

Title: CONTROL DEVICE AND CONTROL METHOD

BACKGROUND

5 Technical Field

[0001] An embodiment of the disclosure relate to a control device and a control method.

Related Art

[0002] Conventionally, there is an air conditioning control device that detects the temperature of occupants in a vehicle cabin using an infrared sensor provided therein, and when a change
10 amount of the temperature of the occupants within a prescribed time exceeds a threshold value, determines that the dressing amount of the occupants has changed, and controls the air conditioning device of the vehicle according to the change in the dressing amount (for example, see Patent Literature 1).

Citation List

15 Patent Literature

[0003] [Patent Literature 1] Japanese Patent 6650583

SUMMARY

Technical Problem

20 **[0004]** However, while air conditioning control, which controls air conditioning device according to changes in the dressing amount, is suitable for temperature control in a vehicle cabin where there is little movement of people's positions and the number of seats is fixed, it is not suitable for large spaces such as offices where the number of people using the space and their positions fluctuate, because information indicating a dressing status of a person changes frequently

and the control state becomes unstable.

[0005] One aspect of the embodiment has been made in view of the above, and aims to provide a control device and a control method capable of performing stable air conditioning control without reducing comfort, while suppressing unnecessary switching of air conditioning control
5 and maintaining immediate responsiveness.

Solution to Problem

[0006] The control device according to one aspect of the embodiment includes a determination unit, a decision unit, a calculation unit, and a control unit. The determination unit periodically determines a dressing amount of a person present in a prescribed area. The decision unit decides
10 a change amount for changing a CLO value of the prescribed area according to a change in the dressing amount determined by the determination unit and, when an increase or decrease of the dressing amount has been reversed, decides the CLO value by setting the change amount to 0. The calculation unit calculates a PMV (Predicted Mean Vote) of the prescribed area based on the CLO value decided by the decision unit. The control unit controls an air conditioning device
15 according to the PMV calculated by the calculation unit.

[0007] The control method according to one aspect of the embodiment is executed by a control device, and the control method includes: a determination step of periodically determining a dressing amount of a person present in a prescribed area; a decision step of deciding a change amount for changing a CLO value of the prescribed area according to a change in the dressing
20 amount determined by the determination step, and when, an increase or decrease of the dressing amount has been reversed, deciding the CLO value by setting the change amount to 0; a calculation step of calculating a PMV (Predicted Mean Vote) of the prescribed area based on the CLO value decided by the decision step; and a control step of controlling an air conditioning device according to the PMV calculated by the calculating step.

Effects

[0008] The control device and control method according to one aspect of the embodiment can perform stable air conditioning control without reducing comfort while suppressing unnecessary switching of air conditioning control and maintaining immediate responsiveness.

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BRIEF DESCRIPTION OF THE DRAWINGS

[0009] Figure 1 is a block diagram illustrating an example of a configuration of a control system according to an embodiment.

Figure 2 is a flowchart illustrating an example of processing executed by a control device according to an embodiment.

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Figure 3 is an explanatory diagram of an example of operation of a control device according to an embodiment.

DESCRIPTION OF THE EMBODIMENTS

15 **[0010]** Hereinafter, an embodiment of a control device and a control method will be described in detail with reference to the accompanying drawings. It should be noted that the disclosure is not limited by the embodiment shown below.

[0011]

[1. Technical field of the control device and control method]

20 First, the technical field of the control device and control method according to the embodiment will be described. In general, the dressing status of a person in the room is an important parameter in deciding air conditioning control. For example, the dressing amount is treated as a CLO value, which is one of the components of PMV (Predicted Mean Vote), and is an indispensable element for estimating human thermal sensation.

[0012] Moreover, since people take off their jackets when it is hot and put on their jackets when it is cold, changes in dressing status may also be considered as an expression of the office worker's thermal sensation. Furthermore, in recent office air conditioning, task-ambient air conditioning, which controls the environment such as room temperature according to individual preferences
5 (expressed by PMV, etc.) around the desk, has also become widespread.

[0013] In view of the recent office air conditioning control as described above, the control device according to the embodiment belongs to the technical field of air conditioning control by PMV, for example, by obtaining the dressing status of a person in the room from RGB information or infrared information acquired by an image sensor such as an RGB camera or an infrared camera
10 and treating the dressing amount as a CLO value.

[0014]

[2. Problems in the conventional technology]

Next, the problems of the conventional technology will be described. For example, in the air conditioning inside a vehicle cabin, there is a technology that detects changes in dressing
15 status using an infrared camera and controls the air conditioning according to the changes in dressing status.

[0015] In a state where people may be measured from the front in a limited space like a car, and where there is almost no movement of people's positions, and the number of seats is fixed, the method of determining that the dressing status has changed when the change in human surface
20 temperature within a certain time exceeds a threshold and switching the air conditioning control is effective.

[0016] However, in large spaces such as offices, unlike the space inside a car, there are physical constraints when installing measuring devices. Thus, it is not always possible to measure the target person from the front, and furthermore, measurements may be impossible due to obstacles.

[0017] Also, in large spaces such as offices, people move frequently, so the number of people within the measurement target range is not fixed. Due to these spatial characteristics, the information representing dressing status of a person may take relatively frequently fluctuating values. Thus, if the information of change in the dressing status is used directly for air conditioning control, a problem arises that the control state becomes unstable.

[0018] On the other hand, it is possible to estimate dressing status of a person using image recognition technology based on deep learning, which has become widely popular in recent years. However, when using image recognition technology for large spaces such as offices, due to the aforementioned spatial characteristics, the information representing the dressing status may change frequently.

[0019] Furthermore, the image recognition accuracy is not 100%, so a certain percentage of misrecognition (including detection omission) will occur. In such a situation, if the detected dressing status from each recognition result is directly converted to CLO values and PMV control is performed, the control tends to become unstable. Thus, in order to maintain immediate responsiveness to changes in dressing status as much as possible while preventing unnecessary control switching, it is necessary to devise a method when converting image recognition results into control parameters.

[3. Overview of the control method]

[0020] Next, an overview of the control method according to the embodiment will be described.

The control device according to the embodiment does not directly decide the CLO value (control parameter) according to the change in the dressing status of a person recognized from an image captured by a camera, but instead decides a CLO value change amount (change amount of a control parameter) according to the change in the dressing status recognized.

[0021] Moreover, when the CLO value change amount changes from a positive state (a state

where the CLO value is increased) to a negative state (a state where the CLO value is decreased), the control device makes an increase or decrease of the CLO value with respect to the change in the dressing status more gradual by making the change amount always go through "0".

[0022] Similarly, when the CLO value change amount changes from a negative state (a state where the CLO value is decreased) to a positive state (a state where the CLO value is increased), the control device makes the increase or decrease of the CLO value with respect to the change in the dressing status more gradual by making the change amount always go through "0".

[0023] In other words, the control device decides the change amount for changing the CLO value of a prescribed area according to the change in the dressing amount recognized, and when the increase or decrease of the dressing amount has been reversed, sets the CLO value change amount to "0" to decide the CLO value. Then, the control device calculates the PMV of the prescribed area based on the CLO value decided and controls the air conditioning device according to the PMV calculated.

[0024] As a result, the control device can suppress unnecessary switching of air conditioning control, and can perform stable air conditioning control without reducing comfort while maintaining immediate responsiveness, even if the number of people in a prescribed area, people's positions, and the dressing amount of the people change frequently. Furthermore, by suppressing unnecessary switching of air conditioning control, the control device can also contribute to energy saving.

[4. Example of control system configuration]

[0025] Next, referring to Figure 1, an example of the configuration of a control system 100 according to the embodiment will be described. Figure 1 is a block diagram illustrating an example of a configuration of the control system 100 according to an embodiment.

[0026] As shown in Figure 1, the control system 100 according to the embodiment includes a

camera 10, an air conditioning device 20, and a control device 1. The camera 10 is an image sensor that captures RGB images or infrared images of people in a prescribed area such as an office. The camera 10 inputs image data of RGB images or infrared images the captured to the control device 1.

5 **[0027]** The air conditioning device 20 is, for example, a heating and cooling device that adjusts the temperature in a prescribed area such as an office. The air conditioning device 20 adjusts the temperature in the prescribed area according to the control signal input from the control device 1.

10 **[0028]** The control device 1 includes a microcomputer having a CPU (Central Processing Unit), ROM (Read Only Memory), RAM (Random Access Memory), or various circuits. The control device 1 includes a determination unit 11, a decision unit 12, a calculation unit 13, and a control unit 14, which function by executing a program stored in the ROM using the RAM as a work region.

15 **[0029]** Moreover, the determination unit 11, the decision unit 12, the calculation unit 13, and the control unit 14 included in the control device 1 may be configured with hardware such as an ASIC (Application Specific Integrated Circuit) or FPGA (Field Programmable Gate Array) in whole or in part.

20 **[0030]** Furthermore, the control device 1 includes a storage unit 2. The storage unit 2 is an information storage device such as a data flash, and stores a CLO value 21, a CLO value change amount 22, and a dressing value 23.

20 **[0031]** The CLO value 21 is a value that serves as an air conditioning control parameter for a measurement target range (prescribed area) of the dressing value 23 and affects the PMV. In this embodiment, the control device 1 is assumed to have one CLO value 21 for each unit area (prescribed area) of individual air conditioning.

20 **[0032]** Here, an initial value of the CLO value 21 is set to "0.8". The initial value of the CLO

value 21 is preferably set to the CLO value 21 corresponding to the most common dressing in the office that is subject to air conditioning control.

[0033] Here, an upper limit of the CLO value 21 is set to "0.8". The upper limit of the CLO value 21 is set, for example, assuming that a person is wearing long sleeves and long pants. Also, here, a lower limit of the CLO value 21 is set to "0.5". The lower limit of the CLO value 21 is set, for example, assuming that a person is wearing short sleeves and long pants.

[0034] For example, when it is determined that a person is absent due to a temporary leave or image recognition error, the control state abruptly changes when the CLO value 21 is initialized, so the control device 1 keeps the CLO value 21 at a previous value even if the person is no longer present in the prescribed area. Then, when a person is detected again, the control device 1 starts controlling to change the CLO value 21 from the CLO value 21 kept.

[0035] The CLO value change amount 22 is a change amount of the CLO value 21 increased or decreased by the control device 1. The control device 1 has one CLO value change amount 22 for each measurement target range (prescribed area) of the dressing value 23 with respect to the CLO value 21. Here, an initial value of the CLO value change amount 22 is set to "0". An upper limit of the CLO value change amount 22 is set to "0.1". A lower limit of the CLO value change amount 22 is set to "-0.1".

[0036] The control device 1 changes the CLO value 21 of the prescribed area by an amount of the CLO value change amount 22 for each measurement cycle of the dressing value 23. When a person is no longer present in the prescribed area, the control device 1 resets the CLO value change amount 22 to the initial value of "0".

[0037] The dressing value 23 is a numerical value corresponding to the dressing status of a person recognized by AI (Artificial Intelligence) from the captured image for each measurement cycle (each frame of the image captured). In this embodiment, the measurement cycle of the

dressing value 23 is set to "30 seconds". Moreover, the measurement cycle is not limited to "30 seconds", and it may be any cycle other than "30 seconds" as long as measurement is made several times in one minute. The control device 1 has one dressing value 23 for each CLO value change amount 22 of measurement target range (prescribed area) of the dressing value 23.

5 **[0038]** The determination unit 11 periodically determines the dressing amount of a person present in the prescribed area. For example, when a person is present in the prescribed area, the determination unit 11 performs image recognition on the image data inputted sequentially from the camera 10 using AI (image recognition model) at each measurement cycle and obtains the dressing value 23 that corresponds to the dressing amount according to the dressing status. The
10 image recognition model used here classifies dressing status of a person into two types: long sleeves and short sleeves.

[0039] The determination unit 11 sets the dressing value 23 for long sleeves as "0.1" and the dressing value 23 for short sleeves as "-0.1". Moreover, if the output value of the image recognition model does not reach a certain value, the determination unit 11 determines it as
15 medium (unclear whether it is long sleeves or short sleeves) and sets the dressing value 23 at this time to "0". When multiple people are present in the area, the determination unit 11 sets the sum of the dressing value 23 of all individuals as the dressing value 23 for the prescribed area.

[0040] The decision unit 12 decides the CLO value change amount 22 for changing the CLO value 21 of the prescribed area according to the change in the dressing value 23 determined by the
20 determination unit 11, and when the increase or decrease of the dressing value 23 has been reversed, decides the CLO value 21 by setting the CLO value change amount 22 to 0.

[0041] For example, when the dressing value 23 of the prescribed area is larger than "0", the decision unit 12 adds "0.1" to the CLO value change amount 22. When the dressing value 23 of the prescribed area is smaller than "0", the decision unit 12 subtracts "0.1" from the CLO value

change amount 22. When the dressing value 23 of the prescribed area is "0", the decision unit 12 sets the CLO value change amount 22 to "0".

[0042] The calculation unit 13 calculates the PMV of the prescribed area based on the CLO value 21 decided by the decision unit 12. The control unit 14 controls the air conditioning device 20 according to the PMV calculated by the calculation unit 13. For example, the control unit 14 controls the air conditioning device 20 with the PMV within the range of "-0.5" to "+0.5".

[0043] Specific operation examples of the control device 1 will be described later with reference to Figure 3. Note that the internal configuration of the control device 1 is not limited to the configuration shown in Figure 1, and may be another configuration as long as it performs the information processing described later.

[5. Processing executed by the control device]

[0044] Next, referring to Figure 2, an explanation will be given of the processing executed by the control device 1 according to the embodiment. Figure 2 is a flowchart illustrating an example of processing executed by the control device 1 according to the embodiment.

[0045] As shown in Figure 2, when the control device 1 starts the measurement, it first sets the CLO value 21 to the initial value of "0" and sets the CLO value change amount 22 to the initial value of "0" (Step S101). Then, the control device 1 detects a person in an area by performing image recognition on image data input from the camera 10 (Step S102).

[0046] Then, the control device 1 determines presence or absence of a person (Step S103), and if it is determined that there is no person, it keeps the CLO value 21 and keeps the CLO value change amount 22 at "0" (Step S105), and proceeds to Step S102. Moreover, when the control device 1 determines that there is a person, it sets an area dressing value to 0 (Step S104).

[0047] Next, the control device 1 determines a dressing status of a person determined as present in Step S103 (Step S106). When the control device 1 determines the dressing status to be short

sleeves, it sets the dressing value 23 to "-0.1" (Step S107). When the control device 1 determines the dressing status to be medium or unclear, it sets the dressing value 23 to "0" (Step S108). When the control device 1 determines the dressing status to be long sleeves, it sets the dressing value 23 to "0.1" (Step S109).

5 **[0048]** Then, the control device 1 loops and repeats the processing of Steps S106 to S109 for the number of people detected in the prescribed area, and obtains the area dressing value by adding dressing the value 23 for the number of people detected (Step S110).

[0049] Then, the control device 1 determines the area dressing value (Step S111). When the control device 1 determines that the area dressing value is smaller than 0, it decides the CLO value
10 change amount 22 as "-0.1" (Step S112). In this case, the control device 1 may decide the CLO value change amount 22 as "-0.05".

[0050] When the control device 1 determines that the area dressing value is 0, it decides the CLO value change amount 22 as 0 (Step S113). When the control device 1 determines that the area dressing value is larger than "0", it decides the CLO value change amount 22 as "+1.0" (Step
15 S114). In this case, the control device 1 may decide the CLO value change amount 22 as "+0.05".

[0051] Then, the control device 1 adds the CLO value change amount 22 decided in Steps S112 to S114 to the CLO value 21, and decides the CLO value 21 (Step S115). At this time, the control device 1 decides the CLO value 21 with an upper limit of "0.8" and a lower limit of "0.5". Then, the control device 1 performs PMV calculation based on the CLO value 21 decided (Step S116).

20 **[0052]** Next, the control device 1 outputs a control signal corresponding to the PMV calculated to the air conditioning device 20 and performs air conditioning control (Step S117). Moreover, after executing the processing in Step S115, the control device 1 moves the processing to Step S102 when 30 seconds have elapsed.

[6. Operation example of the Control Device]

[0053] Next, referring to Figure 3, an operation example of the control device 1 according to the embodiment will be described. Figure 3 is an explanatory diagram of an example of operation of the control device 1 according to the embodiment.

[0054] In the dressing status column detected shown in Figure 3, the presence or absence of people, the number of people, and their dressing in a prescribed area are shown in chronological order for each measurement cycle. For example, "absent" indicates that there is no person in the prescribed area. "Long" indicates that there is one person wearing long sleeves in the prescribed area.

[0055] "Half-long" indicates that there are two people in the prescribed area, one person is wearing short sleeves and the other person is wearing long sleeves. "Half-long-long" indicates that there are three people in the prescribed area, one person is wearing short sleeves, another person is wearing long sleeves, and the remaining person is wearing long sleeves. Moreover, the times t1 to t28 when the dressing value 23 is measured are shown in chronological order in the detected dressing status column.

[0056] In the dressing value 23 column, the sum of the dressing value 23 of all individuals detected in the prescribed area for each measurement cycle is shown in chronological order. In the CLO value change amount 22 column, the amount for changing the value changing the CLO value 21 for each measurement cycle is shown in chronological order. In the CLO value 21 column, the CLO value 21 corresponding to the prescribed area for each measurement cycle is shown in chronological order.

[0057] The determination unit 11 performs image recognition on the number of people in the prescribed area and the dressing of each person by AI from the images input from the camera 10, and determines the dressing value 23 based on the recognition results. The decision unit 12 decides the CLO value change amount 22 at that time based on the dressing value 23 decided by

the determination unit 11, and changes the CLO value 21 by an amount of the CLO value change amount 22 decided so as to decide the CLO value 21 of the prescribed area. Moreover, the CLO value 21 decided at this time is prescribed to have an upper limit of "0.8" and a lower limit of "0.5" as previously mentioned.

5 **[0058]** As shown in Figure 3, when the control device 1 starts measurement, it first sets the CLO value change amount 22 to the initial value of "0" and sets the CLO value 21 of the prescribed area, which is the measurement target range, to the initial value of "0.8".

10 **[0059]** After that, if there is no person in the prescribed area at time t1, the determination unit 11 sets the dressing value 23 to "null". The decision unit 12 sets the CLO value change amount 22 to "0", and thereby decides the CLO value 21 as "0.8".

[0060] At time t2, when there is one person wearing long sleeves in the prescribed area, the determination unit 11 decides the dressing value 23 as "0.1". The decision unit 12 sets the CLO value change amount 22 to "0.1" because the dressing value 23 is larger than "0", but since the CLO value 21 has reached the upper limit of "0.8", it keeps the CLO value 21 at "0.8".

15 **[0061]** At time t3, when there is one person wearing long sleeves in the prescribed area, the determination unit 11 decides the dressing value 23 as "0.1". The decision unit 12 sets the CLO value change amount 22 to "0.1" because the dressing value 23 is larger than "0", but since the CLO value 21 has reached the upper limit of "0.8", it keeps the CLO value 21 at "0.8". In this way, the control device 1 can suppress excessive air conditioning control by setting an upper limit
20 for the CLO value 21.

[0062] At time t4, when there is one person wearing short sleeves in the prescribed area, the determination unit 11 decides the dressing value 23 as "-0.1". The decision unit 12 sets the CLO value change amount 22 temporarily to "0" instead of "-0.1" because the increase or decrease of the dressing value 23 has reversed since the last measurement even though the dressing value 23

is smaller than "0", and keeps the CLO value 21 at "0.8".

[0063] In this way, even if one person in the prescribed area takes off his or her long-sleeved clothes becomes in short sleeves, the control device 1 does not immediately change the CLO value 21 by setting the CLO value change amount 22 temporarily to "0". As a result, the control device
5 1 can suppress frequent switching of air conditioning control and perform stable air conditioning control without reducing comfort.

[0064] At time t5, when there is one person wearing short sleeves in the prescribed area the determination unit 11 decides the dressing value 23 as "-0.1". The decision unit 12 sets the CLO value change amount 22 to "-0.1" because the dressing value 23 is smaller than "0" and the increase
10 or decrease of the dressing value 23 has not reversed since the last measurement, and decides the CLO value 21 as "0.7" by subtracting "0.1" from "0.8".

[0065] At time t6, when there is a person in the prescribed area whose dressing is unclear of long sleeves or short sleeves (medium), the determination unit 11 decides the dressing value 23 as "0". Because the dressing value 23 is "0", the decision unit 12 sets the CLO value change amount
15 22 to "0", and keeps the CLO value 21 at "0.7".

[0066] At time t7, when there is one person wearing short sleeves in the prescribed area, the determination unit 11 decides the dressing value 23 as "-0.1". The decision unit 12 sets the CLO value change amount 22 to "-0.1" because the dressing value 23 is smaller than "0" and the increase
20 or decrease of the dressing value 23 has not reversed since the last measurement, and decides the CLO value 21 as "0.6" by subtracting "0.1" from "0.7". In this way, the control device 1 reduces the CLO value 21 when the dressing value 23 continues to be "0" or less even though the increase or decrease of the dressing value 23 has not reversed, thereby maintaining immediate responsiveness of the air conditioning.

[0067] At time t8, when there is one person wearing short sleeves in the prescribed area, the

determination unit 11 decides the dressing value 23 as "-0.1". The decision unit 12 sets the CLO value change amount 22 to "-0.1" because the dressing value 23 is smaller than "0" and the increase or decrease of the dressing value 23 has not reversed since the last measurement, and decides the CLO value 21 as "0.5" by subtracting "0.1" from "0.6". In this way, the control device 1 reduces the CLO value 21 when the dressing value 23 continues to be smaller than "0", thereby maintaining immediate responsiveness of air conditioning.

[0068] At time t9, when there is one person wearing short sleeves in the prescribed area, the determination unit 11 decides the dressing value 23 as "-0.1". The decision unit 12 keeps the CLO value 21 at "0.5" because the CLO value 21 has reached the lower limit of "0.5" even though the dressing value 23 is smaller than "0" and the increase or decrease of the dressing value 23 has not reversed since the last measurement. In this way, the control device 1 can suppress excessive air conditioning control by setting a lower limit for the CLO value 21.

[0069] At time t10, when there is one person with the dressing value 23 of "-0.1" wearing short sleeves and one person with the dressing value 23 of "0.1" wearing long sleeves in the prescribed area, the determination unit 11 determines "0", which is the sum of the dressing values 23 of the two people, as the dressing value 23. The decision unit 12 sets the CLO value change amount 22 to "0" because the dressing value 23 is "0", and keeps the CLO value 21 at "0.5".

[0070] At time t11, since the detected dressing status is the same as at t10, the dressing value 23 is determined as "0". The decision unit 12 sets the CLO value change amount 22 to "0" because the dressing value 23 is "0", and keeps the CLO value 21 at "0.5".

[0071] At time t12, when there is one person with the dressing value 23 of "-0.1" wearing short sleeves and two people with the dressing value 23 of "0.1" wearing long sleeves in the prescribed area, the determination unit 11 determines "0.1", which is the sum of the dressing values 23 of the three people, as the dressing value 23. The decision unit 12 sets the CLO value change amount

22 to "0.1" and decides the CLO value 21 as "0.6" by adding "0.1" to "0.5", because the dressing value 23 is larger than "0" and the increase or decrease of the dressing value 23 has not reversed since the last measurement. In this way, the control device 1 increases the CLO value 21 when the dressing value 23 continues to be "0" or more, thereby maintaining immediate responsiveness of air conditioning.

[0072] At time t13, since the detected dressing status is the same as at t12, the dressing value 23 is determined as "0.1". The decision unit 12 sets the CLO value change amount 22 to "0.1" and decides the CLO value 21 as "0.7" by adding "0.1" to "0.6", because the dressing value 23 is larger than "0" and the increase or decrease of the dressing value 23 has not reversed since the last measurement. In this way, the control device 1 increases the CLO value 21 when the dressing value 23 continues to be larger than "0", thereby maintaining immediate responsiveness of air conditioning.

[0073] At time t14, since the detected dressing status is the same as at t13, the determination unit 11 determines the dressing value 23 as "0.1". The decision unit 12 sets the CLO value change amount 22 to "0.1" and decides the CLO value 21 as "0.8" by adding "0.1" to "0.7", because the dressing value 23 is larger than "0" and the increase or decrease of the dressing value 23 has not reversed since the last measurement. In this way, the control device 1 increases the CLO value 21 when the dressing value 23 continues to be larger than "0", thereby maintaining immediate responsiveness of air conditioning by.

[0074] At time t15, since the detected dressing status is the same as at t13, the determination unit 11 determines the dressing value 23 as "0.1". The decision unit 12 sets the CLO value change amount 22 to "0.1" because the dressing value 23 is larger than "0" and the increase or decrease of the dressing value 23 has not reversed since the last measurement, but since the CLO value 21 has reached the upper limit of "0.8", it keeps the CLO value 21 at "0.8".

[0075] At time t16, the determination unit 11 determines “-0.1”, which is the sum of the dressing values 23 of three people: two people wearing short sleeves with the dressing value 23 of “-0.1” and one person wearing long sleeves with the dressing value 23 of “0.1” in the prescribed area, as the dressing value 23. The decision unit 12 sets the CLO value change amount 22 to “0” and keeps the CLO value 21 at “0.8” because the dressing value 23 is smaller than “0” and the increase or decrease of the dressing value 23 has reversed since the last measurement.

[0076] At time t17, when there is one person wearing short sleeves with the dressing value 23 of “-0.1”, one person whose dressing is unclear of long sleeves or short sleeves (medium), and one person wearing long sleeves with the dressing value 23 of “0.1” in the prescribed area, the determination unit 11 determines “0”, which is the sum of the dressing values 23 of the three people, as the dressing value 23. The decision unit 12 sets the CLO value change amount 22 to “0” and keeps the CLO value 21 at “0.8” because the dressing value 23 is “0”.

[0077] At time t18, the determination unit 11 determines “-0.1”, which is the sum of the dressing values 23 of three people: two people wearing short sleeves with the dressing value 23 of “-0.1” and one person wearing long sleeves with the dressing value 23 of “0.1” in the prescribed area, as the dressing value 23. The decision unit 12 sets the CLO value change amount 22 to “-0.1” and decides the CLO value 21 as “0.7” by subtracting “0.1” from “0.8” because the dressing value 23 is smaller than “0” and the increase or decrease of the dressing value 23 has not reversed since the last measurement.

[0078] At time t19, the determination unit 11 determines “-0.3”, which is the sum of the dressing values 23 of three people wearing short sleeves with the dressing value 23 of “-0.1” in the prescribed area, as the dressing value 23. The decision unit 12 sets the CLO value change amount 22 to “-0.1” and decides the CLO value 21 as “0.6” by subtracting “0.1” from “0.7”, because the dressing value 23 is smaller than “0” and the increase or decrease of the dressing value 23 has not

reversed since the last measurement.

[0079] At time t20, the determination unit 11 determines "-0.2", which is the sum of the dressing values 23 of two people wearing short sleeves with the dressing value 23 of "-0.1" and one person whose dressing is unclear of long sleeves or short sleeves (medium) in the prescribed area, as the dressing value 23. The decision unit 12 sets the CLO value change amount 22 to "-0.1" and decides the CLO value 21 as "0.5" by subtracting "0.1" from "0.6", because the dressing value 23 is smaller than "0" and the increase or decrease of the dressing value 23 has not reversed since the last measurement.

[0080] At time t21, the determination unit 11 determines "0.3", which is the sum of the dressing values 23 of three people wearing long sleeves with the dressing value 23 of "0.1" in the prescribed area as the dressing value 23. The decision unit 12 sets the CLO value change amount 22 to "0" and keeps the CLO value 21 at "0.5", because the increase or decrease of the dressing value 23 has reversed since the last measurement even though the dressing value 23 is larger than "0".

[0081] At time t22, since the detected dressing status is the same as at t21, the determination unit 11 determines the dressing value 23 as "0.3". The decision unit 12 sets the CLO value change amount 22 to "0.1" and decides the CLO value 21 as "0.6" by adding "0.1" to "0.5", because the dressing value 23 is larger than "0" and the increase or decrease of the dressing value 23 has not reversed since the last measurement.

[0082] At time t23, since the detected dressing status is the same as at t22, the determination unit 11 determines the dressing value 23 as "0.3". The decision unit 12 sets the CLO value change amount 22 to "0.1" and decides the CLO value 21 as "0.7" by adding "0.1" to "0.6", because the dressing value 23 is larger than "0" and the increase or decrease of the dressing value 23 has not reversed since the last measurement.

[0083] At times t24 to t26, if there are no people present in the prescribed area due to their

temporary leave, the dressing value 23 is set to "null". Then, the decision unit 12 sets the CLO value change amount 22 to "0", and thereby keeps the CLO value 21 at "0.7".

[0084] At time t27, when there is one person wearing short sleeves in the prescribed area, the determination unit 11 decides the dressing value 23 as "-0.1". The decision unit 12 sets the CLO value change amount 22 to "-0.1" and decides the CLO value 21 as "0.6" by subtracting "0.1" from "0.7", because the dressing value 23 is smaller than "0" and the increase or decrease of the dressing value 23 has not reversed since the last measurement.

[0085] At time t28, when there is one person wearing short sleeves in the prescribed area, the determination unit 11 decides the dressing value 23 as "-0.1". The decision unit 12 sets the CLO value change amount 22 to "-0.1" and decides the CLO value 21 as "0.5" by subtracting "0.1" from "0.6", because the dressing value 23 is smaller than "0" and the increase or decrease of the dressing value 23 has not reversed since the last measurement.

[0086] The calculation unit 13 calculates the PMV of the prescribed area based on the CLO value 21 each time the CLO value 21 is decided at each time from t1 to t28. Then, the control unit 14 controls the air conditioning device 20 according to the PMV each time it is calculated by the calculation unit 13.

[0087] As described above, the control device 1 according to the embodiment recognizes the status of the dressing value 23 of the people in the prescribed area, and does not change the parameter (for example, the CLO value 21) that affects air conditioning control unless it detects continuous change of the same state or unless there is an medium status to go through.

[0088] Furthermore, the control device 1 assumes temporary absence from the prescribed area or missed image recognition, and keeps the control parameters of the measurement target area even when there are no people in the prescribed area. When people return to the prescribed area, control is started with the parameters kept.

[0089] According to the control device 1, even in situations where it is difficult to measure the target person from the front, such as in a large space like an office, or in situations where measurement is impossible or only partially measurement is possible due to obstacles, the measurement results are less likely to affect air conditioning control even when the measurement target is not in a stable state.

[0090] Furthermore, the control device 1 assumes that multiple people present in a single task air conditioning area and decides the air conditioning control of the target area based on the sum of the dressing status of all individuals. According to the control device 1, for example, even in situations where object movement frequently occurs, such as in a large space like an office, and the number of people within the measurement target range is not fixed, appropriate air conditioning control can be implemented taking into account the dressing status of all individuals even if multiple people gather within the measurement range.

[0091] Moreover, the control device 1 provides air conditioning tailored to each individual's preferences and conditions in task air conditioning. Thus, it is expected to have the effect of preventing unstable control in exceptional situations.

[0092] Further effects and modified examples can be easily derived by those skilled in the art. Thus, the broader aspects of the disclosure are not limited to the specific details and representative embodiment described and shown above. Accordingly, various modifications can be made without departing from the spirit or scope of the general inventive concept defined by the appended claims and their equivalents.

Reference Signs List

[0093] 1 Control device
10 Camera
11 Determination unit

	12	Decision unit
	13	Calculation unit
	14	Control unit
	2	Storage unit
5	20	Air conditioning device
	21	CLO value
	22	CLO value change amount
	23	Dressing value
	100	Control system

CLAIMS:

[Claim 1] A control device, comprising:

a determination unit that periodically determines a dressing amount of a person present in a prescribed area;

5 a decision unit that decides a change amount for changing a CLO value of the prescribed area according to a change in the dressing amount determined by the determination unit and, when an increase or decrease of the dressing amount has been reversed, decides the CLO value by setting the change amount to 0;

10 a calculation unit that calculates a PMV (Predicted Mean Vote) of the prescribed area based on the CLO value decided by the decision unit; and

a control unit that controls an air conditioning device according to the PMV calculated by the calculation unit.

[Claim 2] The control device according to claim 1,

15 wherein the determination unit determines the dressing amount by performing recognition on image data input from an image sensor that captures the prescribed area using AI (Artificial Intelligence).

[Claim 3] A control device according to claim 1,

20 wherein the decision unit decides, when the increase or decrease of the dressing amount between a previous determination and a current determination by the determination unit has not been reversed and the dressing amount increases in the current determination from the previous determination, a value obtained by adding a prescribed value to the CLO value previously decided as a current CLO value.

[Claim 4] The control device according to claim 1,

wherein the decision unit decides, when the increase or decrease of the dressing amount

between a previous determination and a current determination by the determination unit has not been reversed and the dressing amount decreases in the current determination from the previous determination, a value obtained by subtracting a prescribed value from the CLO value previously decided as a current CLO value.

5 [Claim 5] The control device according to claim 1,
 wherein the decision unit decides the CLO value between a pre-set upper limit and lower limit.

 [Claim 6] The control device according to claim 1,
 wherein the determination unit determines the number of people present in the
10 prescribed area and, when multiple people are present in the prescribed area, determines the dressing amount of the prescribed area based on a dressing status of all individuals.

 [Claim 7] The control device according to claim 1,
 wherein when a person present in the prescribed area is not recognized by the determination unit, the decision unit decides the CLO value previously decided as the current CLO
15 value.

 [Claim 8] A control method executed by a control device, the control method comprising:

 a determination step of periodically determining a dressing amount of a person present in a prescribed area;

20 a decision step of deciding a change amount for changing a CLO value of the prescribed area according to a change in the dressing amount determined by the determination step, and when, an increase or decrease of the dressing amount has been reversed, deciding the CLO value by setting the change amount to 0;

 a calculation step of calculating a PMV (Predicted Mean Vote) of the prescribed area

based on the CLO value decided by the decision step; and

a control step of controlling an air conditioning device according to the PMV calculated by the calculating step.