

DESCRIPTION

TITLE:

AIR CONDITIONING EQUIPMENT MONITORING DEVICE

BACKGROUND

Technical Field

[0001] The present invention relates to an air conditioning equipment monitoring device.

Related Art

[0002] Conventionally, the central air conditioner in a large building controls the room temperature of each room in the building by managing multiple air conditioning systems including a primary air conditioner and multiple secondary air conditioners that work together to control the room temperature. Then, the manager examines the data of each air conditioner one by one from a monitoring screen to find the air conditioners with control failures, so it is difficult for the manager to find air conditioners with control failures among a large number of air conditioners in daily operation.

[0003] Thus, as a conventional technology, there is a technology that summarizes the results diagnosed for each air conditioner by frequency of occurrence and time of occurrence and displays the same in a list format, and when a diagnosis result is selected, a list of possible causes of the problem is displayed. (see, e.g., non-Patent Document 1).

Prior-Art Documents

Non-Patent Documents

[0004] [Non-patent Document 1] “Fault Detection and Fault Triage Feature Suite | Johnson Controls”, [online], [Searched on November 15, 2020], Internet <https://www.johnsoncontrols.com/en_middleeast/insights/2020/featured-story/fault-detection-and-fault-triage-feature-suite>

SUMMARY OF THE INVENTION

Problems to Be Solved by the Invention

[0005] However, the above-mentioned conventional technology has a problem in that control failures of the air conditioner may not be easily corrected in some cases. For example, it is difficult to easily determine which floor or air conditioning system within a building is experiencing a problem, in addition, air conditioning control problems are often caused by the influence of multiple equipment problems rather than a single equipment problem, so improving the assumed causes of the indicated problem does not always solve the problem.

Means for Solving the Problems

[0006] In order to solve the above-mentioned problems and achieve the above-mentioned objectives, the air conditioning equipment monitoring device of the present invention is an air conditioning equipment monitoring device that monitors a control status of an air conditioning equipment provided with one or more air conditioning systems that includes: one primary air conditioner and multiple secondary air conditioners that take in a part of conditioning air supplied through a duct from the primary air conditioner and control an amount of conditioning air taken in to eliminate an air conditioning load within each air conditioning area. The air conditioning equipment monitoring device includes: a data acquisition unit, acquiring air conditioning data; a storage unit, storing the air conditioning data acquired by the data acquisition unit, room temperature setting data, and air

conditioning system data; a status determination unit, generating determination data based on room temperature data and the room temperature setting data, which are part of the air conditioning data stored by the storage unit; a first screen generation unit, based on the air conditioning system data, dividing the secondary air conditioners into grouped sections for each of the air conditioning systems on a floor, embedding a section for each of the secondary air conditioners in the grouped sections, and generating a screen with the determination data incorporated in the section for each of the secondary air conditioners; and a display unit, displaying a screen generated by the first screen generation unit.

Effects of the Invention

[0007] The present invention is capable of easily improving control failures of the air conditioner.

BRIEF DESCRIPTION OF THE DRAWINGS

[0008] FIG. 1 is a diagram showing an overview of the air conditioning equipment monitoring system according to one embodiment.

FIG. 2 is a diagram showing a specific example of the air conditioning equipment according to one embodiment.

FIG. 3 is a diagram showing a configuration example of the air conditioning equipment monitoring device according to one embodiment.

FIG. 4 is a diagram showing a specific example of the screen displayed by the air conditioning equipment monitoring device according to one embodiment.

FIG. 5 is a diagram showing a specific example of the screen displayed by the air conditioning equipment monitoring device according to one embodiment.

FIG. 6 is a diagram showing a specific example of the screen displayed by the air conditioning equipment monitoring device according to one embodiment.

FIG. 7 is a diagram showing a specific example of the screen displayed by the air conditioning equipment monitoring device according to one embodiment.

FIG. 8 is a diagram showing a specific example of the screen displayed by the air conditioning equipment monitoring device according to one embodiment.

FIG. 9 is a flowchart showing an example of the processing procedure in the air conditioning equipment monitoring device according to one embodiment.

FIG. 10 is a diagram showing an example of the hardware configuration.

DESCRIPTION OF THE EMBODIMENTS

[0009] The following is a detailed description of the embodiment of the air conditioning equipment monitoring device of the present application based on the figures. Note that the air conditioning equipment monitoring device according to the present application is not limited to this embodiment.

[0010] [1. System configuration example]

First, an overview of a system including an air conditioning equipment monitoring device 100 related to this embodiment is described. FIG. 1 is a diagram showing an overview of the air conditioning equipment monitoring system according to one embodiment. The air conditioning equipment monitoring device 100 is a device that monitors a control status of air conditioning of an air conditioning equipment described below, for example, it is a server device that stores air conditioning data and determination data of the secondary air conditioner.

[0011] In addition, the air conditioning equipment monitoring device 100 is connected to the primary air conditioner controllers 207-1 to 207-n included in the air conditioning equipment 200-1 to 200-n by wire or wirelessly and transmits and receives information. The air conditioning equipment monitoring device 100 is an air conditioning equipment

monitoring device monitoring the air conditioning equipment 200-1 to 200-n that acquires air conditioning data and stores the room temperature, which is a part of the acquired air conditioning data, preset room temperature setting data, and air conditioning system data.

[0012] The air conditioning equipment monitoring device 100 then generates determination data based on the stored room temperature data and the room temperature setting data, which are part of the air conditioning data; based on the air conditioning system data, the secondary air conditioners are divided into grouped sections for each of the air conditioning systems on a floor, a section for each of the secondary air conditioners is embedded in the grouped sections, and after generating a screen with the determination data incorporated in the section for each of the secondary air conditioners, the generated screen is displayed.

[0013] The air conditioning equipment monitoring device 100 first acquires the air conditioning data and stores the air conditioning data acquired, the preset room temperature setting data, and the air conditioning system data. For example, the air conditioning equipment monitoring device 100 acquires the air conditioning data of the secondary air conditioners from the primary air conditioner controllers 207-1 to 207-n of the air conditioning equipment 200-1 to 200-n, respectively, and stores the air conditioning data acquired, the preset room temperature setting data, and the air conditioning system data in a memory unit.

[0014] The air conditioning equipment monitoring device 100 then generates the determination data based on the stored room temperature data and the room temperature setting data, which are part of the air conditioning data. For example, the air conditioning equipment monitoring device 100 calculates a difference between the room temperature data (measured temperature PV) and the room temperature setting data (set temperature SP),

which are part of the air conditioning data, and generates a label according to the calculation result.

[0015] Next, based on the air conditioning system data, the air conditioning equipment monitoring device 100 divides the secondary air conditioners into grouped sections for each of the air conditioning systems on a floor, embeds a section for each of the secondary air conditioners in the grouped sections, and after generating a screen with the determination data incorporated in the section for each of the secondary air conditioners, displays the generated screen.

[0016] For example, based on the air conditioning system data, the air conditioning equipment monitoring device 100 divides the secondary air conditioners into grouped sections for each of the air conditioning systems on a floor, embeds a section for each of the secondary air conditioners in the grouped sections, and after generating a screen with the determination data corresponding to that secondary air conditioner incorporated in the section for each of the secondary air conditioners, displays the generated screen.

[0017] Next, with reference to FIG. 2, specific examples of the air conditioning equipment 200-1 to 200-n in FIG. 1 is described. FIG. 2 is a diagram showing a specific example of the air conditioning equipment according to one embodiment. The air conditioning equipment 200 is an air conditioning equipment provided with one or more air conditioning systems that includes one primary air conditioner and multiple secondary air conditioners that take in a part of conditioning air supplied through a duct from the primary air conditioner and controlling an amount of conditioning air taken in to eliminate an air conditioning load within each air conditioning area.

[0018] In FIG. 2, the primary air conditioner 201 includes a cooling coil 203 to which cold water CW is supplied through an electric valve 202, a heating coil 205 to which hot

water HW is supplied through an electric valve 204, and a blower 206. It should be noted that the blower 206 includes a fan 206a and an inverter 206b.

[0019] The operations of the inverter 206b in the primary air conditioner 201, the electric valve 202, and the electric valve 204 is controlled by the primary air conditioner controller 207, and in the primary air conditioner 201, the conditioning air blown from the fan 206a is supplied to the air conditioning areas 209-1 to 209-n through the air supply duct 208. In addition, the air conditioning areas 209-1 to 209-n are provided with temperature sensors T1 to Tn that measure the room temperature in each area, and the measured temperatures PV obtained by the temperature sensors T1 to Tn are respectively given to the secondary air conditioner controllers 210-1 to 210-n provided locally.

[0020] The secondary air conditioner controllers 210-1 to 210-n calculate the required air volume for the air conditioning areas 209-1 to 209-n, based on the difference between the respectively given measured temperature PV and the set temperature SP, and return the same to the primary air conditioner controller 207.

[0021] On the other hand, the secondary air conditioner controllers 210-1 to 210-n control the opening degrees of the dampers 212-1 to 212-n of the secondary air conditioners 211-1 to 211-n while looking at the measured outputs of the wind speed sensors 213-1 to 213-n to ensure the required air volume.

[0022] The primary air conditioner controller 207 finds the total required air volume of the entire system from the required air volume sent from the secondary air conditioner controllers 210-1 to 210-n and control the rotation number of the fan 206a of the primary air conditioner 201 to ensure this total required air volume. It should be noted that in the secondary air conditioners 211-1 to 211-n, the opening degrees of the dampers 212-1 to 212-n are measured by the opening degree sensors 214-1 to 214-n,

[0023] In addition, the secondary air conditioner controllers 210-1 to 210-n determine the control status as an indoor temperature requirement (secondary air conditioner control status) and transmit this determined control status to the primary air conditioner controller 207. Then, the primary air conditioner controller 207 finds the total control status as the secondary air conditioner general control status based on the control status from the secondary air conditioner controllers 210-1 to 210-n.

[0024] After that, the primary air conditioner controller 207 determines the setting value TSsp of the temperature of the conditioning air from the primary air conditioner 201 based on the total control status, the direction of change in return air temperature, etc.

[0025] It should be noted that, in this embodiment, the setting value TSsp of the conditioning air temperature in the primary air conditioner controller 207 may be changed by manual operation. In other words, the setting value TSsp of the temperature of the conditioning air from the primary air conditioner 201 is generally determined automatically in the primary air conditioner controller 207, but it may be changed artificially if necessary, using a keyboard or other means of changing the setting.

[0026] On the other hand, although the conditioning air passes through the secondary air conditioners 211-1 to 211-n blown out to the air conditioning areas 209-1 to 209-n through the air outlets 215-1 to 215-n are discharged through the discharge adjustment damper 218 via the return air duct 217 from the discharging ports 216-1 to 216-n after contributing to air conditioning control in the air conditioning areas 209-1 to 209-n, a part of the air is returned to the primary air conditioner 201 as the return air through the return air adjustment damper 219. Then, the external air is taken in at a predetermined ratio through the external air adjustment damper 220 with respect to the return air that is returned to the primary air conditioner 201.

[0027] It should be noted that the opening degrees of the discharge adjustment damper 218, the return air adjustment damper 219, and the external air adjustment damper 220 are adjusted according to the commands from the primary air conditioner controller 207. In addition, the measured value TSpv of the temperature of the conditioning air from the primary air conditioner 201 and the measured value TRpv of the return air temperature in the return air duct 217 is given to the primary air conditioner controller 207 through the temperature sensor 221 and the temperature sensor 222.

[0028] Furthermore, the primary air conditioner controller 207 issues a valve output and controls the opening degrees of the electric valve 202 and the electric valve 204 so that the measured value TSpv of the temperature of the conditioning air from the primary air conditioner 201 matches the setting value TSsp.

[0029] [2. Configuration of the air conditioning equipment monitoring device 100]
Next, referring to FIG. 3, the configuration of the air conditioning equipment monitoring device 100 shown in FIG. 1 is described. FIG. 3 is a diagram showing a configuration example of the air conditioning equipment monitoring device according to one embodiment. As shown in FIG. 3, the air conditioning equipment monitoring device 100 according to the embodiment includes a communication unit 110, a control unit 120, and a memory unit 140.

[0030] The communication unit 110 is implemented by, for example, a NIC (network interface card). The communication unit 110 is connected to the primary air conditioner controllers 207-1 to 207-n included in the air conditioning equipment 200-1 to 200-n by wire or wirelessly and transmits and receives information.

[0031] The memory unit 140 is implemented, for example, by a memory device such as a RAM (random access memory) or a hard disk. Although the memory unit 140 stores data and programs necessary for various processes by the control unit 120, in particular, those closely related to the present invention include an air conditioning data memory unit

141, a room temperature setting data memory unit 142, an air conditioning system data memory unit 143, and the determination data memory unit 144.

[0032] The air conditioning data memory unit 141 stores the air conditioning data acquired by the data acquisition unit 121, which will be described later. For example, the air conditioning data memory unit 141 stores data regarding the statuses of the secondary air conditioners such as the room temperature data (measured temperature PV) of each room acquired by the data acquisition unit 121 described later, the air volume measured value and the air volume set value of each secondary air conditioner, the damper opening degree, the start/stop state, and the presence or absence of an abnormal signal.

[0033] The room temperature setting data memory unit 142 stores the room temperature setting data (set temperature SP) of each room. For example, the room temperature setting data memory unit 142 stores the set temperature SP of each room, which is preset before air conditioning control is performed.

[0034] The air conditioning system data memory unit 143 stores data regarding the air conditioning system, including one primary air conditioner and multiple secondary air conditioners. For example, the air conditioning system data memory unit 143 stores the correspondence relationship between the types of air conditioning system and the secondary air conditioners belonging to each of the air conditioning systems for the air conditioning system belong to the air conditioning equipment.

[0035] The determination data memory unit 144 stores the determination data generated by the status determination unit 123, which will be described later. For example, the determination data memory unit 144 stores labels such as “hot” and “cold” generated by the status determination unit 123 described below for the secondary air conditioners, along with the information of the corresponding secondary air conditioner.

[0036] The control unit 120 is implemented by a CPU (central processing unit), an MPU (micro processing unit), etc., to executes various programs stored in the memory device inside the air conditioning equipment monitoring device 100 using the RAM as an operation area. In addition, the control unit 120 is implemented by, for example, an integrated circuit such as an ASIC (application specific integrated circuit) or an FPGA (field programmable gate array).

[0037] The control unit 120 includes a data acquisition unit 121, a storage unit 122, a status determination unit 123, a first screen generation unit 124, and a display unit 125, and if necessary, a second screen generation unit 126, a third screen generation unit 127, a fourth screen generation unit 128, a fifth screen generation unit 129, and a sixth screen generation unit 130 may also be included.

[0038] The data acquisition unit 121 acquires the air conditioning data. Then, the data acquisition unit 121 notifies the storage unit 122 of the acquired air conditioning data. For example, the data acquisition unit 121 acquires data regarding the statuses of the secondary air conditioners, such as the air volume measured value and the air volume set value, the damper opening degree, the start/stop state, and the presence or absence of an abnormal signal from the primary air conditioner controller in the air conditioning equipment to be monitored and notifies the storage unit 122.

[0039] Here, the start/stop state is information that indicates whether the secondary air conditioners are in the operation state, and the abnormal signal refers to signals notified when an abnormality occurs in the operation state of the secondary air conditioners.

[0040] The storage unit 122 stores the air conditioning data acquired by the data acquisition unit 121, the preset room temperature setting data, and the air conditioning system data. For example, the storage unit 122 stores the air conditioning data notified by the data acquisition unit 121 mentioned above in the air conditioning data memory unit 141.

[0041] In addition, the storage unit 122 stores, for example, the room temperature setting data (set temperature SP) that is preset before the air conditioning data is acquired and the air conditioning system data, which is the correspondence relationship between the types of air conditioning systems and the secondary air conditioners belonging to each of the air conditioning systems, in the room temperature setting data memory unit 142 and the air conditioning system data memory unit 143, respectively.

[0042] The status determination unit 123 generates the determination data based on the room temperature data and the room temperature setting data, which are part of the air conditioning data stored by the storage unit 122. Then, the status determination unit 123 stores the generated determination data in the determination data memory unit 144. For example, the status determination unit 123 generates labels such as “hot” and “cold” based on the room temperature data and the room temperature setting data which are respectively stored in the memory unit by the storage unit 122.

[0043] In addition, the status determination unit 123 may generate one of “hot”, “cold”, or “appropriate” labels based on a size of difference value between the room temperature data and the room temperature setting data as the determination data. For example, the status determination unit 123 calculates the difference value between the room temperature data (measured temperature PV) and the room temperature setting data (set temperature SP) as the determination data, generates a label of “appropriate” when the difference in temperature is around 0, “hot” when the same is higher than 0, and “cold” when the same is lower than 0, and stores the labels in the determination data memory unit 144 along with the information of the corresponding secondary air conditioner.

[0044] Furthermore, the status determination unit 123 may generate one of “stop”, “abnormal”, or “appropriate” labels based on the secondary air conditioner status data, which is a part of the air conditioning data, as the determination data. For example, the

status determination unit 123 generates the labels of “stop”, “abnormal”, and “appropriate” for the operation state of the secondary air conditioners based on the secondary air conditioner status data of the start/stop state and the presence or absence of the abnormal signal of the secondary air conditioner, which are parts of the air conditioning data, as the determination data, and stores the labels in the determination data memory unit 144 along with the information of the corresponding secondary air conditioner.

[0045] The first screen generation unit 124, based on the air conditioning system data, divides the secondary air conditioners into grouped sections for each of the air conditioning systems on a floor, embeds a section for each of the secondary air conditioners in the grouped sections, and generates a screen with the determination data incorporated in the section for each of the secondary air conditioners.

[0046] For example, the first screen generation unit 124 divides the air conditioning systems into grouped sections for each of the air conditioning systems on a floor using the air conditioning system data stored in the air conditioning system data memory unit 143. After that, the first screen generation unit 124 embeds sections of the secondary air conditioners belonging to that air conditioning system in the grouped sections for each of the air conditioning systems. Then, the first screen generation unit 124 generates a floor screen with the determination data incorporated in the section for the embedded secondary air conditioners, respectively.

[0047] Here, the screen generated by the first screen generation unit 124 mentioned above is described with reference to FIG. 4. FIG. 4 is a diagram showing a specific example of the screen displayed by the air conditioning equipment monitoring device according to one embodiment. In the example of FIG. 4, “AHU-2901 to AHU-2904” indicate the types of air conditioning system. In addition, “VAV-1 to VAV-6” each indicate a secondary air conditioner.

[0048] In FIG. 4, the grouped sections for each of the air conditioning systems are, for example, the section (upper left of FIG. 4) surrounded for “AHU-2901”, and that section is embedded with the section surrounded for “VAV-1 to VAV-6” of the secondary air conditioners. Then, the sections “VAV-1, 2, 4, 5” are incorporated with the determination data of “hot”, and the sections “VAV-3, 5” are incorporated with “-” indicating the determination data of “appropriate”.

[0049] In addition, the first screen generation unit 124 may generate a screen using different colors according to a size of difference value between the room temperature data and the room temperature setting data in the determination data. For example, the first screen generation unit 124 generates a screen with a preset color applied to the background of the sections of the secondary air conditioners according to a size of difference value between the room temperature data and the room temperature setting data in the determination data.

[0050] Furthermore, the first screen generation unit 124 may generate a floor screen regarding a floor specified by an external input. For example, the first screen generation unit 124 generates the floor screen for the floor specified by the external input.

[0051] The display unit 125 displays the screen generated by the first screen generation unit 124. In addition, the display unit 125 may display the screen generated by the second screen generation unit 126 described later, the screen generated by the third screen generation unit 127 described later, the screen generated by the fourth screen generation unit 128 described later, the screen generated by the fifth screen generation unit 129 described later, and the screen generated by the sixth screen generation unit 130 described later, along with the screen generated by the first screen generation unit.

[0052] For example, the display unit 125 displays the screen generated by the first screen generation unit 124, along with the screen generated by the second screen generation

unit 126, the screen generated by the third screen generation unit 127, the screen generated by the fourth screen generation unit 128, the screen generated by the fifth screen generation unit 129, and the screen generated by the sixth screen generation unit 130. Here, the screen generated by the second to the sixth screen generation units may be switched between displaying and non-displaying by the external input.

[0053] The second screen generation unit 126 summarizes the determination data of the secondary air conditioners belonging to a same air conditioning system and generates a screen for a summary table by air conditioning system. For example, the second screen generation unit 126 summarizes the determination data of “hot”, “cold”, “abnormal”, and “stop” of the secondary air conditioners belonging to a same air conditioning system and generates a screen for a summary table by air conditioning system as a summarizing result.

[0054] The third screen generation unit 127 generates a screen for detailed information about the secondary air conditioner specified by the external input. For example, the third screen generation unit 127 generates a screen for detailed information about the secondary air conditioner specified by the external input displaying the information of the air volume measured value and the air volume set value, the damper opening degree, the start/stop state, and the presence or absence of an abnormal signal, stored as the air conditioning data.

[0055] The fourth screen generation unit 128 generates a floor selection screen. For example, the fourth screen generation unit 128 generates a screen for selecting each floor of a building provided with an air conditioning equipment to be monitored. It should be noted that when there is the external input for any floor of the generated floor selection screen, the floor on which the input was received is regarded as the specified floor, and the floor screen of the floor is generated and displayed.

[0056] The fifth screen generation unit 129 summarizes the determination data of the secondary air conditioners that exist on the floor specified by the external input and

generates a screen for a summary table of the determination data of the secondary air conditioners on the floor. For example, the fifth screen generation unit 129 summarizes the determination data of the secondary air conditioners that exist on the floor specified by the external input for each type of label and generates a screen for a summary table of the determination data of the secondary air conditioners on the specified floor.

[0057] The sixth screen generation unit 130 summarizes the determination data of the secondary air conditioners by floor and generates a screen for a summary table of the determination data of the secondary air conditioners by floor. For example, the sixth screen generation unit 130 generates a screen for a summary table showing the summarizing results of the determination data of the secondary air conditioners belonging to each floor for each type of label. It should be noted that the summary table of the determination data of the secondary air conditioners by floor may be displayed near the floor selection screen.

[0058] [3. Embodiment]

Here, specific examples of the screen displayed by the display unit 125 of the air conditioning equipment monitoring device 100 is described with reference to FIG. 4 to FIG. 8. FIG. 4 to FIG. 8 are diagrams showing specific examples of the screen displayed by the air conditioning equipment monitoring device according to the embodiments. It should be noted that the image shown in FIG. 4 to FIG. 8 may be switched between displaying and non-displaying by, for example, the external input.

[0059] First, referring to FIG. 4, the floor screen generated by the first screen generation unit 124, the summary table by air conditioning system generated by the second screen generation unit 126, and the floor selection screen generated by the fourth screen generation unit 128 are described. The example in FIG. 4 shows an example in which a floor screen of “29F” is generated when “29F” of the floor selection screen is specified externally.

[0060] Then, it is shown that, on that floor, there are four types of air conditioning systems, which are “AHU-2901 to AHU-2904”, with six secondary air conditioners, which are “VAV-1 to VAV-6” belonging to each of the air conditioning systems. In addition, in the section of each of the air conditioning systems, the summary table by air conditioning system is shown; for example, it may be understood that there are five VAVs whose determination data is “hot” and one VAV whose determination data is “cold” in “AHU-2902” air conditioning system.

[0061] Next, referring to FIG. 5, in the floor screen generated by the first screen generation unit 124, a screen with a preset color applied to the background of the sections of the secondary air conditioners according to a size of difference value between the room temperature data and the room temperature setting data is described.

[0062] In the example of FIG. 5, the section surrounded by dotted lines indicates one air conditioning system, and each air conditioning system includes 10 VAVs. Then, the backgrounds of the frames that respectively display the VAVs are applied with preset colors according to the size of difference in temperature (PV-SP) between the room temperature data (measured value PV) and the room temperature setting data (set value SP). In addition, for the determination data of each of the VAVs, “hot” is displayed in red and “cold” is displayed in blue, so that different colors are applied to each type of label of the determination data.

[0063] Next, referring to FIG. 6, the screen for detailed information about the secondary air conditioner generated by the third screen generation unit 127 is described. In the example of FIG. 6, the screen for the detailed information about “VAV-1” that is displayed when “hot” is selected as the determination data of “VAV-1” of “AHU-2902” in the floor screen in the above-mentioned FIG. 4.

[0064] In the example of FIG. 6, the third screen generation unit 127 refers to the air conditioning data for the selected “VAV-1” and generates a screen for the “air volume measured value”, “air volume set value”, “damper opening degree”, “start/stop state”, and “abnormal signal”, and the display unit 125 displays the generated screen.

[0065] Next, with reference to FIG. 7, the screen for the summary table of the determination data of the secondary air conditioners on the specified floor, which is generated by the fifth screen generation unit 129 is described. The example in FIG. 7 shows a summary table in which the determination data of the secondary air conditioners existing on “29F” shown in FIG. 4 is summarized for each type of label.

[0066] In the example of FIG. 7, according to the summary table, it may be understood that on “29F”, there are 10 VAVs with the determination data label “hot”, 3 VAVs with “cold”, 1 VAV with “abnormal”, and no VAV with “stopped”. It should be noted that the summary table in FIG. 7 may be displayed at any position in the floor screen in FIG. 4.

[0067] Next, referring to FIG. 8, the screen for a summary table generated by the sixth screen generation unit 130, which shows the summarizing results of the determination data of the secondary air conditioners belonging to each floor for each type of label is described. In the example of FIG. 8, for the summary table shown in FIG. 7, not only the summary table for the specified floor, but also for each floor of the building to be monitored is summarized. It should be noted that the screen for the summary table in FIG. 8 may be displayed near the floor selection screen in FIG. 4.

[0068] [4. Processing procedure of the air conditioning equipment monitoring device 100]

Next, using FIG. 9, an example of the processing procedure by the air conditioning equipment monitoring device 100 according to the embodiment is described. FIG. 9 is a

flowchart showing an example of the processing procedure in the air conditioning equipment monitoring device according to one embodiment.

[0069] The air conditioning equipment monitoring device 100, for example, receives the specification of a floor (step S101). When the specification of the floor is received (step S101; Yes), the air conditioning equipment monitoring device 100 generates a screen regarding the secondary air conditioners that exist on the specified floor (step S102).

[0070] On the other hand, when the specification of the floor is not received (step S101; No), the air conditioning equipment monitoring device 100 waits until the specification of a floor is received. Then, the air conditioning equipment monitoring device 100 displays the generated screen (step S103) and ends the process.

[0071] [5. Effects of embodiment]

As mentioned above, the air conditioning equipment monitoring device 100 according to this embodiment includes a data acquisition unit 121, a storage unit 122, a status determination unit 123, a first screen generation unit 124, and a display unit 125. The data acquisition unit 121 acquires air conditioning data regarding the secondary air conditioners. The storage unit 122 stores the air conditioning data, the preset room temperature setting data, and the air conditioning system data in the memory unit 140.

[0072] The status determination unit 123 generates the determination data based on the room temperature data and the room temperature setting data, which are part of the air conditioning data. The first screen generation unit 124, based on the air conditioning system data, divides the secondary air conditioners into grouped sections for each of the air conditioning systems on a floor, embeds a section for each of the secondary air conditioners in the grouped sections, and generates a screen with the determination data incorporated in the section for each of the secondary air conditioners. The display unit 125 displays the floor screen generated by the first screen generation unit 124.

[0073] As a result, the air conditioning equipment monitoring device 100 displays an image showing, for each air conditioning system on a floor, the secondary air conditioners belonging to that air conditioning system and the determination data thereof, thereby enabling the user to easily understand the control status of the secondary air conditioners on that floor and to easily improve the control of the air conditioners.

[0074] In addition, the status determination unit 123 of the air conditioning equipment monitoring device 100 generates one of “hot”, “cold”, or “appropriate” labels based on a size of difference value between the room temperature data and the room temperature setting data as the determination data. As a result, the air conditioning equipment monitoring device 100 generates the labels from the room temperature data and the room temperature setting data, thereby enabling the user to easily understand whether the control status of the secondary air conditioners is “hot,” “cold,” or “appropriate” and providing information on control improvement.

[0075] Furthermore, the status determination unit 123 of the air conditioning equipment monitoring device 100 may generate one of “stop”, “abnormal”, or “appropriate” labels based on the secondary air conditioner status data, which is a part of the air conditioning data, as the determination data. As a result, the air conditioning equipment monitoring device 100 generates the labels from the secondary air conditioner status data, thereby enabling the user to easily understand whether the control status of the secondary air conditioners is “stop,” “abnormal,” or “appropriate” and providing information on control improvement.

[0076] In addition, the air conditioning equipment monitoring device 100 further includes the second screen generation unit 126 that summarizes the determination data of the secondary air conditioners belonging to the same air conditioning system and generates a screen for a summary table by air conditioning system, and the display unit 125 display

the generated screen. As a result, the air conditioning equipment monitoring device 100 displays a summary table of the determination data of the secondary air conditioners for each air conditioning system, thereby enabling the user to understand what kind of control improvement is required for each air conditioning system.

[0077] Furthermore, the first screen generation unit 124 of the air conditioning equipment monitoring device 100 generates a screen using different colors according to a size of difference value between the room temperature data and the room temperature setting data in the determination data. As a result, the air conditioning equipment monitoring device 100 applies different colors to the control information of the secondary air conditioners in each air conditioning system, thereby enabling the user to understand the control information of each of the secondary air conditioners at a glance, and also to easily understand information such as which air conditioning system has the secondary air conditioners with large temperature differences between the set temperature and measured temperature.

[0078] In addition, the air conditioning equipment monitoring device 100 further includes the third screen generation unit 127 that generates a screen for detailed information about the secondary air conditioner specified by the external input, and the display unit 125 display the generated screen. As a result, the air conditioning equipment monitoring device 100 enables the user to understand the detailed control information of any secondary air conditioner and provides information on control improvement.

[0079] Furthermore, the first screen generation unit 124 of the air conditioning equipment monitoring device 100 generates a floor screen regarding a floor specified by the external input. As a result, the air conditioning equipment monitoring device 100 enables the user to understand the control status of the secondary air conditioners for any floor specified externally and provides information on control improvement.

[0080] In addition, the air conditioning equipment monitoring device 100 further includes the fourth screen generation unit 128 that generates a floor selection screen, and the display unit 125 display the generated screen. As a result, the air conditioning equipment monitoring device 100 selects any floor on the floor selection screen, thereby enabling the user to understand the control status of the secondary air conditioners for any floor and providing information on control improvement.

[0081] Furthermore, the air conditioning equipment monitoring device 100 further includes the fifth screen generation unit 129 that summarizes the determination data of the secondary air conditioners that exist on the floor specified by the external input and generates a screen for a summary table of the determination data of the secondary air conditioners on the floor, and the display unit 125 display the generated screen. As a result, the air conditioning equipment monitoring device 100 displays a summary table of the determination data of all secondary air conditioners on any floor for which the floor screen is displayed, thereby enabling the user to understand what kind of control status of the secondary air conditioners on that floor is most common and to providing information on control improvement.

[0082] In addition, the air conditioning equipment monitoring device 100 further includes the sixth screen generation unit 130 that summarizes the determination data of the secondary air conditioners by floor and generates a screen for a summary table of the determination data of the secondary air conditioners by floor, and the display unit 125 display the generated screen. As a result, the air conditioning equipment monitoring device 100 allows the user to understand the summary table of the determination data of the secondary air conditioners on each floor, thereby enabling the user to compare the summary number for each floor and select a floor with a higher priority for control improvement.

[0083] [6. Hardware configuration]

The air conditioning equipment monitoring device 100 according to the embodiment described above is implemented by, for example, a computer 1000 having a configuration as shown in FIG. 10. FIG. 10 is a hardware configuration diagram showing an example of a computer that implements the functions of the air conditioning equipment monitoring device 100. The computer 1000 has a configuration in which a CPU 1100, a RAM 1200, a ROM 1300, an auxiliary memory device 1400, a communication I/F (interface) 1500, and an input/output I/F (interface) 1600 are connected by a bus 1800.

[0084] The CPU 1100 operates based on a program stored in the ROM 1300 or the auxiliary memory device 1400 and controls each part. The ROM 1300 stores a boot program executed by the CPU 1100 when the computer 1000 is started, programs depending on the hardware of the computer 1000, etc.

[0085] The auxiliary memory device 1400 stores programs executed by the CPU 1100, data used by the programs, etc. The communication I/F 1500 receives data from other machine through a predetermined communication network and transmits the same to the CPU 1100, and transmits data generated by the CPU 1100 to the other machine through the predetermined communication network.

[0086] The CPU 1100 controls output devices such as a display and a printer, and input/output devices 1700 such as a keyboard and a mouse through an input/output I/F 1600. The CPU 1100 acquires data from the input/output devices 1700 through the input/output I/F 1600. Further, the CPU 1100 outputs the generated data to the input/output devices 1700 through the input/output I/F 1600.

[0087] For example, when the computer 1000 functions as the air conditioning equipment monitoring device 100 according to this embodiment, the CPU 1100 of the computer 1000 implements the functions of the control unit 120 by executing the loaded program on the RAM 1200.

[0088] [7. Others]

Among the processes described in the above embodiment, all or part of the processes described as being performed automatically may also be performed manually, alternatively, all or part of the processes described as being performed manually may also be performed automatically using known methods. In addition, the processing procedures, specific names, and information including various data and parameters shown in the above documents and figures may be arbitrarily changed unless otherwise specified. For example, the various pieces of information shown in each figure are not limited to the illustrated information.

[0089] Further, each component of each device shown in the figures is functionally conceptual, and does not necessarily need to be physically configured as shown in the figures. In other words, the specific form of distribution and integration of each device is not limited to that shown in the figure, but can be configured by functionally or physically distributing and integrating all or part of the same in arbitrary units according to various loads and usage conditions.

[0090] The above-mentioned components include those that may be easily imagined by those skilled in the art, those that are substantially the same, and those that are in the so-called equivalent range. Furthermore, the embodiments described above may be combined as appropriate within a range that does not conflict with the processing contents.

[0091] In addition, the above-mentioned “section, module, unit” may be read as “means”, “circuit”, etc. For example, the control unit may be read as control means or control circuit.

[0092] The above is a detailed description of some of the embodiments of the present invention based on the figures. However, these are all examples, and the present invention can be implemented in other forms with various variations and improvements based on the

knowledge of those skilled in the art, including the embodiments recited in the disclosure of the present invention.

REFERENCE SIGNS LIST

[0093]

100	Air conditioning equipment monitoring device
110	Communication unit
120	Control unit
121	Data acquisition unit
122	Storage unit
123	Status determination unit
124	First screen generation unit
125	Display unit
126	Second screen generation unit
127	Third screen generation unit
128	Fourth screen generation unit
129	Fifth screen generation unit
130	Sixth screen generation unit
140	Memory unit
141	Air conditioning data memory unit
142	Room temperature setting data memory unit
143	Air conditioning system data memory unit
144	Determination data memory unit
200, 200-1~200-n	Air conditioning equipment
201	Primary air conditioner
202, 204	Electric valve

203	Cooling coil
205	Heating coil
206	Blower
206a	Fan
206b	Inverter
207	Primary air conditioner controller
208	Air supply duct
209-1~209-n	Air conditioning area
210-1~210-n	Secondary air conditioner controller
211-1~211-n	Secondary air conditioner
212-1~212-n	Damper
213-1~213-n	Wind speed sensor
214-1~214-n	Opening degree sensor
215-1~215-n	Air outlet
216-1~216-n	Discharging port
217	Return air duct
218	Discharge adjustment damper
219	Return air adjustment damper
220	External air adjustment damper
221, 222, T1, Tn	Temperature sensor

CLAIMS

Claim 1:

An air conditioning equipment monitoring device, monitoring a control status of an air conditioning equipment provided with one or more air conditioning systems that comprises: one primary air conditioner and a plurality of secondary air conditioners that take in a part of conditioning air supplied through a duct from the primary air conditioner and control an amount of conditioning air taken in to eliminate an air conditioning load within each air conditioning area, wherein the air conditioning equipment monitoring device comprises:

- a data acquisition unit, acquiring air conditioning data;

- a storage unit, storing the air conditioning data acquired by the data acquisition unit, room temperature setting data, and air conditioning system data;

- a status determination unit, generating determination data based on room temperature data and the room temperature setting data, which are part of the air conditioning data stored by the storage unit;

- a first screen generation unit, based on the air conditioning system data, dividing the secondary air conditioners into grouped sections for each of the air conditioning systems on a floor, embedding a section for each of the secondary air conditioners in the grouped sections, and generating a screen with the determination data incorporated in the section for each of the secondary air conditioners; and

- a display unit, displaying a screen generated by the first screen generation unit.

Claim 2:

The air conditioning equipment monitoring device according to claim 1, wherein the status determination unit generates one of “hot”, “cold”, or “appropriate” labels based on a

size of difference value between the room temperature data and the room temperature setting data as the determination data.

Claim 3:

The air conditioning equipment monitoring device according to claim 1, wherein the status determination unit generates one of “stop”, “abnormal”, or “appropriate” labels based on secondary air conditioner status data, which is a part of the air conditioning data, as the determination data.

Claim 4:

The air conditioning equipment monitoring device according to claim 1, further comprising:

a second screen generation unit, summarizing the determination data of the secondary air conditioners belonging to a same air conditioning system and generating a screen for a summary table by air conditioning system, and

wherein the display unit displays a screen generated by the first screen generation unit or the second screen generation unit.

Claim 5:

The air conditioning equipment monitoring device according to claim 1, wherein the first screen generation unit generates a screen using different colors according to a size of difference value between the room temperature data and the room temperature setting data in the determination data.

Claim 6:

The air conditioning equipment monitoring device according to claim 1, further comprising:

a third screen generation unit, generating a screen for detailed information about the secondary air conditioner specified by an external input, and

wherein the display unit displays a screen generated by the first screen generation unit or the third screen generation unit.

Claim 7:

The air conditioning equipment monitoring device according to any one of claims 1 to 6, wherein the first screen generation unit generates a floor screen regarding a floor specified by an external input.

Claim 8:

The air conditioning equipment monitoring device according to claim 7, further comprising:

a fourth screen generation unit, generating a floor selection screen, and

wherein the display unit displays a screen generated by the first screen generation unit or the fourth screen generation unit.

Claim 9:

The air conditioning equipment monitoring device according to claim 7, further comprising:

a fifth screen generation unit, summarizing the determination data of the secondary air conditioners that exist on the floor specified by an external input and generating a screen

for a summary table of the determination data of the secondary air conditioners on the floor,
and

wherein the display unit displays a screen generated by the first screen generation unit
or the fifth screen generation unit.

Claim 10:

The air conditioning equipment monitoring device according to claim 7, further
comprising:

a sixth screen generation unit, summarizing the determination data of the secondary air
conditioners by floor and generating a screen for a summary table of the determination data
of the secondary air conditioners by floor, and

wherein the display unit displays a screen generated by the first screen generation unit
or the sixth screen generation unit.