or 2,
wherein the requested environment acquisition unit acquires the requested environment settings from environment setting terminals of each of the plurality of users.

4. The air conditioning control device according to any one of claims 1 to 3,
wherein the position acquisition unit acquires the user's position from the environment setting terminal of each of the plurality of users.

5. An air conditioning system comprising:

the air conditioning control device described in any one of claims 1 to 4; and
the indoor unit for air conditioning configured to blow out air on the basis of control performed by the air conditioning control device.

6. A control method comprising the steps of:

acquiring requested environment settings from each of a plurality of users;
acquiring users' positions at which each of the plurality of users is present;
identifying actual environment settings which bring an environment at users' positions of the plurality of users who have set requested environment settings closer to the requested environment settings on the basis of the requested environment settings and the users' positions; and
controlling an indoor unit for air conditioning on the basis of the identified actual environment settings.

7. A program which causes a computer to execute the steps of:

acquiring requested environment settings from each of a plurality of users;
acquiring users' positions at which each of the plurality of users is present;
identifying actual environment settings which bring an environment at users' positions of the plurality of users

who have set requested environment settings closer to the requested environment settings on the basis of the requested environment settings and the users' positions; and
controlling an indoor unit for air conditioning on the basis of the identified actual environment settings.

FIG. 1

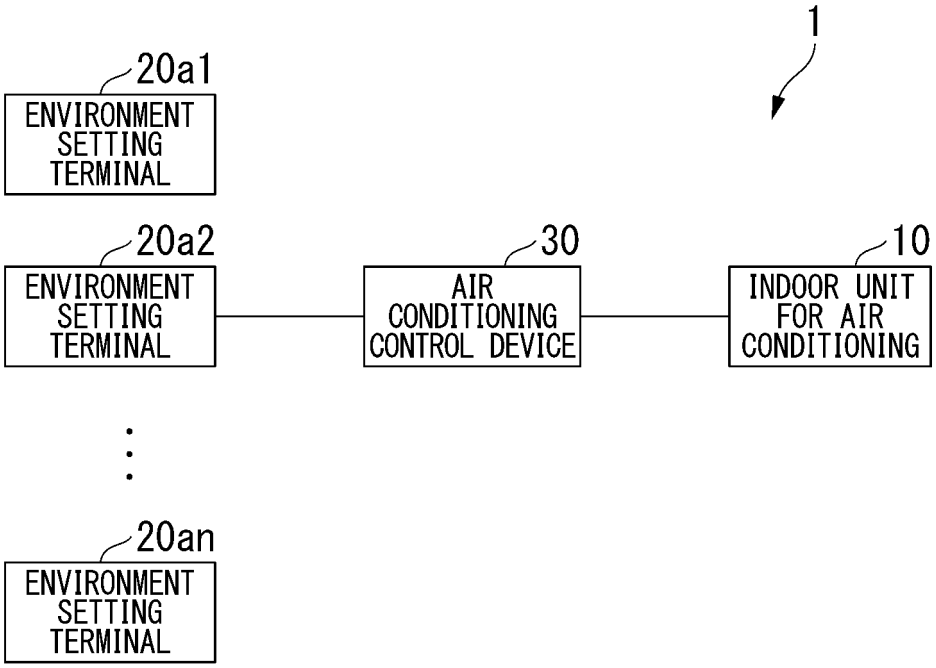

1
20a1
ENVIRONMENT SETTING TERMINAL
20a2
ENVIRONMENT SETTING TERMINAL
30
AIR CONDITIONING CONTROL DEVICE
10
INDOOR UNIT FOR AIR CONDITIONING
20an
ENVIRONMENT SETTING TERMINAL

FIG. 2

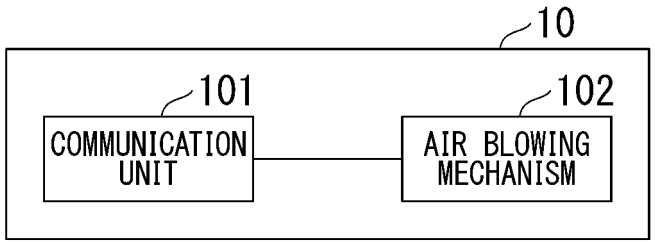

10
101
COMMUNICATION UNIT
102
AIR BLOWING MECHANISM

FIG. 3

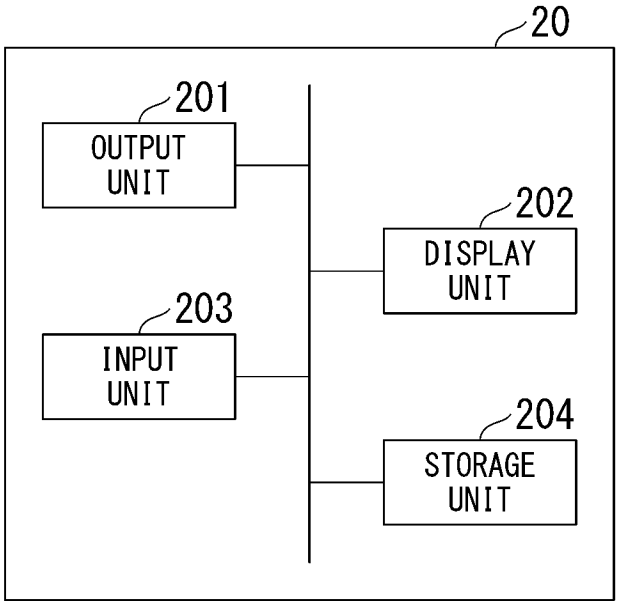

20
201
OUTPUT UNIT
202
DISPLAY UNIT
203
INPUT UNIT
204
STORAGE UNIT

FIG. 4

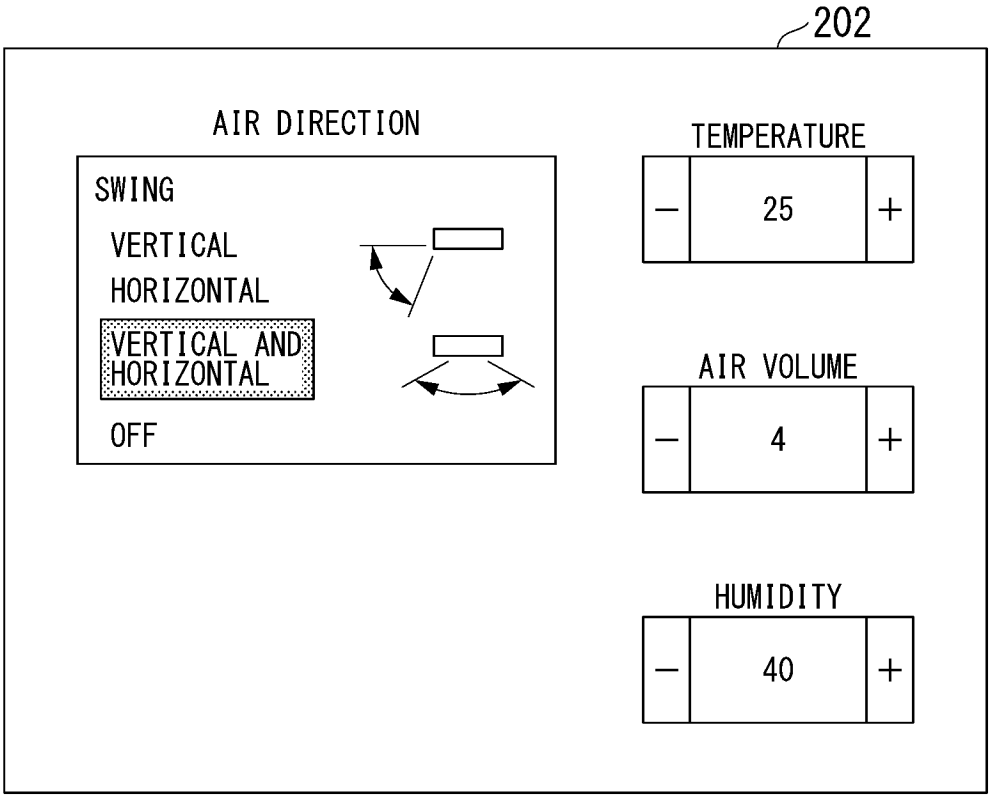
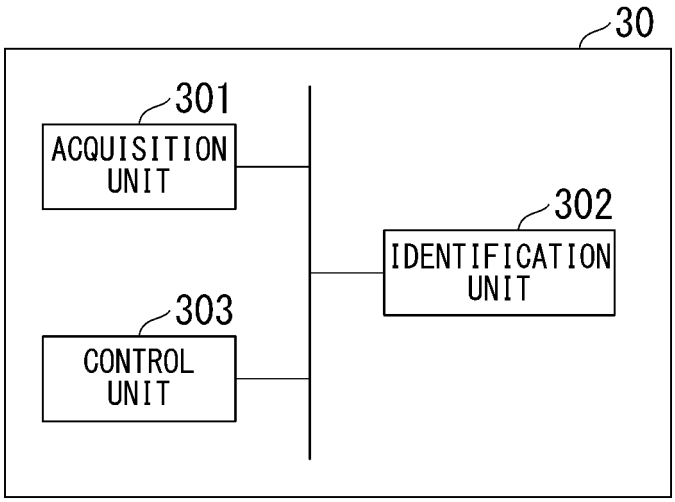

202
AIR DIRECTION
SWING
VERTICAL
HORIZONTAL
VERTICAL AND HORIZONTAL
OFF
TEMPERATURE
−
25
+
AIR VOLUME
−
4
+
HUMIDITY
−
40
+

FIG. 5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301
ACQUISITION UNIT
302
IDENTIFICATION UNIT
303
CONTROL UNIT

FIG. 6

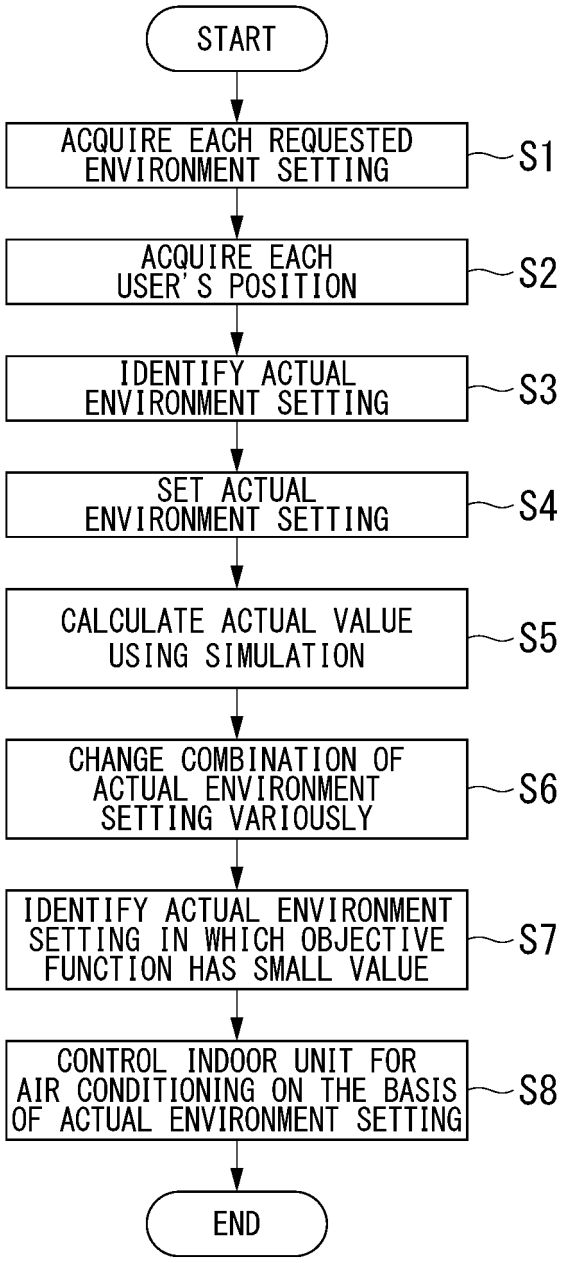
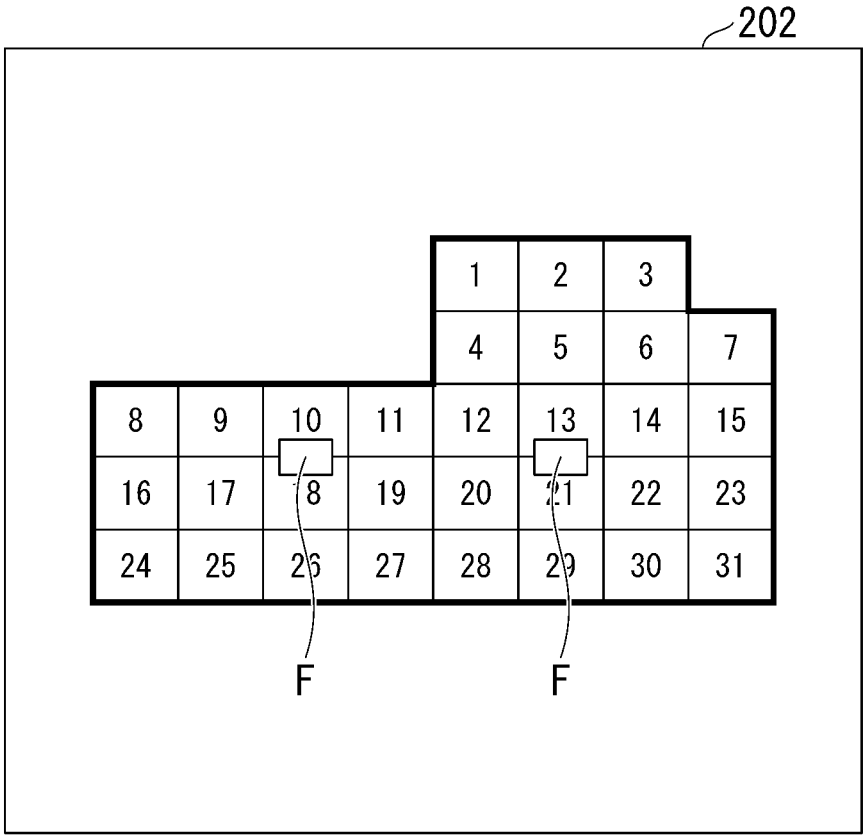

START
ACQUIRE EACH REQUESTED ENVIRONMENT SETTING
S1
ACQUIRE EACH USER'S POSITION
S2
IDENTIFY ACTUAL ENVIRONMENT SETTING
S3
SET ACTUAL ENVIRONMENT SETTING
S4
CALCULATE ACTUAL VALUE USING SIMULATION
S5
CHANGE COMBINATION OF ACTUAL ENVIRONMENT SETTING VARIOUSLY
S6
IDENTIFY ACTUAL ENVIRONMENT SETTING IN WHICH OBJECTIVE FUNCTION HAS SMALL VALUE
S7
CONTROL INDOOR UNIT FOR AIR CONDITIONING ON THE BASIS OF ACTUAL ENVIRONMENT SETTING
S8
END

FIG. 7


202
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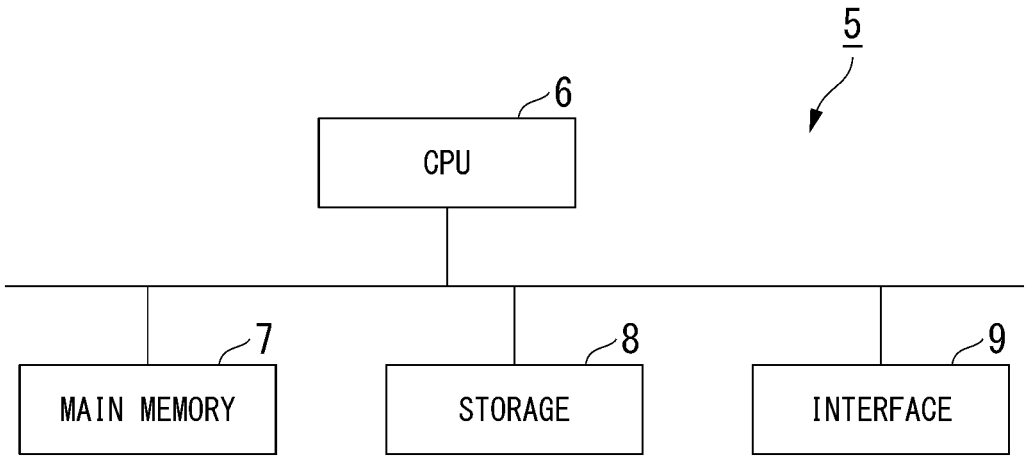
F

FIG. 8


5
6
CPU
7
MAIN MEMORY
8
STORAGE
9
INTERFACE

INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP2018/015772

A. CLASSIFICATION OF SUBJECT MATTER
Int.Cl. F24F11/80(2018.01)i, F24F11/54(2018.01)i, F24F11/74(2018.01)i, F24F11/79(2018.01)i, F24F120/12(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. F24F11/80, F24F11/54, F24F11/74, F24F11/79, F24F120/12

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

Published examined utility model applications of Japan	1922–1996
Published unexamined utility model applications of Japan	1971–2018
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 2011-75138 A (MITSUBISHI ELECTRIC CORP.) 14 April 2011, paragraphs [0014]-[0132], fig. 1, 3, 5 (Family: none)	1-7
Y	JP 2015-87102 A (RICOH CO., LTD.) 07 May 2015, paragraphs [0005], [0011]-[0051], [0062]-[0074], fig. 5, 10-12 & US 2015/0088313 A1, paragraphs [0026]-[0067], [0078]-[0090], fig. 5, 10-12	1-7
A	JP 2013-124809 A (MITSUBISHI ELECTRIC BUILDING TECHNO-SERVICE CO., LTD.) 24 June 2013, entire text, all drawings (Family: none)	1-7
A	JP 2007-107782 A (DAIKIN INDUSTRIES, LTD.) 26 April 2007, entire text, all drawings (Family: none)	1-7

☐ 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
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"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
28 May 2018 (28.05.2018)	12 June 2018 (12.06.2018)

Name and mailing address of the ISA/	Authorized officer
Japan Patent Office 3-4-3, Kasumigaseki, Chiyoda-ku, Tokyo 100-8915, Japan	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 2017128992 A **[0002]**
- JP 4737037 B **[0004]**