

[DESCRIPTION]

[Title of Invention] AIR CONDITIONING CONTROL SYSTEM, AIR
CONDITIONING CONTROL METHOD, AND PROGRAM

[Technical Field]

5 [0001]

The present invention relates to, for example, an air conditioning control system for controlling air conditioning equipment.

[Background Art]

10 [0002]

PTL 1 discloses an air conditioning control system. This air conditioning control system includes an air conditioner, a setting unit, a controller, and a learning unit. The air conditioner performs air conditioning of the indoor air. The setting unit sets a first
15 temperature and a second temperature. The first temperature is a target temperature for a first area of the indoor space. The second temperature is a target temperature for a second area of the indoor space. The controller controls the air conditioner to bring the temperature of the first area closer to the first temperature and to
20 bring the temperature of the second area closer to the second temperature. The learning unit learns to control the air conditioner to bring the temperature of the first area closer to the first temperature and to bring the temperature of the second area closer to the second temperature.

25 [Citation List]

[Patent Literature]

[0003]

[PTL 1] Japanese Unexamined Patent Application Publication No.
2021-32479

30 [Summary of Invention]

[Technical Problem]

[0004]

The present invention provides an air conditioning control system and the like that can easily shorten the time until the area
35 temperature of a target area reaches a target temperature while

reducing power consumption.

[Solution to Problem]

[0005]

5 An air conditioning control system according to one aspect of the present invention includes an obtainer, a calculator, and a controller. The obtainer obtains an area temperature of a target area among areas in each of which one or more indoor units are provided, and a target temperature of the target area. The calculator determines the control content of the one or more indoor
10 units for each of the areas. The controller controls, for each of the areas, the one or more indoor units in the area based on the control content determined by the calculator. The calculator so determines the control content as to: cause a set temperature of the one or more indoor units in each of the areas to be the target temperature of the target area in an initial period from when operation of the one or
15 more indoor units in the target area starts until the area temperature of the target area reaches the target temperature of the target area; and after the initial period, return the control content to a state before the initial period in each of the areas excluding the target
20 area.

[0006]

An air conditioning control system according to one aspect of the present invention includes an obtainer, a calculator, and a controller. The obtainer obtains an area temperature of each of
25 areas in each of which one or more indoor units are provided, and a target temperature of each of the areas. The calculator determines the control content of the one or more indoor units for each of the areas. The controller controls, for each of the areas, the one or more indoor units in the area based on the control content
30 determined by the calculator. Based on the target temperature of each of the areas, the calculator determines an area from among the areas that satisfies a predetermined condition as a target area. The calculator so determines the control content as to: cause a set temperature of the one or more indoor units in each of the areas to
35 be the target temperature of the target area in an initial period from

when operation of the one or more indoor units in the target area starts until the area temperature of the target area reaches the target temperature of the target area; and after the initial period, return the control content to a state before the initial period in each of the areas excluding the target area.

[0007]

An air conditioning control method according to one aspect of the present invention includes obtaining, determining, and controlling. In the obtaining, an area temperature of a target area among areas in each of which one or more indoor units are provided, and a target temperature of the target area are obtained. In the determining, the control content of the one or more indoor units is determined for each of the areas. In the controlling, for each of the areas, the one or more indoor units in the area are controlled based on the control content determined in the determining. In the determining, the control content is so determined as to: cause a set temperature of the one or more indoor units in each of the areas to be the target temperature of the target area in an initial period from when operation of the one or more indoor units in the target area starts until the area temperature of the target area reaches the target temperature of the target area; and after the initial period, return the control content to a state before the initial period in each of the areas excluding the target area.

[0008]

An air conditioning control method according to one aspect of the present invention includes obtaining, determining, and controlling. In the obtaining, an area temperature of each of areas in each of which one or more indoor units are provided, and a target temperature of each of the areas are obtained. In the determining, the control content of the one or more indoor units is determined for each of the areas. In the controlling, for each of the areas, the one or more indoor units in the area are controlled based on the control content determined in the determining. The determining includes determining, based on the target temperature of each of the areas, an area from among the areas that satisfies a predetermined

condition as a target area. In the determining, the control content is so determined as to: cause a set temperature of the one or more indoor units in each of the areas to be the target temperature of the target area in an initial period from when operation of the one or more indoor units in the target area starts until the area temperature of the target area reaches the target temperature of the target area; and after the initial period, return the control content to a state before the initial period in each of the areas excluding the target area.

[0009]

A program according to one aspect of the present invention causes one or more processors to execute the air conditioning control method.

[Advantageous Effects of Invention]

[0010]

The air conditioning control system and the like according to the present invention has an advantage that the time until the area temperature of a target area reaches a target temperature can be easily shortened while reducing power consumption.

[Brief Description of Drawings]

[0011]

[FIG. 1]

FIG. 1 is a block diagram illustrating the overall configuration including an air conditioning control system according to an embodiment of the present disclosure.

[FIG. 2]

FIG. 2 is a flowchart illustrating operations performed in a first control example by an air conditioning control system according to an embodiment of the present disclosure.

[FIG. 3]

FIG. 3 illustrates a temperature distribution of areas in a first control example of an air conditioning control system according to an embodiment of the present disclosure.

[FIG. 4]

FIG. 4 is a flowchart illustrating operations performed in a

second control example by an air conditioning control system according to an embodiment of the present disclosure.

[FIG. 5]

FIG. 5 illustrates a temperature distribution of areas in a second control example of an air conditioning control system according to an embodiment of the present disclosure.

[FIG. 6]

FIG. 6 is a diagram for explaining the analysis model used in a simulation.

10 [FIG. 7]

FIG. 7 is a diagram for explaining a first analysis of the simulation.

[FIG. 8]

FIG. 8 is a diagram for explaining a second analysis of the simulation.

[FIG. 9]

FIG. 9 is a diagram for explaining the results of the first analysis of the simulation.

[FIG. 10]

FIG. 10 is a diagram for explaining the results of the second analysis of the simulation.

[Description of Embodiments]

[0012]

[Embodiment]

Hereinafter, one or more embodiments of the present disclosure will be described in detail with reference to the drawings. Each embodiment described below illustrates a general or specific example. The numerical values, shapes, materials, elements, the arrangement and connection of the elements, steps, order of the steps, etc., shown in the following embodiments are mere examples, and therefore do not limit the scope of the present invention. Accordingly, among the elements in the following embodiments, those not recited in any of the independent claims are described as optional elements.

35 [0013]

Note that the figures are schematic diagrams and are not necessarily precise illustrations. In the figures, elements that are essentially the same share the same reference signs, and repeated description may be omitted or simplified in some cases.

5 [0014]

[1. Overall Configuration]

First, the overall configuration including the air conditioning control system according to the embodiment will be described with reference to FIG. 1. FIG. 1 is a block diagram illustrating the overall configuration including air conditioning control system 100 according to the embodiment. Air conditioning control system 100 is a system for controlling the area temperature of each area A1 by controlling one or more indoor units 2 provided in each area A1 in space Sp1 including a plurality of areas A1.

15 [0015]

Space Sp1 is a space within a facility such as a large room of an office, and includes a plurality of areas A1. In the embodiment, one or more desks and one or more chairs provided in each area A1 for users to perform office work and the like, and in this way, each area A1 is a space where one or more users can perform office work and the like. In the embodiment, the boundaries of each area A1 are not clearly defined, but for example, by installing partitions or the like, the boundaries of each area A1 may be clearly defined. Note that in space Sp1, adjacent areas A1 may be partitioned or may not be partitioned, but even when they are partitioned, heat can be exchanged between adjacent areas A1.

[0016]

Each area A1 includes one or more indoor units 2. Therefore, space Sp1 includes indoor units 2 in the same number as the number of areas A1, or in a number greater than the number of areas A1. In the embodiment, each indoor unit 2 is an indoor unit of a commercial air conditioner, but it may be an indoor unit of a household air conditioner. In the embodiment, each indoor unit 2 is a ceiling-embedded cassette unit, but this example is non-limiting. For example, indoor unit 2 may be a ceiling-embedded duct unit, a

ceiling-suspended unit, or a floor-standing unit. In the embodiment, each indoor unit 2 is capable of performing both cooling and heating. Note that each indoor unit 2 may be configured to be capable of only performing cooling, or may be configured to be capable of only performing heating.

[0017]

The area temperature is the air temperature of the corresponding area A1. In the embodiment, the area temperature is based on the temperature detected by a temperature sensor included in indoor unit 2 provided in corresponding area A1. For example, when one indoor unit 2 is provided in an arbitrary area A1, the area temperature of that area A1 is a temperature based on the temperature detected by a temperature sensor included in that indoor unit 2. For example, when a plurality of indoor units 2 are provided in an arbitrary area A1, the area temperature of that area A1 is a temperature based on a representative value (for example, an average value) of the temperatures detected by a plurality of temperature sensors respectively included in the plurality of indoor units 2. Note that when a temperature sensor is provided in an arbitrary area A1, the area temperature of that area A1 may be a temperature based on the temperature detected by that temperature sensor.

[0018]

In the embodiment, air conditioning control system 100 is implemented by server 10 as illustrated in FIG. 1. Server 10 is configured to be capable of communicating with each of indoor units 2 via network N1, one example of which is the internet. Server 10 is configured to be capable of communicating with input device 3 via network N1, one example of which is the internet. The communication between server 10 and each indoor unit 2 may be wireless or wired communication. The communication between server 10 and input device 3 may be wireless or wired communication.

[0019]

Input device 3 is, for example, a controller dedicated to air

conditioning control system 100, or an information terminal possessed by a user. The information terminal may include, for example, a smartphone, a tablet terminal, or a personal computer. Input device 3 is configured to accept various inputs from a user and to transmit information based on the accepted inputs to air conditioning control system 100. For example, input device 3 accepts input for selecting area A1 that the user uses or plans to use. For example, input device 3 accepts input for specifying a target temperature, which is a target value of the area temperature of an arbitrary area A1.

[0020]

[2. Configuration of Air Conditioning Control System]

Air conditioning control system 100 includes obtainer 11, calculator 12, controller 13, and storage 14. Note that it is sufficient if air conditioning control system 100 includes at least obtainer 11, calculator 12, and controller 13; air conditioning control system 100 need not include storage 14.

[0021]

Obtainer 11 obtains the area temperature of each area A1. In the embodiment, obtainer 11 obtains the temperature detected by the temperature sensor included in each indoor unit 2 by communicating with each indoor unit 2. Alternatively, obtainer 11 obtains the temperature detected by each temperature sensor by communicating with temperature sensors provided in areas A1. Obtainer 11 obtains the area temperature by performing appropriate correction calculations on the obtained temperature for each area A1. Alternatively, for each area A1, obtainer 11 takes the temperature obtained for area A1 as the area temperature.

[0022]

Obtainer 11 obtains the target temperature of each area A1. In the embodiment, obtainer 11 obtains the target temperature of each area A1 by communicating with input device 3. Note that for area A1 for which a target temperature is not input in input device 3, obtainer 11 does not obtain the target temperature of that area A1.

[0023]

Calculator 12 determines the control content of one or more indoor units 2 for each of areas A1. The control content includes control for operating one or more indoor units 2 of a target area A1 to bring the area temperature of that area A1 to the set temperature, and may include control for stopping the one or more indoor units 2 of that area A1. Specific examples of determination of control content by calculator 12 will be described in detail later in <First Control Example> and <Second Control Example> in the section "[3. Operation]".

[0024]

Controller 13 controls one or more indoor units 2 in each of areas A1 based on the control content determined by calculator 12. In the embodiment, controller 13 transmits a control signal including control content to one or more corresponding indoor units 2 per area A1 by communicating with each indoor unit 2. When indoor unit 2 receives a control signal, it is controlled according to the control content included in the received control signal.

[0025]

Storage 14 is a storage device in which information (computer programs, etc.) necessary for obtainer 11, calculator 12, and controller 13 to perform their respective functions is stored. Storage 14 also stores the area temperature of each area A1 and the target temperature of each area A1 obtained by obtainer 11. Storage 14 also stores the control content of each indoor unit 2 determined by calculator 12. Storage 14 may be implemented by a hard disk drive (HDD), and may be implemented by a semiconductor memory. Any known electronic information storage means may be used to implement storage 14 without particular limitation.

[0026]

[3. Operations]

Hereinafter, operations performed by air conditioning control system 100 according to the embodiment will be described. In the embodiment, air conditioning control system 100 can execute either one of the operations shown in the first control example or the operations shown in the second control example. For example, air

conditioning control system 100 may be configured to be capable of only the operations shown in the first control example, or may be configured to be capable of only the operations shown in the second control example. For example, from among the operations shown in the first control example and the operations shown in the second control example, air conditioning control system 100 may execute operations specified by user input via input device 3. The description that follows assumes that each indoor unit 2 performs cooling. Note that even when each indoor unit 2 performs heating, air conditioning control system 100 can execute either one of the operations shown in the first control example or the operations shown in the second control example.

[0027]

<First Control Example>

First, operations performed in the first control example by air conditioning control system 100 according to the embodiment will be described with reference to FIG. 2 and FIG. 3. FIG. 2 is a flowchart illustrating operations performed in the first control example by air conditioning control system 100 according to the embodiment. FIG. 3 illustrates a temperature distribution of areas A1 in the first control example of air conditioning control system 100 according to the embodiment. In FIG. 3, space Sp1 includes four areas A1: first area A11, second area A12, third area A13, and fourth area A14. In FIG. 3, the dot-hatched portions indicate the temperature distribution, where darker colored portions indicate lower area temperature, and lighter colored portions indicate higher area temperature.

[0028]

First, obtainer 11 obtains the area temperature and the target temperature of target area A2 among areas A1 (S11). In the first control example, target area A2 is area A1 that the user uses or plans to use. Target area A2 is determined based on the user's input on input device 3. In the example illustrated in FIG. 3, area A1 that the user uses or plans to use is third area A13. Therefore, in the example illustrated in FIG. 3, third area A13 becomes target area A2. Note that areas A1 excluding target area A2 are not being used by the

user or are not planned to be used by the user.

[0029]

Next, calculator 12 determines control content for the initial period for each indoor unit 2 (S12). Here, the initial period is a period from when operation of the one or more indoor units 2 in target area A2 start until the area temperature of target area A2 reaches the target temperature of target area A2. For example, when the target temperature of target area A2 is 28 degrees Celsius, the initial period is a period from when the one or more indoor units 2 in target area A2 start cooling until the area temperature of target area A2 reaches 28 degrees Celsius.

[0030]

More specifically, calculator 12 so determines the control content of all indoor units 2 as to cause the set temperature of all indoor units 2 to be the target temperature of target area A2 in the initial period. Stated differently, calculator 12 so determines the control content for each area A1 as to cause the set temperature of one or more indoor units 2 to be the target temperature of target area A2. For example, when the target temperature of target area A2 is 28 degrees Celsius, calculator 12 so determines the control content of all indoor units 2 as to cause the set temperature of all indoor units 2 to be 28 degrees Celsius.

[0031]

Next, controller 13 controls each indoor unit 2 based on the control content determined by calculator 12 (S13). With this, all indoor units 2 are controlled based on the control content for the one or more indoor units 2 in target area A2 determined by calculator 12. For example, when the target temperature of target area A2 is 28 degrees Celsius, all indoor units 2 perform cooling with a set temperature of 28 degrees Celsius.

[0032]

Thereafter, until the area temperature of target area A2 reaches the target temperature of target area A2 (that is, until the initial period elapses) (S14: No), calculator 12 does not change the control content of any indoor unit 2. Stated differently, until the

area temperature of target area A2 reaches the target temperature of target area A2, the control of each indoor unit 2 is maintained.

[0033]

When the area temperature of target area A2 reaches the target temperature of target area A2 (that is, when the initial period elapses) (S14: Yes), calculator 12 determines the control content for after the initial period for each indoor unit 2 (S15). More specifically, after the initial period, calculator 12 maintains the same control content for the one or more indoor units 2 in target area A2 as the control content established for the initial period. For each of areas A1 excluding target area A2, after the initial period, calculator 12 returns the control content to the state before the initial period.

[0034]

For example, if the one or more indoor units 2 in any area A1 other than target area A2 were stopped before the initial period, the control content from before the initial period corresponds to stopping the one or more indoor units 2. For example, if the one or more indoor units 2 in any area A1 other than target area A2 were performing cooling with a set temperature of 25 degrees Celsius before the initial period, the control content from before the initial period corresponds to performing cooling with the one or more indoor units 2 with a set temperature of 25 degrees Celsius.

[0035]

Next, controller 13 controls each indoor unit 2 based on the control content determined by calculator 12 (S16). With this, the one or more indoor units 2 provided in target area A2 are controlled based on the control content for the initial period. On the other hand, the one or more indoor units 2 provided in each of areas A1 excluding target area A2 are controlled based on the control content from before the initial period. In the example illustrated in FIG. 3, the one or more indoor units 2 provided in third area A13, which is target area A2, continue to execute cooling based on the control content for the initial period. However, among areas A1 other than target area A2, in each of first area A11, third area A13, and fourth area A14, the one or more indoor units 2 stop based on the control

content from before the initial period.

[0036]

As described above, in the first control example, air conditioning control system 100 first controls all indoor units 2 based on the same control content. Then, after the initial period, air conditioning control system 100 continues operation of the one or more indoor units 2 in third area A13, which is target area A2, and stops all indoor units 2 in first area A11, third area A13, and fourth area A14, which area areas A1 other than target area A2. In the example illustrated in FIG. 3, the area temperature of third area A13, which is target area A2, is maintained at the target temperature.

[0037]

In this way, in the first control example, each indoor unit 2 is controlled such that only area A1 that the user uses or plans to use is maintained at the target temperature of that area A1.

[0038]

In the first control example, step S11 corresponds to the obtaining in the air conditioning control method, steps S12, S14, and S15 correspond to the determining in the air conditioning control method, and steps S13 and S16 correspond to the controlling in the air conditioning control method.

[0039]

<Second Control Example>

Next, operations performed in the second control example by air conditioning control system 100 according to the embodiment will be described with reference to FIG. 4 and FIG. 5. FIG. 4 is a flowchart illustrating operations performed in the second control example by air conditioning control system 100 according to the embodiment. FIG. 5 illustrates a temperature distribution of areas A1 in the second control example of air conditioning control system 100 according to the embodiment. In FIG. 5, space Sp1 includes four areas A1: first area A11, second area A12, third area A13, and fourth area A14. In FIG. 5, second area A12 is, unlike third area A13, an area where a user performs office work and the like while standing or moving. Therefore, the set temperature of the one or more

indoor units 2 in second area A12 is set lower than the set temperature of the one or more indoor units 2 in third area A13. In FIG. 5, the dot-hatched portions indicate the temperature distribution, where darker colored portions indicate lower area temperature, and lighter colored portions indicate higher area temperature.

[0040]

First, obtainer 11 obtains the area temperature and target temperature of each area A1 (S21).

[0041]

Next, calculator 12 determines target area A2 from among areas A1 (S22). More specifically, based on the target temperature of each of areas A1, calculator 12 determines area A1 that satisfies a predetermined condition from among areas A1 as target area A2. In the second control example, two or more areas A1 are being used by the user or are planned to be used by the user. In the example illustrated in FIG. 5, each of second area A12 and third area A13 among areas A1 is being used by users. Therefore, calculator 12 determines target area A2 based on the target temperature of each of areas A1, in other words, based on the target temperature of each of two or more areas A1 that are being used by users or are planned to be used by users.

[0042]

In this example, the predetermined condition is that the difference between the target temperature and the area temperature is the largest. Therefore, calculator 12 determines area A1 with the largest difference between the target temperature and the area temperature from among the above-described two or more areas A1 as target area A2. Here, calculator 12 determines third area A13 as target area A2.

[0043]

Next, calculator 12 determines control content for the initial period for each indoor unit 2 (S23). More specifically, calculator 12 so determines the control content of all indoor units 2 as to cause the set temperature of all indoor units 2 to be the target temperature of

target area A2 in the initial period. Stated differently, calculator 12 so determines the control content for each area A1 as to cause the set temperature of one or more indoor units 2 to be the target temperature of target area A2. For example, when the target temperature of target area A2 is 28 degrees Celsius, calculator 12 so determines the control content of all indoor units 2 as to cause the set temperature of all indoor units 2 to be 28 degrees Celsius.

[0044]

Next, controller 13 controls each indoor unit 2 based on the control content determined by calculator 12 (S24). With this, all indoor units 2 are controlled based on the control content for the one or more indoor units 2 in target area A2 determined by calculator 12. For example, when the target temperature of target area A2 is 28 degrees Celsius, all indoor units 2 perform cooling with a set temperature of 28 degrees Celsius.

[0045]

Thereafter, until the area temperature of target area A2 reaches the target temperature of target area A2 (that is, until the initial period elapses) (S25: No), calculator 12 does not change the control content of any indoor unit 2. Stated differently, until the area temperature of target area A2 reaches the target temperature of target area A2, the control of each indoor unit 2 is maintained.

[0046]

When the area temperature of target area A2 reaches the target temperature of target area A2 (that is, when the initial period elapses) (S25: Yes), calculator 12 determines the control content for after the initial period for each indoor unit 2 (S26). More specifically, after the initial period, calculator 12 maintains the same control content for the one or more indoor units 2 in target area A2 as the control content established for the initial period. For each of areas A1 excluding target area A2, after the initial period, calculator 12 returns the control content to the state before the initial period.

[0047]

For example, if the one or more indoor units 2 in any area A1 other than target area A2 were stopped before the initial period, the

control content from before the initial period corresponds to stopping the one or more indoor units 2. For example, if the one or more indoor units 2 in any area A1 other than target area A2 were performing cooling with a set temperature of 25 degrees Celsius before the initial period, the control content from before the initial period corresponds to performing cooling with the one or more indoor units 2 with a set temperature of 25 degrees Celsius.

[0048]

Next, controller 13 controls each indoor unit 2 based on the control content determined by calculator 12 (S27). With this, the one or more indoor units 2 provided in target area A2 are controlled based on the control content for the initial period. On the other hand, the one or more indoor units 2 provided in each of areas A1 excluding target area A2 are controlled based on the control content from before the initial period. In the example illustrated in FIG. 5, the one or more indoor units 2 provided in third area A13, which is target area A2, continue to execute cooling based on the control content for the initial period. However, among areas A1 other than target area A2, in each of first area A11 and fourth area A14, the one or more indoor units 2 stop based on the control content from before the initial period. Among areas A1 other than target area A2, in second area A12, the one or more indoor units 2 continue to execute cooling based on the control content from before the initial period. After the initial period, the set temperature of the one or more indoor units 2 in second area A12 is lower than the set temperature of the one or more indoor units 2 in third area A13.

[0049]

As described above, in the second control example, air conditioning control system 100 first controls all indoor units 2 based on the same control content. Then, after the initial period, air conditioning control system 100 continues operation of the one or more indoor units 2 in third area A13, which is target area A2, as well as the one or more indoor units in second area A12, which is an area A1 other than target area A2, and stops the one or more indoor units 2 in each of first area A11 and fourth area A14, which are areas A1

other than target area A2. In the example illustrated in FIG. 5, the area temperature of third area A13, which is target area A2, is maintained at the target temperature of that area, and the area temperature of second area A12, which is an area other than target area A2, is maintained at the target temperature of that area.

[0050]

In this way, in the second control example, similar to the first control example, each indoor unit 2 is controlled such that only area A1 that the user uses or plans to use is maintained at the target temperature of that area A1.

[0051]

In the second control example, step S21 corresponds to the obtaining in the air conditioning control method, steps S22, S23, S25, and S26 correspond to the determining in the air conditioning control method, and steps S24 and S27 correspond to the controlling in the air conditioning control method.

[0052]

[4. Simulation]

Hereinafter, a simulation conducted to verify the effects of air conditioning control system 100 according to the embodiment will be described. FIG. 6 is a diagram for explaining analysis model M1 used in the simulation. FIG. 6 illustrates analysis model M1, which is a model that simulates an office with an area of approximately 1000 square meters, with furniture omitted. In this analysis model M1, the office includes eight ceiling-embedded indoor units AC1 to AC8. In the following description, the area where indoor units AC1 and AC2 are provided is referred to as area "A", the area where indoor units AC3 and AC4 are provided is referred to as area "B", the area where indoor units AC5 and AC6 are provided is referred to as area "C", and the area where indoor units AC7 and AC8 are provided is referred to as area "D" (see FIG. 7 and 8 to be described later). In this analysis model M1, it is assumed that the season is summer, and conditions are set where the outside air temperature is 30 degrees Celsius and the air temperature of the room adjacent to the office is 29 degrees Celsius. Additionally, this analysis model M1 includes a

plurality of air supply ports, a plurality of exhaust ports, and a plurality of windows, etc., and the air supply volume, exhaust volume, and thermal transmittance of the windows and walls are appropriately set.

5 [0053]

In the simulation, using the above-mentioned analysis model M1, a first analysis and a second analysis as shown below were performed. FIG. 7 is a diagram for explaining the first analysis of the simulation. FIG. 8 is a diagram for explaining the second analysis of the simulation. In (a) in FIG. 7 and (a) in FIG. 8, the black circles represent users. In (b) in FIG. 7 and (b) in FIG. 8, the dot-hatched portions indicate the temperature distribution, where darker colored portions indicate lower air temperature, and lighter colored portions indicate higher air temperature.

15 [0054]

In the first analysis, as illustrated in (a) in FIG. 7, a simulation was performed under the assumption that 20 users are distributed throughout the office. In the simulation, all indoor units AC1 to AC8 in all areas A to D were performing cooling with a set temperature of 25 degrees Celsius. In the first analysis, as illustrated in (b) in FIG. 7, the result of the simulation indicated that several hours after the start of operation of each indoor unit AC1 to AC8, the air temperature in all areas A to D is maintained at approximately 25 degrees Celsius.

[0055]

25 In the second analysis, as illustrated in (a) in FIG. 8, a simulation was performed under the assumption that 20 users are using only area B. In the simulation, only indoor units AC3 and AC4 in area B were performing cooling with a set temperature of 25 degrees Celsius. In the second analysis, as illustrated in (b) in FIG. 8, the result of the simulation indicated that several hours after the start of operation of each indoor unit AC3 and AC4, only the air temperature in area B was maintained at approximately 25 degrees Celsius, and the air temperature in the other areas A, C, and D became higher than the air temperature in area B.

35 [0056]

Focusing on area B, in both the first analysis and the second analysis, the air temperature is maintained at the set temperature, but the result indicated that power consumption is reduced in the second analysis compared to the first analysis. Therefore, when operation is stable, i.e., when fluctuations in air temperature are small, the results indicated that operating only one or more indoor units provided in areas used by users, rather than operating all indoor units in the office, can reduce power consumption.

[0057]

FIG. 9 is a diagram for explaining the results of the first analysis of the simulation. FIG. 10 is a diagram for explaining the results of the second analysis of the simulation. In (a) in FIG. 9 and (a) in FIG. 10, the average air temperature of each area (unit: "°C") is represented on the vertical axis, and the elapsed time (unit: "min.") is represented on the horizontal axis. In (a) in FIG. 9 and (a) in FIG. 10, the solid line represents the average air temperature of area A, the broken line represents the average air temperature of area B, the dotted line represents the average air temperature of area C, and the dash-dot line represents the average air temperature of area D.

[0058]

In (b) in FIG. 9 and (b) in FIG. 10, the left vertical axis represents power consumption (unit: "W"), the right vertical axis represents coefficient of performance (COP), and the horizontal axis represents the elapsed time (unit: "min."). In (b) in FIG. 9 and (b) in FIG. 10, the solid line represents the total power consumption of the entire office, and the broken line represents the coefficient of performance (COP).

[0059]

As illustrated in (a) in FIG. 10, in the second analysis, the time required for the average air temperature of each area to reach the set temperature of 25 degrees Celsius after starting the operation of each indoor unit (hereinafter referred to as "temperature stabilization time") is approximately 40 minutes (see the circled portion in (a) in FIG. 10). In contrast, as illustrated in (a) in FIG. 9,

in the first analysis, the temperature stabilization time is approximately 10 minutes (see the circled portion in (a) in FIG. 9). Stated differently, the results indicated that the temperature stabilization time is shorter in the first analysis than in the second analysis.

[0060]

As illustrated in (b) in FIG. 9 and (b) in FIG. 10, the results moreover indicated that the total power consumption during the temperature stabilization time is less in the first analysis than in the second analysis (see the area enclosed by the solid line in the circled portions in (b) in FIG. 9 and (b) in FIG. 10). The results in (b) in FIG. 9 and (b) in FIG. 10 also indicated that the energy consumption efficiency (in other words, air conditioning efficiency) during the temperature stabilization time is greater in the first analysis than in the second analysis (see the circled portions in (b) in FIG. 9 and (b) in FIG. 10).

[0061]

As described above, the results indicated that even when maintaining only the area that is used by users or is scheduled to be used by users at the target temperature, first operating all indoor units 2 can shorten the temperature stabilization time, can reduce power consumption, and can improve air conditioning efficiency.

[0062]

[5. Advantages]

Hereinafter, advantages of air conditioning control system 100 and the air conditioning control method according to the embodiment will be described. In air conditioning control system 100 and the air conditioning control method according to the embodiment, in the initial period, all indoor units 2 in all areas A1 including target area A2 are so controlled as to cause the set temperature to be the target temperature of target area A2. Thereafter, in air conditioning control system 100 and the air conditioning control method according to the embodiment, each indoor unit 2 in areas A1 excluding target area A2 is controlled with the control content from before the initial period.

[0063]

Therefore, in air conditioning control system 100 and the air conditioning control method according to the embodiment, compared to a case where only the one or more indoor units 2 in target area A2 are operated in the initial period, there is an advantage that the time until the area temperature of target area A2 reaches the target temperature can be easily shortened while reducing power consumption. In air conditioning control system 100 and the air conditioning control method according to the embodiment, compared to a case where only the one or more indoor units 2 in target area A2 are operated in the initial period, there is an advantage that the temperature stabilization time until the area temperature of target area A2 reaches the target temperature can be easily shortened, and air conditioning efficiency can be easily improved.

[0064]

The air conditioning control system disclosed in PTL 1 learns to control the air conditioners such that the area temperature of each of the areas reaches the target temperature. However, in the air conditioning control system disclosed in PTL 1, there is a problem that in the initial stage of learning, the control of the air conditioners is not optimized, and air conditioning efficiency tends to deteriorate. In contrast, in air conditioning control system 100 and the air conditioning control method according to the embodiment, there is an advantage that the above problem cannot occur because each indoor unit 2 can be controlled without relying on learning.

[0065]

[6. Variations]

Although the embodiment has been described based on the above embodiment, the present invention is not limited to the above embodiment.

[0066]

In the second control example of the embodiment, calculator 12 determines area A1 with the largest difference between the area temperature and the target temperature as target area A2, but this example is non-limiting. For example, calculator 12 may determine

area A1 with the lowest target temperature as target area A2 when each indoor unit 2 is to perform cooling, and may determine area A1 with the highest target temperature as target area A2 when each indoor unit 2 is to perform heating. Stated differently, the predetermined condition may be that the target temperature is the lowest when the one or more indoor units 2 in each of areas A1 are to perform cooling and the highest when the one or more indoor units 2 in each of areas A1 are to perform heating.

[0067]

In the embodiment, indoor units 2 provided in space Sp1 are not included as elements of air conditioning control system 100, but may be included as elements of air conditioning control system 100. Stated differently, air conditioning control system 100 may further include the one or more indoor units 2 that are provided in each of areas A1.

[0068]

In the embodiment, controller 13 is included in server 10, but this example is non-limiting. For example, controller 13 may be implemented by a module different from server 10. In such cases, the module including controller 13 may be configured to be capable of communicating with server 10, and configured to be capable of communicating with each indoor unit 2.

[0069]

In the embodiment, controller 13 controls all indoor units 2 provided in space Sp1, but this example is non-limiting. For example, controller 13 may be provided for each area A1. In such cases, the number of controllers 13 and the number of areas A1 will be the same, and each controller 13 will control the one or more indoor units 2 of the corresponding area A1.

[0070]

The air conditioning control system may be implemented by a plurality of devices (for example, a plurality of servers), and, alternatively, may be implemented as a single device (for example, a single server). When the air conditioning control system is implemented by a plurality of devices, the elements (in particular,

functional elements) included in the air conditioning control system may be distributed in any manner among the plurality of devices.

[0071]

5 The communication method between devices in the above embodiment is not particularly limited. In communication between devices, a relay device (such as a broadband router) that is not shown may intervene.

[0072]

10 In the above embodiment, processing performed by a particular processing unit may be performed by a different processing unit. The order of the plurality of processes may be changed, and the plurality of processes may be executed in parallel.

[0073]

15 In the above embodiment, each element may be implemented by executing a software program suitable for the element. Each element may be implemented by a program execution unit such as a CPU or processor reading and executing a software program recorded on a recording medium such as a hard disk or semiconductor memory.

20 [0074]

Each element may be implemented by hardware. For example, each element may be a circuit (or an integrated circuit). These circuits may constitute a single circuit as a whole, or may be separate circuits. These circuits may each be a general-purpose
25 circuit or a dedicated circuit.

[0075]

General or specific aspects of the present invention may be realized as a system, an apparatus or device, a method, an integrated circuit, a computer program, or a computer-readable
30 recording medium such as a CD-ROM. Any given combination of a system, an apparatus or device, a method, an integrated circuit, a computer program, and a recording medium may be used to realize the aspects.

[0076]

35 For example, the present invention may be realized as an

information processing method executed by a computer of the air conditioning control system of the above embodiment. The present invention may be realized as a program (computer program product) for causing a computer to execute these information processing methods. The present invention may be realized as a computer-readable non-transitory recording medium on which such a program is recorded.

[0077]

Embodiments arrived at by a person skilled in the art making various modifications to any one of the embodiments, or embodiments realized by arbitrarily combining elements and functions in the embodiments which do not depart from the essence of the present invention are also included in the present invention.

[0078]

(Summary)

As described above, air conditioning control system 100 according to a first aspect includes obtainer 11, calculator 12, and controller 13. Obtainer 11 obtains an area temperature of target area A2 among areas A1 in each of which one or more indoor units 2 are provided, and a target temperature of target area A2. Calculator 12 determines the control content of one or more indoor units 2 for each of areas A1. Controller 13 controls one or more indoor units 2 in each of areas A1 based on the control content determined by calculator 12. Calculator 12 so determines the control content as to: cause a set temperature of the one or more indoor units 2 in each of areas A1 to be a target temperature of target area A2 in an initial period from when operation of the one or more indoor units 2 in target area A2 starts until the area temperature of target area A2 reaches the target temperature of target area A2; and after the initial period, return the control content to the state before the initial period in each of areas A1 excluding target area A2.

[0079]

In this air conditioning control system 100, compared to a case where only the one or more indoor units 2 in target area A2 are operated in the initial period, there is an advantage that the time

until the area temperature of target area A2 reaches the target temperature can be easily shortened while reducing power consumption.

[0080]

5 Air conditioning control system 100 according to a second aspect includes obtainer 11, calculator 12, and controller 13. Obtainer 11 obtains an area temperature of each of areas A1 in each of which one or more indoor units 2 are provided, and a target temperature of each of areas A1. Calculator 12 determines the control content of one or more indoor units 2 for each of areas A1. Controller 13 controls one or more indoor units 2 in each of areas A1 based on the control content determined by calculator 12. Based on the target temperature of each of areas A1, calculator 12 determines an area that satisfies a predetermined condition from among areas A1 as target area A2. Calculator 12 so determines the control content as to: cause a set temperature of the one or more indoor units 2 in each of areas A1 to be a target temperature of target area A2 in an initial period from when operation of the one or more indoor units 2 in target area A2 starts until the area temperature of target area A2 reaches the target temperature of target area A2; and after the initial period, return the control content to the state before the initial period in each of areas A1 excluding target area A2.

[0081]

25 In this air conditioning control system 100, compared to a case where only the one or more indoor units 2 in target area A2 are operated in the initial period, there is an advantage that the time until the area temperature of target area A2 reaches the target temperature can be easily shortened while reducing power consumption.

30 [0082]

 Air conditioning control system 100 according to a third aspect is air conditioning control system 100 according to the second aspect, wherein the predetermined condition is that the difference between the target temperature and the area temperature is the largest.

35 [0083]

In this air conditioning control system 100, compared to a case where area A1 with a relatively small difference between the target temperature and the area temperature is determined as target area A2, there is an advantage that the time until the area temperature of each area A1 reaches the target temperature can be easily shortened.

[0084]

Air conditioning control system 100 according to a fourth aspect is air conditioning control system 100 according to the second aspect, wherein the predetermined condition is that the target temperature is the lowest when the one or more indoor units 2 in each of areas A1 are to perform cooling and the highest when the one or more indoor units 2 in each of areas A1 are to perform heating.

[0085]

In this air conditioning control system 100, compared to a case where area A1 with a relatively small difference between the target temperature and the area temperature is determined as target area A2, there is an advantage that the time until the area temperature of each area A1 reaches the target temperature can be easily shortened.

[0086]

Air conditioning control system 100 according to a fifth aspect is air conditioning control system 100 according to any one of the first to fourth aspects, further including the one or more indoor units 2 that are provided in each of areas A1.

[0087]

In this air conditioning control system 100, compared to a case where only the one or more indoor units 2 in target area A2 are operated in the initial period, there is an advantage that the time until the area temperature of target area A2 reaches the target temperature can be easily shortened while reducing power consumption.

[0088]

An air conditioning control method according to a sixth aspect includes obtaining (S11), determining (S12, S14, and S15), and

controlling (S13 and S16). In the obtaining, an area temperature of target area A2 among areas A1 in each of which one or more indoor units 2 are provided, and a target temperature of target area A2 are obtained. In the determining, the control content of the one or more indoor units 2 is determined for each of areas A1. In the controlling, the one or more indoor units 2 in each of areas A1 are controlled based on the control content determined in the determining. In the determining, the control content is so determined as to: cause a set temperature of the one or more indoor units 2 in each of areas A1 to be the target temperature of target area A2 in an initial period from when operation of the one or more indoor units 2 in target area A2 starts until the area temperature of target area A2 reaches the target temperature of target area A2; and after the initial period, return the control content to a state before the initial period in each of areas A1 excluding target area A2.

[0089]

In this air conditioning control method, compared to a case where only the one or more indoor units 2 in target area A2 are operated in the initial period, there is an advantage that the time until the area temperature of target area A2 reaches the target temperature can be easily shortened while reducing power consumption.

[0090]

An air conditioning control method according to a seventh aspect includes obtaining (S21), determining (S22, S23, S25, and S26), and controlling (S24 and S27). In the obtaining, an area temperature of each of areas A1 in each of which one or more indoor units 2 are provided, and a target temperature of each of areas A1 are obtained. In the determining, the control content of the one or more indoor units 2 is determined for each of areas A1. In the controlling, the one or more indoor units 2 in each of areas A1 are controlled based on the control content determined in the determining. The determining includes determining, based on the target temperature of each of areas A1, an area that satisfies a predetermined condition from among areas A1 as target area A2. In

the determining, the control content is so determined as to: cause a set temperature of the one or more indoor units 2 in each of areas A1 to be the target temperature of target area A2 in an initial period from when operation of the one or more indoor units 2 in target area A2 starts until the area temperature of target area A2 reaches the target temperature of target area A2; and after the initial period, return the control content to a state before the initial period in each of areas A1 excluding target area A2.

[0091]

In this air conditioning control method, compared to a case where only the one or more indoor units 2 in target area A2 are operated in the initial period, there is an advantage that the time until the area temperature of target area A2 reaches the target temperature can be easily shortened while reducing power consumption.

[0092]

A program according to an eighth aspect causes one or more processors to execute the air conditioning control method according to the sixth or seventh aspect.

[0093]

With this program, compared to a case where only the one or more indoor units 2 in target area A2 are operated in the initial period, there is an advantage that the time until the area temperature of target area A2 reaches the target temperature can be easily shortened while reducing power consumption.

[Reference Signs List]

[0094]

100 air conditioning control system

11 obtainer

12 calculator

13 controller

2 indoor unit

A1 area

A2 target area

[CLAIMS]

[Claim 1]

An air conditioning control system comprising:

an obtainer that obtains an area temperature of a target area
5 among areas in each of which one or more indoor units are provided,
and a target temperature of the target area;

a calculator that determines, for each of the areas, control
content of the one or more indoor units in the area; and

a controller that controls, for each of the areas, the one or
10 more indoor units in the area based on the control content
determined by the calculator, wherein

the calculator so determines the control content as to:

cause a set temperature of the one or more indoor units
in each of the areas to be the target temperature of the target area
15 in an initial period from when operation of the one or more indoor
units in the target area starts until the area temperature of the target
area reaches the target temperature of the target area; and

after the initial period, return the control content to a
state before the initial period in each of the areas excluding the
20 target area.

[Claim 2]

An air conditioning control system comprising:

an obtainer that obtains an area temperature of each of areas
25 in each of which one or more indoor units are provided, and a target
temperature of each of the areas;

a calculator that determines, for each of the areas, control
content of the one or more indoor units in the area; and

a controller that controls, for each of the areas, the one or
30 more indoor units in the area based on the control content
determined by the calculator, wherein

based on the target temperature of each of the areas, the
calculator determines an area from among the areas that satisfies a
predetermined condition as a target area, and

35 the calculator so determines the control content as to:

cause a set temperature of the one or more indoor units in each of the areas to be the target temperature of the target area in an initial period from when operation of the one or more indoor units in the target area starts until the area temperature of the target area reaches the target temperature of the target area; and

after the initial period, return the control content to a state before the initial period in each of the areas excluding the target area.

10 [Claim 3]

The air conditioning control system according to claim 2, wherein

the predetermined condition is that a difference between the target temperature and the area temperature is largest.

15

[Claim 4]

The air conditioning control system according to claim 2, wherein

the predetermined condition is that the target temperature is lowest when the one or more indoor units in each of the areas are to perform cooling and highest when the one or more indoor units in each of the areas are to perform heating.

[Claim 5]

25 The air conditioning control system according to any one of claims 1 to 4, further comprising:

the one or more indoor units provided in each of the areas.

[Claim 6]

30 An air conditioning control method comprising:

obtaining an area temperature of a target area among areas in each of which one or more indoor units are provided, and a target temperature of the target area;

determining, for each of the areas, control content of the one or more indoor units in the area; and

controlling, for each of the areas, the one or more indoor units in the area based on the control content determined in the determining, wherein

the determining so determines the control content as to:

- 5 cause a set temperature of the one or more indoor units in each of the areas to be the target temperature of the target area in an initial period from when operation of the one or more indoor units in the target area starts until the area temperature of the target area reaches the target temperature of the target area; and
- 10 after the initial period, return the control content to a state before the initial period in each of the areas excluding the target area.

[Claim 7]

- 15 An air conditioning control method comprising:

obtaining an area temperature of each of areas in each of which one or more indoor units are provided, and a target temperature of each of the areas;

- 20 determining, for each of the areas, control content of the one or more indoor units in the area; and

controlling, for each of the areas, the one or more indoor units in the area based on the control content determined in the determining, wherein

- 25 the determining includes determining, based on the target temperature of each of the areas, an area from among the areas that satisfies a predetermined condition as a target area, and

the determining so determines the control content as to:

- 30 cause a set temperature of the one or more indoor units in each of the areas to be the target temperature of the target area in an initial period from when operation of the one or more indoor units in the target area starts until the area temperature of the target area reaches the target temperature of the target area; and

- 35 after the initial period, return the control content to a state before the initial period in each of the areas excluding the target area.

[Claim 8]

A program that causes one or more processors to execute the air conditioning control method according to claim 6 or 7.

5