

DESCRIPTION

TITLE OF THE INVENTION:

INFORMATION PROCESSING DEVICE, INFORMATION PROCESSING METHOD,
5 AND INFORMATION PROCESSING PROGRAM

BACKGROUND

Technical Field

10 **[0001]** The present invention relates to an information processing device, an information processing method, and an information processing program.

Related Art

[0002] Conventionally, in building air conditioning systems, it is very important to quickly discover deterioration of an indoor environment due to control abnormality and the
15 like to maintain comfort of occupants. However, as the scale of buildings increases, e.g., an increasing number of floors, it becomes difficult to monitor all indoor environments within the system solely by human effort.

[0003] Thus, systems have been proposed to support efficient building management by processing vast amounts of air conditioning data in real-time using AI or rule-based
20 determination devices, and notifying a manager of locations where an issue has occurred (e.g., see Patent Document 1).

Related Art Documents

Patent Documents

[0004] [Patent Document 1] Japanese Patent Application Laid-Open No. 2013-164212
25

SUMMARY

Problem to Be Solved by Invention

[0005] However, in the conventional art, it is not possible to easily identify target equipment with a high handling priority from among multiple target equipment with control abnormality. For example, conventionally, the method is specialized as determining whether indoor control is good or abnormal at the time of measurement, and cannot identify air conditioning equipment with a high handling priority from among air conditioning equipment determined to be abnormal.

Means for Solving Problem

[0006] To solve the above problem, an information processing device of the present invention includes a collection unit, a probability density distribution calculation unit, a difference calculation unit, and a priority decision unit. The collection unit collects measurement data of target equipment in each of multiple specified periods. The probability density distribution calculation unit calculates a probability density distribution of each of the specified periods based on the measurement data collected by the collection unit. The difference calculation unit calculates a difference between the probability density distributions of multiple periods serving as targets of evaluation calculated by the probability density distribution calculation unit. The priority decision unit decides target equipment with a high priority of handling from among multiple target equipment according to the difference calculated by the difference calculation unit.

Effects of Invention

[0007] The present invention achieves effects of being capable of easily identifying target equipment with a high handling priority from among multiple target equipment with control abnormality.

BRIEF DESCRIPTION OF THE DRAWINGS

[0008] FIG. 1 is a view showing an air conditioning control system including an information processing device according to an embodiment.

FIG. 2 is a block diagram showing a configuration example of the information processing device according to the embodiment.

FIG. 3 is a view showing a specific example of data stored in a storage unit according to the embodiment.

FIG. 4 is a view showing a flow of an overall processing of the information processing device according to the embodiment.

FIG. 5 is a view showing a specific example of a display screen according to the embodiment.

FIG. 6 is a view showing a specific example of a display screen according to the embodiment.

FIG. 7 is a view showing a specific example of a display screen according to the embodiment.

FIG. 8 is a flowchart showing an example of a processing procedure of the information processing device according to the embodiment.

FIG. 9 is a hardware configuration diagram showing an example of a computer that realizes functions of the information processing device according to the embodiment.

DESCRIPTION OF THE EMBODIMENTS

[0009] Hereinafter, embodiments of an information processing device, an information processing method, and an information processing program according to the present application will be described in detail with reference to the drawings. The information processing device, the information processing method, and the information processing

program according to the present application are not limited to these embodiments.

[0010] [1. Introduction]

To begin with, an overview of a system including an information processing device 100 according to the present embodiment will be described. FIG. 1 is a view showing an air conditioning control system including the information processing device according to the embodiment. The following describes a case where an air conditioning control system is taken as an example of the system according to the present embodiment, and target equipment for which a priority is to be identified is an air conditioner having a variable air volume system (VAV) and the like, but the embodiment is not limited thereto and may also be applied to other equipment such as large machinery operating in factories.

[0011] In the example of FIG. 1, the information processing device 100 is connected to an air conditioning system monitoring device 200 in a wired or wireless manner, and performs transmission and reception of information to and from the air conditioning system monitoring device 200. In addition, the air conditioning system monitoring device 200 is connected to an air conditioner system 210 and an air conditioner system 220. In the example of FIG. 1, the air conditioning system monitoring device 200 is connected to two air conditioner systems, but the embodiment is not limited thereto, and the number of air conditioner systems may be increased or decreased in any manner.

[0012] In addition, the air conditioner system 210 includes an air conditioner 211, and a VAV 212 and a VAV 215 connected to the air conditioner 211. The VAV 212 is connected to an indoor temperature sensor 213 and corresponds to air outlets 214-1 to 214-n. Similarly, the VAV 215 is connected to an indoor temperature sensor 216 and corresponds to air outlets 217-1 to 217-n. In addition, the configuration of the air conditioner system 220 from an air conditioner 221 onward is similar to that of the air conditioner system 210. The configuration of the air conditioner system is not limited to

the configuration shown in FIG. 1, and the number of air conditioners and the number of VAVs may be increased or decreased in any manner.

[0013] The information processing device 100 is a server device that receives measurement values of an indoor temperature, an air supply volume of a VAV, a radiation temperature of a floor surface, etc. from the air conditioning system monitoring device 200 and the indoor temperature sensors 213 and 216, and stores such information as history data. The information processing device 100 is realized by a personal computer (PC), a cloud system, etc.

[0014] The air conditioning system monitoring device 200 monitors a control status of air conditioning equipment such as the air conditioner 211 and the VAV 212 belonging to each air conditioning system. Then, the air conditioning system monitoring device 200 transmits information related to an indoor environment, such as the air supply volume of each VAV and the temperature, to the information processing device 100.

[0015] The air conditioner 211 is air conditioning equipment composed of, for example, a cooling coil, a heating coil, and a fan, and an action of the air conditioner 211 is monitored by the air conditioning system monitoring device 200. In addition, conditioned air blown out by the air conditioner 211 and the air conditioner 221 is supplied to each area via air supply ducts. The VAV 212 and the VAV 215 are air conditioning equipment that controls a take-in conditioned air amount of the conditioned air supplied from the air conditioner 211, such that an air conditioning load in each indoor space is relieved. In addition, the VAV 212 and the VAV 215 adjust an air volume supplied from each air outlet by controlling an opening degree of a damper.

[0016] The indoor temperature sensor 213 and the indoor temperature sensor 216 are measuring devices that measure a temperature in the vicinity, and also measure radiation temperatures of walls, ceilings, floor surfaces, etc. in addition to the indoor temperature.

Then, the temperature measured by each temperature sensor is transmitted to the information processing device 100 along with the time of measurement and the like.

[0017] Next, an issue of the conventional art in abnormality detection of the air conditioner according to the present embodiment will be described. Conventionally, abnormality detection of an air conditioner is specialized as determination as “good/abnormal” at the time of measurement, and determination considering a time series is difficult. Thus, for example, in the case where indoor control now is abnormal, it is not possible to determine whether abnormality has continued since before, or a good status in the past has changed to an abnormal status.

[0018] In the case of the two abnormal states described above, a manager is required to prioritize handling the air conditioner that has changed from a good status in the past to an abnormal status. This is because, generally, there are individual differences in how people perceive an indoor environment, and even if control abnormality is determined, users themselves may not feel particularly uncomfortable. Thus, in the case where there has not been any action such as a complaint from the users in the past, it may be assumed that the users are tolerating the control abnormality to some extent. Consequently, among air conditioners with control abnormality, in the case where the same control abnormality has continued from the past, the handling priority can be determined to be low.

[0019] In other words, in the conventional art, it is difficult to consider a time series in abnormality determination of an air conditioner. Thus, it is not possible to learn about time-series changes in control abnormality, and it is not possible to identify an air conditioner with a high handling priority from among multiple air conditioners with control abnormality.

[0020] Next, an overview of a processing of the information processing device 100 according to the present embodiment will be described. In view of the issue described

above, the information processing device 100 according to the present embodiment collects measurement data of target equipment in each of multiple specified periods, and calculates a probability density distribution of each specified period based on the measurement data. Then, with respect to the multiple probability density distributions, the information processing device 100 calculates a difference between probability density distributions of periods serving as targets of evaluation, and decides target equipment with a high priority of handling from among multiple target equipment according to the calculated difference.

[0021] For example, the information processing device 100 collects measurement data related to target equipment, such as an indoor temperature, a set temperature, an air supply volume, etc., in a period specified in advance such as one month. Then, the information processing device 100 calculates a probability density distribution in the specified period based on the measurement data.

[0022] Then, with respect to the probability density distributions calculated respectively in the specified period, the information processing device 100, for example, calculates a distance between probability density distributions of periods serving as targets of evaluation, such as last month and this month, using a Kullback-Leibler divergence (KL divergence). Then, as the calculated distance is larger, the information processing device 100 determines the target equipment as target equipment in which the control state has changed in the evaluation target periods, and identifies the target equipment as target equipment with a higher handling priority.

[0023] Accordingly, as a magnitude of the distance between the probability density distributions of the evaluation target periods is larger, the information processing device 100 can determine the target equipment as target equipment in which the control state has changed and the handling priority is higher. Thus, the information processing device 100 can easily identify target equipment with a high handling priority from among multiple

target equipment with control abnormality.

[0024] [2. Configuration of information processing device 100]

Next, referring to FIG. 2, a configuration of the information processing device 100 shown in FIG. 1 will be described. FIG. 2 is a block diagram showing a configuration example of the information processing device according to the embodiment. As shown in FIG. 2, the information processing device 100 according to the embodiment includes a communication unit 110, a control unit 120, and a storage unit 130.

[0025] The communication unit 110 is realized, for example, by a network interface card (NIC) or the like. The communication unit 110 is connected to the air conditioning system monitoring device 200 in a wired or wireless manner and performs transmission and reception of information.

[0026] The storage unit 130 is realized, for example, by a storage device such as a random access memory (RAM) or a hard disk. The storage unit 130 stores data and programs necessary for various processings performed by the control unit 120. The storage unit 130 stores measurement data related to the control state of air conditioners such as VAVs, which is collected by a collection unit 121 to be described later.

[0027] Herein, referring to FIG. 3, the measurement data stored in the storage unit 130 will be described. FIG. 3 is a view showing a specific example of data stored in the storage unit according to the embodiment. As shown in FIG. 3, the storage unit 130 stores measurement data related to items such as “date/time”, “air supply temperature”, “VAV air volume”, and “indoor temperature”. “Date/time” stores date/time information of the time of measurement, and “air supply temperature” stores the measured temperature of the conditioned air supplied to the indoor space by the VAV. “VAV air volume” stores the measured air volume of the conditioned air supplied to the indoor space by the VAV, and “indoor temperature” stores the measured temperature of the indoor space (indoor space

serving as conditioning target) in which the VAV is installed.

[0028] The measurement data stored in the storage unit 130 is not limited to the data shown in FIG. 3, and any measurement data set by maintenance personnel or the like in advance for determining abnormality of the air conditioner may be stored.

5 **[0029]** Returning to the description of FIG. 2, the control unit 120 is realized by a central processing unit (CPU), a micro processing unit (MPU), etc. executing various programs stored in the internal storage device of the information processing device 100, with the RAM taken as a work area. In addition, the control unit 120 is realized, for example, by an integrated circuit such as an application specific integrated circuit (ASIC) or a field
10 programmable gate array (FPGA). The control unit 120 includes a collection unit 121, a determination unit 122, a probability density distribution calculation unit 123, a difference calculation unit 124, a priority decision unit 125, and a display unit 126.

[0030] The collection unit 121 collects measurement data of target equipment in each of multiple specified periods. For example, the collection unit 121 collects measurement
15 data of the VAV of each of multiple specified periods such as last month and this month from the air conditioning system monitoring device 200, and stores the measurement data to the storage unit 130. Herein, the collected measurement data is, for example, measurement data that the air conditioning system monitoring device 200 acquires periodically, such as at a 10-minute cycle or the like, for the VAV 212. Measurement data
20 within the specified period may be collected all at once, or the acquired data may be collected upon each acquisition and stored in a time-series order to the storage unit 130. The air conditioning system monitoring device 200 is configured to be capable of storing measurement data of each air conditioning equipment to the internal storage device.

[0031] The determination unit 122 determines a state of the target equipment in the
25 specified period calculated using the measurement data collected by the collection unit 121.

For example, the determination unit 122 refers to the measurement data stored in the storage unit 130, determines a good/abnormal status for each measurement within the specified period, and calculates an abnormality ratio totaling the determination results. Specifically, the determination unit 122 determines a good/abnormal status of measurement data for all measurement data collected at a 10-minute cycle this month, and determines whether the control state of the VAV this month is good or abnormal by calculating a ratio of data determined to be abnormal among all measurements.

[0032] The probability density distribution calculation unit 123 calculates a probability density distribution of each specified period based on the measurement data collected by the collection unit 121. For example, the probability density distribution calculation unit 123 refers to the measurement data stored in the storage unit 130 and calculates a probability density distribution of the specified period using all measurement data within the specified period. The calculated probability density distribution may be approximated by a normal distribution.

[0033] In addition, the probability density distribution calculation unit 123 may calculate a probability density distribution in the target equipment determined to be abnormal by the determination unit 122. For example, the probability density distribution calculation unit 123 determines that the VAV is abnormal in the case where the abnormality ratio of the control state of the VAV in the specified period is equal to or greater than a threshold set in advance, and calculates a probability density distribution of all measurement data in the specified period. Accordingly, for example, in the case where the specified period is this month, a processing of priority decision to be described later can be implemented only on the VAV in which the control state this month is abnormal.

[0034] The difference calculation unit 124 calculates a difference between probability density distributions of multiple periods serving as targets of evaluation calculated by the

probability density distribution calculation unit 123. For example, the difference calculation unit 124 calculates the distance between the probability density distributions of multiple periods serving as targets of evaluation, such as this month and last month, using the KL divergence.

5 **[0035]** Herein, the KL divergence is an index in which a degree of similarity (separation) between two probability distributions is calculated as a distance, is 0 in the case where the two probability distributions are identical, and the distance is calculated to be larger as the distributions differ more from each other. In other words, by using the KL divergence, the difference calculation unit 124 can calculate a magnitude of the difference
10 between probability density distributions as a magnitude of a distance. The method for calculating the difference between probability density distributions by the difference calculation unit 124 is not limited to the method using the KL divergence described above.

[0036] By implementing the processing from the probability density distribution calculation unit 123 to the difference calculation unit 124 to calculate the distance between
15 the probability density distributions, the information processing device 100 can more appropriately evaluate changes in a tendency of the good/abnormal status of the VAV compared to the case of simply comparing the abnormality ratios calculated by the determination unit 122. Accordingly, the information processing device 100 can appropriately evaluate that the types of control abnormality are different, even in the case
20 where completely different types of control abnormality occur between last month and this month, and the abnormality ratio itself exhibits little change.

[0037] The priority decision unit 125 decides target equipment with a high priority of handling from among multiple target equipment according to the difference calculated by the difference calculation unit 124. For example, the priority decision unit 125 determines
25 that target equipment in which the distance between the probability distributions calculated

by the difference calculation unit 124 is larger than a threshold set in advance is target equipment with a large change in the control state in the evaluation target periods, and decides the target equipment as target equipment with a high priority of handling.

[0038] In addition, the priority decision unit 125 may decide the priority of the target equipment to be higher as the difference calculated by the difference calculation unit 124 is larger. For example, the priority decision unit 125 decides the target equipment as target equipment with a high handling priority according to a descending order of values of the distances calculated by the difference calculation unit 124.

[0039] In addition, the priority decision unit 125 decides the target equipment with a high priority of handling from among multiple target equipment according to the determination result of the determination unit 122 and the difference calculated by the difference calculation unit 124. For example, with respect to multiple target equipment with a same distance calculated by the KL divergence, the priority decision unit 125 configures the handling priority to be higher as the abnormality ratio now is higher, or configures the handling priority to be lower as the abnormality ratio of the past is also higher.

[0040] The display unit 126 displays information of multiple target equipment arranged in a descending order of the priorities. For example, with respect to multiple VAVs managed by a manager of the air conditioning control system, the display unit 126 refers to the handling priorities decided by the priority decision unit 125 according to a descending order of the distances, and displays information on a management screen, with information of the VAVs arranged in a descending order of the handling priorities.

[0041] [3. Examples]

Herein, referring to FIG. 4, a flow of an overall processing implemented by the information processing device 100 will be described. FIG. 4 is a view showing a flow of

an overall processing of the information processing device according to the embodiment. The processing content shown in FIG. 4 is an example, and the processing implemented by the information processing device 100 is not limited to the processing content described below.

5 **[0042]** First, from the air conditioning system monitoring device 200, the collection unit 121 collects measurement data of last month and measurement data of this month of each target equipment, respectively, and stores the measurement data to the storage unit 130. Next, the determination unit 122 determines a good/abnormal status for all measurement data of last month stored in the storage unit 130, and calculates an abnormality ratio of
10 “20%” in all measurement data. As a result, since the abnormality ratio is lower than 50% which is the threshold, the control state of the target equipment last month is determined to be “good”. In addition, the determination unit 122 also implements a similar processing for this month and determines an abnormality ratio of “60%” and a control state of “abnormal”.

15 **[0043]** In addition, the probability density distribution calculation unit 123 calculates a probability density distribution of last month using all measurement data of last month stored in the storage unit 130 for the target equipment. In addition, the probability density distribution calculation unit 123 also implements a similar processing for this month and calculates a probability density distribution of this month. Accordingly, the probability
20 density distribution of last month and the probability density distribution of this month are calculated for each target equipment.

[0044] Then, the difference calculation unit 124 calculates a distance between the probability density distributions using the KL divergence, taking the calculated probability density distribution of last month and the calculated probability density distribution of this
25 month as a set. Accordingly, the distance between the probability density distributions is

calculated for each target equipment.

[0045] Next, with respect to multiple target equipment, the priority decision unit 125 comprehensively determines on the magnitudes of the calculated distances, the abnormality ratios and the control states obtained by the determination unit 122, and decides handling priorities. In the determination at this time, for example, with respect to multiple target equipment exhibiting a same distance calculated, the handling priority is configured to be higher as the abnormality ratio this month is higher, or the handling priority is configured to be lower as the abnormality ratio last month is also higher. Subsequently, the display unit 126 sorts and displays the target equipment in a handling priority order on the management screen.

[0046] According to the series of processings described above, the information processing device 100 can enable the manager to identify target equipment with a large change in the control state between this month and last month as target equipment with a high handling priority from among the target equipment.

[0047] Next, referring to FIG. 5 to FIG. 7, image examples displayed on the management screen by the display unit 126 will be described. FIG. 5 to FIG. 7 are views showing specific examples of display screens according to the embodiment.

[0048] As shown in FIG. 5, the display unit 126 displays a screen showing information such as “Floor”, “AHU/FCU”, “VAV”, “Before”, “After”, and “Transition” with respect to the VAVs serving as management targets.

[0049] “Floor” displays information of the floor where the target VAV is installed, and “AHU/FCU” displays information of the air conditioner (corresponding to the air conditioner 211 in FIG. 1) connected to the target VAV. “VAV” displays information of the target VAV. “Before” displays a determination result of “good/abnormal” of the VAV in an earlier period (e.g., last month) between two periods serving as targets of evaluation,

and “After” displays similar information for the other period (e.g., this month). “Transition” displays information indicating a change status of the result between “Before” and “After”.

[0050] For example, from among the VAVs that have become abnormal this month, since “VAV-O-13-1-19” connected to “AHU-O-13-1” on “Floor13” was “Good” last month but has become “Abnormal” this month, the display unit 126 displays that the change in the control status is “↓” to enable one to learn that the VAV is a VAV with a high handling priority.

[0051] In addition, as shown in FIG. 5, with respect to multiple VAVs with the control status being “↓”, the display unit 126 sorts and displays in a descending order of the priorities decided by the priority decision unit 125. In other words, among the multiple VAVs with the control status being “↓” shown in FIG. 5, the display unit 126 shows that “VAV-O-13-1-19” has the highest handling priority, and the handling priority decreases as a display spot moves downward.

[0052] Accordingly, with respect to multiple VAVs that exhibit an abnormal control state this month and require handling, the display unit 126 can display the change in the control status of the VAV and the handling priority on the management screen. Thus, the manager can be enabled to easily learn about information of the VAV with a high handling priority.

[0053] In addition, the display unit 126 can cause the screen to transition to a screen shown in FIG. 6 or FIG. 7 upon clicking on a display field of any VAV shown in FIG. 5. In a graph shown in FIG. 6, the vertical axis is an index (Flow Rate (%)) indicating an air supply volume of the VAV, and the horizontal axis indicates a difference (Room Temp Diff (Measured-Setpoint) [°C]) between a measured temperature and a set temperature of an indoor space serving as an adjustment target.

[0054] FIG. 6 shows a graph plotting all measurement data of “202203” which is last month, and all measurement data of “202204” which is this month, respectively. In addition, air conditioning at the time of creating FIG. 6 is assumed to be a cooling mode. Herein, in FIG. 6, a range (upper left of the graph) in which the temperature difference is “-1” or less and the air volume is “40%” or more indicates that the indoor temperature is in a state lower than the set temperature, and the air volume is also strong. Thus, control data plotted in this range is abnormality data in which the indoor space is being cooled excessively and the air volume is also strong. Similarly, data plotted in a range (lower right of the graph) in which the temperature difference is “1” or more and the air volume is “80%” or less is abnormality data in which the indoor space is being cooled insufficiently and the air volume is also weak.

[0055] In FIG. 6, areas other than the upper left or lower right of the graph are areas where there is no problem (tolerable) in control, and measurement data plotted in these areas are considered good data. In other words, the display unit 126 can enable one to learn about the distribution of good/abnormal data of all measurement data of last month and this month of the target VAV from the graph shown in FIG. 6.

[0056] The graph shown in FIG. 7 is a histogram representing the content of the scatter plot shown in FIG. 6 in terms of frequency. The vertical axis is an index (Occurrence count [hour]) indicating a frequency of measurement data, and the horizontal axis indicates items corresponding to each area shown in FIG. 6. For example, the upper left area (excessively cooled and strong air) of the graph in FIG. 6 corresponds to the item of “Cold/Excessive” in FIG. 7.

[0057] As shown in FIG. 7, in the measurement data of last month of the target VAV, the frequency of measurement data in the range of “Cold/Adequate” indicating good measurement data is high. In contrast, in the measurement data of this month, the

frequency of measurement data in the range of “Cold/Excessive” indicating abnormal measurement data is high. In other words, it is shown that the ratio of abnormal data in the range of “Cold/Excessive” has increased in the measurement data this month compared to last month.

5 **[0058]** Accordingly, since the display unit 126 can display the frequency of good/abnormal measurement data of last month and this month, the display unit 126 can enable one to easily learn about changes in measurement data between last month and this month.

[0059] [4. Processing procedure performed by information processing device]

10 Next, referring to FIG. 8, an example of a processing procedure performed by the information processing device 100 according to the embodiment will be described. FIG. 8 is a flowchart showing an example of the processing procedure of the information processing device according to the embodiment. Each step in the flowchart shown in FIG. 8 may be executed in a different order, and some processings may be omitted. In addition,
15 the processings shown in FIG. 8 illustrate the flow of processing content implemented for specific target equipment, and the information processing device 100 is configured to implement the same processing respectively for multiple target equipment serving as management targets.

[0060] First, the collection unit 121 collects measurement data of target equipment in
20 each of multiple specified periods (S101). Subsequently, the determination unit 122 determines whether a control state of the target equipment in the specified period is good or abnormal (S102).

[0061] In the case of being determined as abnormal in the target equipment (S103; Yes), the probability density distribution calculation unit 123 calculates a probability density
25 distribution of each specified period based on the measurement data (S104). In contrast,

in the case of not being determined as abnormal in the target equipment (S103; No), the information processing device 100 ends the processing process on the target equipment.

[0062] After S104, the difference calculation unit 124 calculates a difference between the probability density distributions of the periods serving as targets of evaluation according to a distance of the KL divergence (S105). Then, the priority decision unit 125 decides a handling priority of the target equipment based on a magnitude of the calculated difference (distance) (S106), and the information processing device 100 ends the processing process.

[0063] [5. Effects of embodiment]

As described above, the information processing device 100 according to the present embodiment includes the collection unit 121, the probability density distribution calculation unit 123, the difference calculation unit 124, and the priority decision unit 125. The collection unit 121 collects measurement data of target equipment in each of multiple specified periods. The probability density distribution calculation unit 123 calculates a probability density distribution of each of the specified periods based on the measurement data collected by the collection unit 121.

[0064] The difference calculation unit 124 calculates a difference between the probability density distributions of multiple periods serving as targets of evaluation calculated by the probability density distribution calculation unit 123. The priority decision unit 125 decides target equipment with a high priority of handling from among multiple target equipment according to the difference calculated by the difference calculation unit 124.

[0065] Accordingly, since the information processing device 100 can decide target equipment with a large difference in the control state in the period serving as a target of evaluation as target equipment with a high priority of handling, the information processing device 100 can easily identify target equipment with a high handling priority from among

multiple target equipment with control abnormality.

[0066] In addition, the information processing device 100 further includes the display unit 126. The display unit 126 displays information of the target equipment arranged in a descending order of the priorities for multiple target equipment. In this case, the priority decision unit 125 decides the priority of the target equipment to be higher as the difference calculated by the difference calculation unit 124 is larger.

[0067] Accordingly, since the information processing device 100 can display information shown in a descending order of the priorities for multiple target equipment serving as management targets, the information processing device 100 can provide useful information when deciding the order of handling from among the target equipment with high handling priorities.

[0068] In addition, the information processing device 100 further includes the determination unit 122. The determination unit 122 determines a state of the target equipment in the specified period, calculated using the measurement data collected by the collection unit 121. In this case, the probability density distribution calculation unit 123 calculates a probability density distribution in the target equipment determined to be abnormal by the determination unit 122.

[0069] Accordingly, the information processing device 100 can decide the handling priority for the target equipment determined to be abnormal based on the good/abnormal determination result of the target equipment determined according to the measurement data of the period serving as a target of evaluation. Thus, the information processing device 100 can perform the series of processings only for the target equipment that exhibits an abnormal control state and requires handling, and can reduce a load of processing.

[0070] In addition, in the case where the information processing device 100 includes the determination unit 122, the priority decision unit 125 decides the target equipment with

a high priority of handling from among the multiple target equipment according to the determination result of the determination unit 122 and the difference calculated by the difference calculation unit 124.

[0071] Accordingly, since the information processing device 100 combines the good/abnormal determination result of the target equipment and the distance between the probability density distributions to decide the handling priority of the target equipment, the information processing device 100 can decide a more accurate handling priority considering the state of the target equipment.

[0072] [6. Hardware configuration]

The information processing device 100 according to the embodiment described above is realized, for example, by a computer 1000 with a configuration as shown in FIG. 9. FIG. 9 is a hardware configuration diagram showing an example of a computer that realizes the functions of the information processing device according to the embodiment. The computer 1000 has a configuration in which a CPU 1100, a RAM 1200, a ROM 1300, an auxiliary storage device 1400, a communication interface (I/F) 1500, and an input/output interface (I/F) 1600 are connected via a bus 1800.

[0073] The CPU 1100 acts based on programs stored in the ROM 1300 or the auxiliary storage device 1400, and performs control on each unit. The ROM 1300 stores boot programs executed by the CPU 1100 at startup of the computer 1000, programs dependent on the hardware of the computer 1000, etc.

[0074] The auxiliary storage device 1400 stores programs executed by the CPU 1100, and data used by such programs. The communication I/F 1500 receives data from other devices via a predetermined communication network and sends the data to the CPU 1100, and transmits data generated by the CPU 1100 to other devices via the predetermined communication network.

[0075] The CPU 1100 controls an input/output device 1700 such as a keyboard and a mouse, and output devices such as a display and a printer, via the input/output I/F 1600. The CPU 1100 acquires data from the input/output device 1700 via the input/output I/F 1600. In addition, the CPU 1100 outputs generated data to the input/output device 1700 via the input/output I/F 1600.

[0076] For example, in the case where the computer 1000 functions as the information processing device 100 according to the present embodiment, the CPU 1100 of the computer 1000 realizes the function of the control unit 120 by executing a program loaded onto the RAM 1200.

[0077] [7. Others]

Among the various processings described in the above embodiments, all or a part of the processing described as being performed automatically may also be performed manually. Alternatively, all or a part of the processing described as being performed manually may also be performed automatically according to conventional methods. In addition, the processing procedures, specific names, and information including various data and parameters shown in the above document or drawings may be changed in any manner unless otherwise specified. For example, the various types of information shown in each figure are not limited to the information illustrated.

[0078] In addition, each constituent element of devices shown in the figures is conceptually functional and does not necessarily need to be physically configured as illustrated. In other words, the specific forms of distribution and integration of each device are not limited to those shown in the figures, and all or a part of them may be functionally or physically distributed or integrated in any units depending on various loads, usage conditions, etc.

[0079] The constituent elements described above include those that can be easily

conceived by those skilled in the art, those that are substantially identical thereto, and those within the so-called equivalent ranges. Furthermore, the embodiments described above may be appropriately combined to the extent that the processing content does not contradict each other.

5 **[0080]** In addition, the term “unit (section, module)” described above may be reinterpreted as a “means” or a “circuit”. For example, the control unit may be reinterpreted as a control means or a control circuit.

[0081] Although several embodiments of the present invention have been described in detail above based on the drawings, these embodiments are examples, and the present
10 invention may be implemented in other forms with various modifications and improvements applied based on the knowledge of those skilled in the art, including the aspects described in the disclosure section of the present invention.

Reference Signs List

[0082] 100: information processing device
15 110: communication unit
 120: control unit
 121: collection unit
 122: determination unit
 123: probability density distribution calculation unit
20 124: difference calculation unit
 125: priority decision unit
 126: display unit
 130: storage unit
 200: air conditioning system monitoring device
25 210, 220: air conditioner system

211, 221: air conditioner

212, 215: VAV

213, 216: indoor temperature sensor

214-1 to 214-n, 217-1 to 217-n: air outlet

CLAIMS

Claim 1: An information processing device comprising:

a collection unit collecting measurement data of target equipment in each of a plurality of specified periods;

5 a probability density distribution calculation unit calculating a probability density distribution of each of the specified periods based on the measurement data collected by the collection unit;

a difference calculation unit calculating a difference between the probability density distributions of a plurality of periods serving as targets of evaluation calculated by
10 the probability density distribution calculation unit; and

a priority decision unit deciding target equipment with a high priority of handling from among a plurality of target equipment according to the difference calculated by the difference calculation unit.

15 Claim 2: The information processing device according to claim 1, wherein the priority decision unit decides the priority of the target equipment to be higher as the difference calculated by the difference calculation unit is larger, and

the information processing device further comprises a display unit displaying information of the target equipment arranged in a descending order of the priorities for a
20 plurality of the target equipment.

Claim 3: The information processing device according to claim 1, further comprising a determination unit determining a state of the target equipment in the specified period, calculated using the measurement data collected by the collection unit, wherein

the probability density distribution calculation unit calculates the probability density distribution in the target equipment determined to be abnormal by the determination unit.

5 Claim 4: The information processing device according to claim 1, further comprising a determination unit determining a state of the target equipment in the specified period, calculated using the measurement data collected by the collection unit, wherein

the priority decision unit decides the target equipment with a high priority of handling from among a plurality of the target equipment according to a determination result
10 of the determination unit and the difference calculated by the difference calculation unit.

Claim 5: An information processing method executed by an information processing device, the information processing method comprising:

a collection process of collecting measurement data of target equipment in each
15 of a plurality of specified periods;

a probability density distribution calculation process of calculating a probability density distribution of each of the specified periods based on the measurement data collected by the collection process;

a difference calculation process of calculating a difference between the
20 probability density distributions of a plurality of periods serving as targets of evaluation calculated by the probability density distribution calculation process; and

a priority decision process of deciding target equipment with a high priority of handling from among a plurality of target equipment according to the difference calculated by the difference calculation process.

Claim 6: An information processing program causing a computer to execute:

a collection procedure of collecting measurement data of target equipment in each of a plurality of specified periods;

5 a probability density distribution calculation procedure of calculating a probability density distribution of each of the specified periods based on the measurement data collected by the collection procedure;

a difference calculation procedure of calculating a difference between the probability density distributions of a plurality of periods serving as targets of evaluation calculated by the probability density distribution calculation procedure; and

10 a priority decision procedure of deciding target equipment with a high priority of handling from among a plurality of target equipment according to the difference calculated by the difference calculation procedure.