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(54) TEMPERATURE AND HUMIDITY COMPREHENSIVE ADJUSTMENT CONTROL METHOD, AND ADJUSTMENT DEVICE, ADJUSTMENT SYSTEM AND MEDIUM

(57) A temperature and humidity comprehensive adjustment control method, comprising the following steps: acquiring a thermal comfort influence parameter corresponding to a user in a working space of an adjustment device, and a preset relative humidity range (S10); determining a target temperature range according to the thermal comfort influence parameter and the relative humidity range (S20); determining a target moisture content range according to the preset relative humidity range (S30); and determining an operating parameter of the adjustment device according to the current temperature, the current moisture content, the target moisture content range and the target temperature range in the working space, and controlling the adjustment device to operate according to the determined operating parameter (S40).

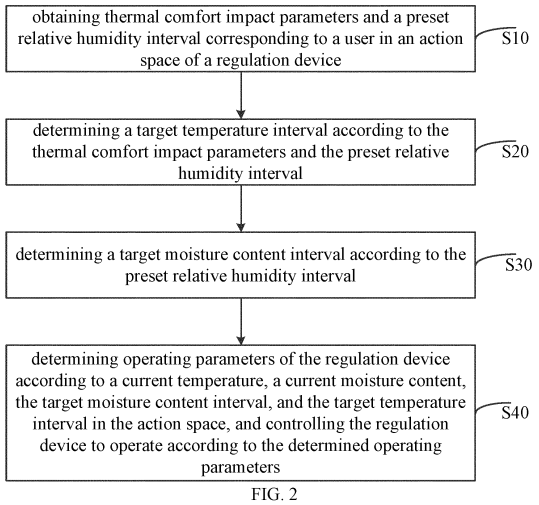

FIG. 2

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Description

[0001] The present application claims priority to Chinese Patent Application No. 202010793953.3, and filed on August 7, 2020, the entire contents of which are incorporated herein by reference.

TECHNICAL FIELD

[0002] The present application relates to the technical field of virtual reality, and in particular to a method for comprehensively regulating temperature and humidity, a regulation device, a regulation system and a computer readable storage medium.

BACKGROUND

[0003] To improve the comfort of the air conditioner, the humidifier needs to be turned on when the air conditioner is turned on. The humidification function and the temperature regulation function can only be controlled independently, resulting in lowering relative humidity in the room when the air conditioner performs cooling regulation. To protect the humidity in the home, it is necessary to turn on an independent humidifier for humidification, which causes a waste of resources and energy.

[0004] The foregoing is intended only to assist in understanding the technical solution of the present application and does not represent an admission that the foregoing is prior art.

SUMMARY

[0005] The main purpose of the present application is to provide a method for comprehensively regulating temperature and humidity, a regulation device, a regulation system and a computer readable storage medium, aiming at reducing energy consumption of the air conditioner.

[0006] In order to achieve the above purpose, the present application provides a method for comprehensively regulating temperature and humidity, including:

obtaining thermal comfort impact parameters and a preset relative humidity interval corresponding to a user in an action space of a regulation device;
determining a target temperature interval according to the thermal comfort impact parameters and the preset relative humidity interval;
determining a target moisture content interval according to the preset relative humidity interval; and
determining operating parameters of the regulation device according to a current temperature, a current moisture content, the target moisture content interval, and the target temperature interval in the action space, and controlling the regulation device to operate according to the determined operating parameters.

[0007] In an embodiment, the thermal comfort impact parameters include a dressing index of the user, an activity amount of the user, and/or a human metabolic rate.

[0008] In an embodiment, before the operation of obtaining the thermal comfort impact parameters and the preset relative humidity interval corresponding to the user in the action space of the regulation device, the method further includes:

obtaining an outdoor ambient temperature corresponding to a space where the regulation device is located;
wherein the operation of obtaining the thermal comfort impact parameters and the preset relative humidity interval corresponding to the user in the action space of the regulation device includes:
determining the dressing index according to the outdoor ambient temperature; and
obtaining the preset relative humidity interval.

[0009] In an embodiment, the operation of determining the dressing index according to the outdoor ambient temperature includes:
determining the obtained dressing index corresponding to the outdoor ambient temperature according to a pre-stored corresponding relationship between the outdoor ambient temperature and the dressing index.

[0010] In an embodiment, the operation of obtaining the outdoor ambient temperature corresponding to the space where the regulation device is located includes:

obtaining position information of the regulation device and weather forecast data; and
determining the outdoor ambient temperature according to the position information and the weather forecast data.

[0011] In an embodiment, the operation of determining the dressing index according to the outdoor ambient temperature includes:

obtaining a current time; and
determining a current season and/or a current seasonal weather corresponding to the space where the regulation device is located according to the current time and the position information;
wherein the operation of determining the dressing index according to the outdoor ambient temperature includes:
determining the dressing index according to the current time, the outdoor ambient temperature, and at least one of the current season and the current seasonal weather.

[0012] In an embodiment, before the operation of obtaining the thermal comfort impact parameters and the preset relative humidity interval corresponding to the user in the action space of the regulation device, the method further includes:

obtaining temperature detection data detected by an infrared detection sensor in the space where the regulation device is located;
wherein the operation of obtaining the thermal comfort impact parameters and the preset relative humidity interval corresponding to the user in the action space of the regulation device comprises:
determining the activity amount corresponding to the user in the action space of the regulation device according to the temperature detection data, and obtaining the preset relative humidity interval.

[0013] In an embodiment, the operation of determining the target temperature interval according to the preset relative humidity interval and at least one of the dressing index and the activity amount includes:

obtaining a first heat-sensing index and a second heat-sensing index that are pre-stored, wherein the first heat-sensing index is lower than the second heat-sensing index;
determining a first temperature curve according to the first heat-sensing index, the preset relative humidity interval, and at least one of the dressing index and the activity amount;
determining a second temperature curve according to the second heat-sensing index, the preset relative humidity interval, and at least one of the dressing index and the activity amount; and
determining the target temperature interval according to the first temperature curve and the second temperature curve.

[0014] In an embodiment, before the operation of determining the target moisture content interval according to the preset relative humidity interval, the method further includes:

obtaining a vapor partial pressure value in the action space of the regulation device;
wherein the operation of determining the target moisture content interval according to the preset relative humidity interval includes:
determining a moisture content curve according to the vapor partial pressure value, the target temperature interval, and the preset relative humidity interval; and
determining the target moisture content interval according to the moisture content curve.

[0015] In an embodiment, before the operation of determining the operating parameters of the regulation device according to the current temperature, the current moisture content, the target moisture content interval, and the target temperature interval in the action space, and controlling the regulation device to operate according to the determined operating parameters, the method further includes:
obtaining the current temperature and the current moisture content in an action space of an air conditioner.

[0016] In an embodiment, the operation of determining the operating parameters of the regulation device according to the current temperature, the current moisture content, the target moisture content interval, and the target temperature interval in the action space, and controlling the regulation device to operate according to the determined operating parameters includes:

determining a first corresponding relationship between the current temperature and the target temperature interval, and a second corresponding relationship between the current moisture content and the target moisture content interval;
determining operating parameters of the regulation device according to the first corresponding relationship and the second corresponding relationship; and
controlling the regulation device to operate according to the determined operating parameters.

[0017] In an embodiment, the regulation device includes a temperature regulation assembly and a humidity regulation assembly, and the temperature regulation assembly and the humidity regulation assembly are separated or integrated together.

[0018] In addition, in order to achieve the above purpose, the present application also provides a regulation device, including: a memory, a processor and a program for comprehensively regulating temperature and humidity that is stored on the memory and operable on the processor, the program for comprehensively regulating temperature and humidity when executed by the processor implements the method for comprehensively regulating temperature and humidity as mentioned.

[0019] In addition, in order to achieve the above purpose, the present application also provides a regulation system, including: a humidity regulation device, a temperature regulation device and a control unit, the control unit comprises a memory, a processor and a program for comprehensively regulating temperature and humidity that is stored on the memory and operable on the processor, the program for comprehensively regulating temperature and humidity when executed by the processor implements the method for comprehensively regulating temperature and humidity as mentioned above.

[0020] In addition, in order to achieve the above purpose, the present application also provides a computer readable storage medium, the computer readable storage medium stores a program for comprehensively regulating temperature and humidity, the program for comprehensively regulating temperature and humidity when executed by the processor implements the method for comprehensively regulating temperature and humidity as mentioned above.

[0021] The embodiments of the present application provide a method for comprehensively regulating temperature and humidity. Thermal comfort impact parameters and a preset relative humidity interval corresponding to a user in an action space of a regulation device are first obtained; then, a target temperature interval is determined according to the thermal comfort impact parameters and the preset relative humidity interval, and a target moisture content interval is determined according to the preset relative humidity interval; and finally operating parameters of the regulation device are determined according to a current temperature, a current moisture content, the target moisture content interval, and the target temperature interval in the action space, and the regulation device is controlled to operate according to the determined operating parameters. Since the humidity and temperature are taken into account when determining the operating parameters, the air conditioner is regulated according to the determined operating parameters by combining the humidity and temperature, thus avoiding the phenomenon that when the air conditioner is regulated independently to reduce the temperature, the relative humidity in the room will decrease, hence the energy consumption of the air conditioner can be reduced. In addition, the humidity and temperature can be integrated to regulate the operating parameters of the air conditioner, to avoid the decline in comfort caused by independent regulation, to improve the comfort of the air conditioner.

BRIEF DESCRIPTION OF THE DRAWINGS

[0022]

FIG. 1 is a schematic diagram of the terminal structure of the hardware operating environment according to an embodiment of the present application.

FIG. 2 is a flowchart of a method for comprehensively regulating temperature and humidity according to an embodiment of the present application.

FIG. 3 a flowchart of a method for comprehensively regulating temperature and humidity according to another embodiment of the present application.

FIG. 4 is a schematic diagram of a comfort zone according to an embodiment of the present application.

[0023] The realization of the purpose, functional features and advantages of the present application will be further described in conjunction with the embodiments, with reference to the drawings.

DETAILED DESCRIPTION OF THE EMBODIMENTS

[0024] It should be understood that the specific embodiments described herein are intended to explain the present application only and are not intended to limit the present application.

[0025] The primary solutions of embodiments of the present application are as follows:

obtaining thermal comfort impact parameters and a preset relative humidity interval corresponding to a user in an action space of a regulation device;

determining a target temperature interval according to the thermal comfort impact parameters and the preset relative humidity interval;

determining a target moisture content interval according to the preset relative humidity interval; and

determining operating parameters of the regulation device according to a current temperature, a current moisture content, the target moisture content interval, and the target temperature interval in the action space, and controlling the regulation device to operate according to the determined operating parameters.

[0026] Since the humidity and temperature are taken into account when determining the operating parameters, the air conditioner is regulated according to the determined operating parameters by combining the humidity and temperature, thus avoiding the phenomenon that when the air conditioner is regulated independently to reduce the temperature, the relative humidity in the room will decrease, hence the energy consumption of the air conditioner can be reduced. In addition, the humidity and temperature can be integrated to regulate the operating parameters of the air conditioner, to avoid the decline in comfort caused by independent regulation, to improve the comfort of the air conditioner.

[0027] As shown in FIG. 1, FIG. 1 is a schematic diagram of the terminal structure of the hardware operating environment according to the embodiment of the present application.

[0028] The terminal of the present application embodiment may be a terminal device such as an air conditioner.

[0029] As shown in FIG. 1, the terminal may include: a processor 1001, such as a CPU, a network interface 1004, a user interface 1003, a memory 1005, and a communication bus 1002. The communication bus 1002 is used to implement communication among these components. A user interface 1003 can include a display, an input unit such as a keyboard, etc.. The user interface 1003 can optionally include a standard wired interface, a wireless interface. The network interface 1004 optionally can include a standard wired interface, a wireless interface (such as WI-FI interface). The memory 1005 can be a high-speed RAM memory, or a non-volatile memory, such as a disk memory. The memory 1005 optionally may also be a storage device independent of the aforementioned processor 1001.

[0030] It will be understood by those skilled in the art that the terminal structure illustrated in FIG. 1 does not limit the terminal and may include more or fewer components than illustrated, or a combination of certain components, or a different arrangement of components.

[0031] As shown in FIG. 1, the memory 1005, which is a computer storage medium, may include an operating system, a network communication module, a user interface module, and a program for comprehensively regulating temperature and humidity.

[0032] In the terminal shown in FIG. 1, the network interface 1004 is primarily used to connect to the backend server and communicate with the backend server for data; the processor 1001 can invoke the program for comprehensively regulating temperature and humidity stored in the memory 1005 and perform the following operations:

obtaining thermal comfort impact parameters and a preset relative humidity interval corresponding to a user in an action space of a regulation device;
determining a target temperature interval according to the thermal comfort impact parameters and the preset relative humidity interval;
determining a target moisture content interval according to the preset relative humidity interval; and
determining operating parameters of the regulation device according to a current temperature, a current moisture content, the target moisture content interval, and the target temperature interval in the action space, and controlling the regulation device to operate according to the determined operating parameters.

[0033] In an embodiment, the processor 1001 may invoke the program for comprehensively regulating temperature and humidity stored in the memory 1005, and further perform the following operations:

obtaining an outdoor ambient temperature corresponding to a space where the regulation device is located;
the operation of obtaining the thermal comfort impact parameters and the preset relative humidity interval corresponding to the user in the space where the regulation device is located includes:
determining the dressing index according to the outdoor ambient temperature; and
obtaining the preset relative humidity interval.

[0034] In an embodiment, the processor 1001 may invoke the program for comprehensively regulating temperature and humidity stored in the memory 1005, and further perform the following operations:
determining the obtained dressing index corresponding to the outdoor ambient temperature according to a pre-stored corresponding relationship between the outdoor ambient temperature and the dressing index.

[0035] In an embodiment, the processor 1001 may invoke the program for comprehensively regulating temperature and humidity stored in the memory 1005, and further perform the following operations:

obtaining position information of the regulation device and weather forecast data; and
determining the outdoor ambient temperature according to the position information and the weather forecast data.

[0036] In an embodiment, the processor 1001 may invoke the program for comprehensively regulating temperature and humidity stored in the memory 1005, and further perform the following operations:

obtaining a current time;
determining a current season and/or a current seasonal weather corresponding to the space where the regulation device is located according to the current time and the position information;
the operation of determining the dressing index according to the outdoor ambient temperature includes:
determining the dressing index according to the current time, the outdoor ambient temperature, and at least one of the current season and the current seasonal weather.

[0037] In an embodiment, the processor 1001 may invoke the program for comprehensively regulating temperature and humidity stored in the memory 1005, and further perform the following operations:

obtaining temperature detection data detected by an infrared detection sensor in the space where the regulation device is located;
the operation of obtaining the thermal comfort impact parameters and the preset relative humidity interval corresponding to the user in the space where the regulation device is located includes:
determining the activity amount corresponding to the user in the action space of the regulation device according to the temperature detection data, and obtaining the preset relative humidity interval.

[0038] In an embodiment, the processor 1001 may invoke the program for comprehensively regulating temperature and humidity stored in the memory 1005, and further perform the following operations:

obtaining a first heat-sensing index and a second heat-sensing index that are pre-stored, wherein the first heat-sensing index is lower than the second heat-sensing index;
determining a first temperature curve according to the first heat-sensing index, the preset relative humidity interval, and at least one of the dressing index and the activity amount;
determining a second temperature curve according to the second heat-sensing index, the preset relative humidity interval, and at least one of the dressing index and the activity amount; and
determining the target temperature interval according to the first temperature curve and the second temperature curve.

[0039] In an embodiment, the processor 1001 may invoke the program for comprehensively regulating temperature and humidity stored in the memory 1005, and further perform the following operations:

obtaining a vapor partial pressure value in the space where the regulation device is located;
the operation of determining the target moisture content interval according to the preset relative humidity interval includes:
determining a moisture content curve according to the vapor partial pressure value, the target temperature interval, and the preset relative humidity interval; and
determining the target moisture content interval according to the moisture content curve.

[0040] In an embodiment, the processor 1001 may invoke the program for comprehensively regulating temperature and humidity stored in the memory 1005, and further perform the following operations:
obtaining the current temperature and the current moisture content in an action space of an air conditioner.

[0041] In an embodiment, the processor 1001 may invoke the program for comprehensively regulating temperature and humidity stored in the memory 1005, and further perform the following operations:

determining a first corresponding relationship between the current temperature and the target temperature interval, and a second corresponding relationship between the current moisture content and the target moisture content interval;
determining operating parameters of the regulation device according to the first corresponding relationship and the second corresponding relationship; and
controlling the regulation device to operate according to the determined operating parameters.

[0042] Referring to FIG. 2, in an embodiment of the method for comprehensively regulating temperature and humidity of the present application, the method for comprehensively regulating temperature and humidity includes:

operation S10, obtaining thermal comfort impact parameters and a preset relative humidity interval corresponding to a user in an action space of a regulation device;
operation S20, determining a target temperature interval according to the thermal comfort impact parameters and the preset relative humidity interval;
operation S30, determining a target moisture content interval according to the preset relative humidity interval; and
operation S40, determining operating parameters of the regulation device according to a current temperature, a current moisture content, the target moisture content interval, and the target temperature interval in the action space, and controlling the regulation device to operate according to the determined operating parameters.

[0043] In conventional air conditioners, the temperature control and humidity control are performed independently, resulting that conventional air conditioners reduce relative humidity in the room when lowering the temperature. To ensure the humidity in the home, a separate humidifier needs to be turned on for humidification, which raises the energy consumption of the air conditioner. In order to solve the above defects of the conventional air conditioner, the present application proposes a method for comprehensively regulating temperature and humidity, which aims to comprehensively regulate the temperature and the humidity of the air conditioner, so as to reduce the energy consumption of the air conditioner. Moreover, the air conditioner is controlled by combining the temperature and the humidity, which can also make the air conditioner maintain both temperature and humidity within a comfortable range, to improve the comfort of the air conditioner.

[0044] In the embodiment, the thermal comfort impact parameters are quantifiable data that affects the thermal comfort of the user, which may include, for example, a dressing index of the user, an activity amount of the user, and/or a human metabolic rate. In the following, the present application is explained by using an air conditioner that has humidification and temperature regulation functions as an execution device.

[0045] The air conditioner may first obtain at least one of a dressing index and an activity amount corresponding to a user in the action space of the air conditioner, and obtain a preset relative humidity interval. It should be understood that the preset relative humidity interval may be determined by the producer of the air conditioner according to experimental data and pre-stored in a database corresponding to the air conditioner. It should be understood that the database may be a local database of the air conditioner, and/or a network database set on a server. The air conditioner is further provided with a network module that enables the air conditioner to communicate with the server, to enable the air conditioner to access the data stored in the network database that is set at the server, and/or receive the updated packets sent by the network server, and update the specific values in the preset relative humidity interval that is stored in the local database, according to the updated packets sent by the network server.

[0046] In an embodiment, the outdoor ambient temperature corresponding to the position of the air conditioner may be obtained first, and then the dressing index may be determined according to the outdoor ambient temperature, and/or the air conditioner may also be provided with an infrared detection sensor, such that the air conditioner may detect the temperature detection data corresponding to the user in the action space by the infrared detection sensor, and then determine the dressing index of the user and/or the activity amount according to the temperature detection data.

[0047] An air conditioner is provided with an outdoor ambient temperature detection sensor, such that the air conditioner can obtain the outdoor ambient temperature by the outdoor ambient temperature detection sensor, and/or the air conditioner is connected to a network, such that the air conditioner can first determine its' positioning data according to its' connected network, and then obtain the current time according to its' connected network, and/or obtain the current time according to the local data. Then the positioning data is sent to the server to obtain the weather forecast data corresponding to the positioning data through the server. Then, the outdoor ambient temperature is determined according to the current time and the weather forecast data.

[0048] In an embodiment, when the outdoor ambient temperature is determined, a corresponding relationship between the outdoor ambient temperature and the dressing index can be obtained, and then the current moment and the dressing index corresponding to the user in the action space are determined according to the corresponding relationship.

[0049] In an embodiment, the corresponding relationship between the outdoor ambient temperature and the dressing index may be stored in the database of the air conditioner in the form of a table, as shown in Table 1 below.

Table 1:

outdoor ambient temperature T4/°C	dressing index
T4 > 32	0.3
30≤T4≤32	0.5
26≤T4 < 30	0.7
22 < T4 < 26	0.7

(continued)

outdoor ambient temperature T4/°C	dressing index
17 < T4≤22	0.9
10≤T4≤17	1.0
T4 < 10	1.1

[0050] When the temperature detection data is obtained, a temperature respective chart corresponding to the user in the space can be generated according to the temperature detection data, and then the activity amount of the user can be determined according to the temperature respective chart.

[0051] In an embodiment, after the air conditioner obtains the preset relative humidity interval and at least one of the dressing index and/or the activity amount, the target temperature interval may be determined first.

[0052] In an embodiment, the producer of the air conditioner may pre-store a first body sensory index and a second body sensory index in the air conditioner, the first body sensory index may be lower than the second body sensory index. The first body sensory index and the second body sensory index can be predicted mean vote (PMV) pre-stored in the database, the predicted mean vote is an evaluation index indicating the thermal response of the human body. It can be understood that the PMV can be set to correspond to different areas according to different application areas of the air conditioner. For example, when the application area of the air conditioner is China, the first body sensory index and second body sensory index are set to PMV_{chn} (the expected average heat sensory index suitable for Chinese people). When PMV_{chn} is 0, the comfort level is the best; when PMV_{chn} is positive, the comfort level is slightly hotter, and the larger the absolute value is, the hotter it is; when PMV_{chn} is negative, the comfort level is slightly colder, and the larger the absolute value is, the colder it is.

[0053] In an embodiment, the first body sensory index is -0.2 and the second heat sensory index is 0.3.

[0054] Since the PMV_{chn} can be calculated according to the following formulas.

$$PMV_{chn}=a\times[(M-W)-3.05\times10^{-3}\times[5733-6.99(M-W)p_a]-0.42\times[(M-W)-58.15]-1.7\times10^{-5}M(5876-P_a)-0.0014M(34-t_a)-3.96\times10^{-8}f_{cl}\times[(t_{cl}+273)^4-(\bar{t_r}+273)^4]-f_{cl}h_c(t_{cl}-t_a)]+b$$

[0055] Where t_{cl} indicates a surface temperature of clothes in°C, its calculation formula is:

$$t_{cl}=35.7-0.028(M-W)-I_{cl}\{3.96\times10^{-8}f_{cl}\times[(t_{cl}+273)^4--(\bar{t_r}+273)^4]+f_{cl}h_{cl}\ (t_{cl}-t_a)\}$$

[0056] h_c is a convective heat transfer coefficient in W/(m^2·°C), related to the air flow rate and a temperature difference between the ambient temperature and the surface temperature of clothes;

$$h_c=\begin{cases}2.38(t_{cl}-t_a)^{0.25}\text{when}2.38(t_{cl}-t_a)^{0.25}>12.1\sqrt{v_{ar}}\\12.1\sqrt{v_{ar}}\text{when}2.38(t_{cl}-t_a)^{0.25}<12.1\sqrt{v_{ar}}\end{cases}$$

[0057] f_{cl} is a ratio of a surface area of human body when dressed to a surface area of human body when naked.

$$f_{cl}=\begin{cases}1.00+1.290I_{cl}\text{when}\ I_{cl}\le0.078m^2\cdot°\text{C/W}\\1.05+0.645I_{cl}\text{when}\ I_{cl}>0.078m^2\cdot°\text{C/W}\end{cases}$$

[0058] M is a metabolic rate in W/m^2 and is equal to 70 W/m^2 according to GB/T33658-2017.

[0059] W is the heat consumed by external work (negligible for most activities), in W/m^2.

[0060] I_{cl} is a thermal resistance of clothes, in m^2·°C/W, calculated as I_{cl} is equal to dressing index Ci multiplied by

0.155, the dressing index Ci is determined according to the outdoor ambient temperature and the corresponding season, with a range of 0.3 to 1.1.

[0061] Where T1 is an air temperature in °C.

[0062] Where $\bar{t}_r$ is an average radiation temperature in °C, approximated as the air temperature T1.

[0063] Where v_{ar} is an air flow speed (wind speed) in m/s.

[0064] Where P_a is a water vapor partial pressure in P_a, calculated from an formula (X-X).

[0065] Where a is a thermal sensitivity characteristic coefficient, indicating the sensitivity of the human body to the thermal environment, the larger the coefficient is, the more sensitive to changes in the thermal environment under this operating condition, the narrower the comfort interval is, a is equal to 0.0260.

[0066] Where b is a thermal sensitivity characteristic coefficient, indicating the deviation degree of a human thermal sensation from the theoretical comfort temperature, the larger the absolute value of the coefficient, the greater the deviation degree from the relative comfort temperature under this operating condition, a positive coefficient indicates cold-resistant and fear of heat, a negative coefficient indicates cold-resistant and fear of cold, b is equal to -0.2074.

[0067] Where Pa indicates the water vapor partial pressure.

[0068] Where ta is the temperature value.

[0069] Where H is a relative humidity.

[0070] Based on the above formulas, it can be seen that when the first body sensory index and the second body sensory index are determined, since all parameters other than the dressing index and the activity amount are fixed constants, or values of operating parameters can be directly determined by the air conditioner. Thus, based on the above formulas, a temperature inverse function can be calculated according to the dressing index, the activity amount, the first heat sensory index and the preset relative humidity interval, and the first temperature curve can then be determined according to the temperature inverse function. Similarly, the second temperature curve can be determined according to the second body sensory index, and the target temperature interval is determined according to the above temperature curves. That is, in the temperature icon, the target temperature interval takes the first temperature curve as a lower boundary and the second temperature curve as an upper boundary. It should be understood that when a first temperature boundary value and a second temperature boundary value are determined only according to the dressing index or the activity amount. One of the dressing index and the activity amount may be used as data obtained in real time and the other is a fixed constant pre-stored in the air conditioner.

[0071] It can be understood that, in order to reduce the amount of computing of the processor of the air conditioner and reduce the system overhead, a calculation model can be generated and saved in the air conditioner according to the above formulas, such that the air conditioner, after obtaining the dressing index and or the activity amount, can directly derive the corresponding target temperature interval by the calculation model.

[0072] In an embodiment, a moisture content interval may also be determined according to the preset humidity interval. Specifically, the vapor partial pressure value (i.e., saturated water vapor partial pressure) in the action space of the air conditioner can be obtained first, the vapor partial pressure value can be calculated according to the Hyland-Wexler formula.

[0073] When the vapor partial pressure value is determined, the target moisture content interval can be determined according to the vapor partial pressure value and the preset relative humidity interval. Referring to FIG. 4, the preset relative humidity interval [m, n] intersects with the first temperature curve and the second temperature curve at points A, B, C and D, respectively, and then the moisture content curves d1, d2, d3 and d4 corresponding to points A, B, C and D, respectively, can be calculated according to the vapor partial pressure value and the temperature value.

[0074] In an embodiment, the boundary value corresponding to the target moisture content interval can be calculated according to the vapor partial pressure value and the preset relative humidity interval. When the target moisture content interval and the target temperature interval are determined, the current temperature and the current moisture content in the action space can be obtained, and then the operating parameters of the air conditioner can be determined according to the current temperature, the current moisture content, the target moisture content interval, and the target temperature interval in the action space, and the air conditioner can be controlled to operate according to the determined operating parameters.

[0075] In an embodiment, a first corresponding relationship between the current temperature value and the target temperature interval, and a second corresponding relationship between the current moisture content and the target moisture content interval may be determined, and then the operating parameters of the air conditioner are determined according to the first corresponding relationship and the second corresponding relationship, and the air conditioner is controlled to operate according to the determined operating parameters.

[0076] It should be noted that the first corresponding relationship includes a lower boundary where the current temperature is lower than the target temperature interval, and an upper boundary where the current temperature is within and greater than the target temperature interval. The second corresponding relationship includes a lower boundary where the current moisture content is lower than the target moisture content interval, and an upper boundary where the

current moisture content is within and greater than the target moisture content interval. When the operating parameters are determined, the air conditioner can be controlled to operate according to the determined operating parameters.

[0077] It should be noted that when the method for comprehensively regulating temperature and humidity is performed by a regulation system, the regulation system includes a humidity regulation device, a temperature regulation device, and a control unit. The control unit is used to determine the operating parameters of the humidity regulation device and the temperature regulation device according to the method for comprehensively regulating temperature and humidity, so as to comprehensively control the humidity regulation device and the temperature regulation device to comprehensively regulate the temperature and humidity. The temperature regulation device can be an air conditioner, and the humidity regulation device can be a humidifier. The humidifier and the air conditioner can be wired or wireless with the control unit. The control unit can be set up with the humidifier or air conditioner as a whole, or can be set up independently of the humidifier and the air conditioner, which are not limited in the embodiment.

[0078] In the technical solution disclosed in the embodiment, at least one of the dressing index and the activity amount corresponding to the user in the action space of the air conditioner and the preset relative humidity interval are first obtained, then the target temperature interval is determined according to the preset relative humidity interval and at least one of the dressing index and the activity amount, and the target moisture content interval is determined according to the preset relative humidity interval, and finally operating parameters of the air conditioner is determined according to the current temperature, the current moisture content, the target moisture content interval, and the target temperature interval in the action space, and control the air conditioner to operate according to the determined operating parameters. Since the humidity and temperature are taken into account when determining the operating parameters, the air conditioner is regulated according to the determined operating parameters by combining the humidity and temperature into account, thus avoiding the phenomenon of lowering the relative humidity in the room at reducing of the temperature caused by when the air conditioner is regulated independently, to reduce the energy consumption of the air conditioner. In addition, the humidity and temperature can be integrated to regulate the operating parameters of the air conditioner, to avoid the decline in comfort caused by independent regulation, to improve the comfort of the air conditioner.

[0079] In an embodiment, the operation of determining the operating parameters of the air conditioner according to the current temperature, the current moisture content, the target moisture content interval, and the target temperature interval in the action space, and controlling the air conditioner to operate according to the determined operating parameters includes:

operation S41, determining a first corresponding relationship between the current temperature and the target temperature interval, and a second corresponding relationship between the current moisture content and the target moisture content interval;

operation S42, determining operating parameters of the regulation device according to the first corresponding relationship and the second corresponding relationship; and

operation S43, controlling the regulation device to operate according to the determined operating parameters.

[0080] In the embodiment, a first corresponding relationship between the current temperature value and the target temperature interval, and a second corresponding relationship between the current moisture content and the target moisture content interval can be determined first, and then the operating mode of the air conditioner can be determined according to the first corresponding relationship and the second corresponding relationship. The air conditioner pre-stores the operating parameters corresponding to different operating modes, so that after determining the operating mode, the operating parameters corresponding to the determined operating mode can be obtained.

[0081] In an embodiment, the mapping relationship between the first corresponding relationship, the second corresponding relationship and the operating mode can be pre-saved. It is understood that, with reference to FIG. 4, t1, t4 are the temperature upper boundary T_{max} extension lines of the comfort zone , t2, t3 are the temperature lower boundary T_{min} extension lines of the comfort zone; d1 is the moisture content line between the temperature lower boundary and an endpoint n of the humidity right boundary , d2 is the moisture content line between the temperature upper boundary and an endpoint of the humidity right boundary, d3 is the moisture content line between the temperature upper boundary and an endpoint m of the humidity left boundary, d4 is the moisture content line between the lower temperature boundary and the humidity left boundary endpoints. The mapping relationship between the first corresponding relationship and the second corresponding relationship to the operating modes may be stored in the database in the form of a table, as shown in Table 2 below.

Table 2:

operating mode	the first corresponding relationship	the second corresponding relationship
cooling and dehumidification	T>t4	$d>d_2$

(continued)

operating mode	the first corresponding relationship	the second corresponding relationship
constant humidity and cooling	$T>T_{max}$	$d\in[d_3, d_4]$
cooling and humidification	$T>t_3$	$d<d_4$
constant enthalpy and humidification	$T\in[t_2, t_1]$	$d<m$
heating and humidification	$T<t_2$	$d<d_4$
constant humidity and heating	$T<T_{min}$	$d\in[d_4, d_1]$
heating and dehumidification	$T<t_3$	$d>d_1$
constant temperature and dehumidification	$T\in[t_3, t_4]$	$d>n$

[0082] In the cooling and dehumidification mode, it is determined that there is a demand for cooling and dehumidification in the action space, at this time, the air conditioner operates in the cooling and dehumidification mode and controls the temperature of the indoor heat exchanger to be lower than the dew point temperature for cooling and dehumidification.

[0083] In the constant humidity and cooling mode, it is determined that there is only a demand for constant humidity and cooling in the action space, so the indoor heat exchanger of the air conditioner can be controlled to cool at a state higher than the dew point temperature, to avoid decreasing humidity due to condensation of water from the indoor heat exchanger, so as to achieve constant humidity and cooling.

[0084] In an embodiment, to ensure the cooling effect of the air conditioner, the indoor heat exchanger of the air conditioner can also be controlled to be slightly lower than the dew point temperature in the constant humidity and cooling mode. When the temperature of the heat exchanger is lower than the dew point temperature, the difference between the dew point temperature and the temperature of the heat exchanger is lower than a preset difference. The preset difference can be set by the producer. The humidifier is controlled to operate according to the difference to maintain humidity in the home.

[0085] In the cooling and humidification mode, it is determined that there is a demand for the cooling and humidification in the action space, so the air conditioner operates in the cooling and humidification mode, and cooling and humidifying of the air conditioner are avoided at the same time to prevent the condensation of the cold air for cooling meeting the water vapor for humidifying. Specifically, first cooling is performed without humidification, and then when the temperature is reached, the cooling is closed and humidification is performed; or the cooling and humidification are performed intermittently.

[0086] In the constant enthalpy and humidification mode, it is determined that the air conditioner only requires to humidify, so the air conditioner can be controlled to operate directly in the humidification mode.

[0087] In the heating and humidification mode, it is determined that there is a demand for humidification and heating in the action space, and the air conditioner operates in the heating and humidification mode at this time.

[0088] In the constant humidity and heating mode, it is determined that there are only demands for heating in the action space, and the air conditioner operates in the heating mode without humidification at this time.

[0089] In the heating and dehumidification mode, it is determined that there is a demand for dehumidification and heating in the action space, at this time, the air conditioner operates in the dehumidification and reheating mode, and for the system with heat recovery reheating system, the evaporating temperature is controlled to be lower than the target dew point temperature for dehumidification according to the control method of the system, and then the reheater is used to heat the dehumidified air to raise the output air temperature. The air conditioner with electric auxiliary reheating performs cooling according to the control method of the system to control evaporating temperature to be lower than the target dew point temperature for dehumidification, and then the electric auxiliary heat power is controlled to heat the dehumidified air to raise the output air temperature.

[0090] In the constant temperature and dehumidification mode, it is determined that there is a demand for maintaining the temperature and dehumidification in the action space, and at this time, the air conditioner operates in the constant temperature and dehumidification mode, and the control method is the same as that in the heating and dehumidification mode.

[0091] In an embodiment, after the current determination of operating parameters, the air conditioner is controlled to operate according to the determined operating parameters.

[0092] In the technical solution disclosed in the embodiment, a first corresponding relationship between the current temperature and the target temperature interval, and a second corresponding relationship between the current moisture content and the target moisture content interval are first determined, and then the operating parameters of the air

conditioner are determined according to the first corresponding relationship and the second corresponding relationship, and the air conditioner is controlled to operate according to the determined operating parameters, which achieves the effect of comprehensively regulating the air conditioner by combining humidity and temperature.

[0093] In an embodiment, in order to improve the accuracy of the obtained dressing index, the current time information can be obtained after obtaining the outdoor ambient temperature, the current season information is determined according to the outdoor ambient temperature and the current time information, and then the dressing index is determined according to a correlation relationship between the outdoor ambient temperature, the season information and the dressing index. The correlation relationship may be pre-stored in the database in the form of a table, as shown in Table 3 below.

Table 3.

outdoor ambient temperature T4/ °C	season, weather	dressing index
T4 > 32	hot	0.3
30≤T4≤32	summer	0.5
26≤T4 < 30	early summer	0.7
22 < T4 < 26	early summer, April to October	0.7
22 < T4 < 26	early winter, November to March	0.9
17 < T4≤22	early winter	0.9
10≤T4≤17	winter	1.0
T4 < 10	frigid	1.1

[0094] It should be noted that the dressing index is determined according to the twenty-four solar terms and the outdoor environment temperature, or the dressing index can be determined in combination with the seasons and the twenty-four solar terms and the outdoor ambient temperature.

[0095] In the embodiment, after the outdoor ambient temperature is obtained, the current time information is obtained, the current season information is determined according to the outdoor ambient temperature and the current time information, and then the dressing index is determined according to the correlation relationship between the outdoor ambient temperature and the season information and the dressing index, to improve the accuracy of the obtained dressing index.

[0096] In addition, embodiments of the present application propose an air conditioner, the air conditioner includes a memory, a processor and a program for comprehensively regulating temperature and humidity that is stored on the memory and operable on the processor, the program for comprehensively regulating temperature and humidity when executed by the processor implements the method for comprehensively regulating temperature and humidity according to the above embodiments.

[0097] In addition, embodiments of the present application provide a computer readable storage medium, the computer readable storage medium stores a program for comprehensively regulating temperature and humidity, the program for comprehensively regulating temperature and humidity when executed by the processor implements the method for comprehensively regulating temperature and humidity according to the above embodiments.

[0098] It is noted that herein the terms "including", "comprising", or any other variation thereof are intended to cover non-exclusive inclusion such that a process, a method, an article, or a system comprising a set of elements includes not only those elements, but also other elements that are not explicitly listed, or that are inherent to such process, the method, the article, or the system. Without further limitation, an element defined by the statement "including a ....." does not preclude the existence of additional identical elements in the process, the method, the article, or the system that includes that element.

[0099] The serial numbers of the embodiments of the present application are for descriptive purposes only and do not represent the merits of the embodiments.

[0100] From the above description of the embodiments, it will be clear to those skilled in the art that the method in the above embodiments can be implemented with the aid of software plus the necessary common hardware platform, or of course with hardware, but in many cases the former is the better implementation. Based on such an understanding, the technical solution of the present application, in essence or the part that contributes to the prior art, may be embodied in the form of a software product stored in a storage medium (e.g., a ROM/RAM, a disk, a CD-ROM) as described above, including a number of instructions to cause a terminal device (which may be an air conditioner, etc.) to perform the method in various embodiments of the present application.

[0101] The above are only some embodiments of the present application and are not intended to limit the scope of the present application. Any equivalent structure or equivalent process transformation using the contents of the speci-

fication and the drawings of the present application, or any direct or indirect application in other related fields of technology, all fall in the scope of the present application.

Claims

1. A method for comprehensively regulating temperature and humidity, **characterized by** comprising:

   obtaining thermal comfort impact parameters and a preset relative humidity interval corresponding to a user in an action space of a regulation device;
   determining a target temperature interval according to the thermal comfort impact parameters and the preset relative humidity interval;
   determining a target moisture content interval according to the preset relative humidity interval; and
   determining operating parameters of the regulation device according to a current temperature, a current moisture content, the target moisture content interval, and the target temperature interval in the action space, and controlling the regulation device to operate according to the determined operating parameters.

2. The method for comprehensively regulating temperature and humidity according to claim 1, wherein the thermal comfort impact parameters comprise a dressing index of the user, an activity amount of the user, and/or a human metabolic rate.

3. The method for comprehensively regulating temperature and humidity according to claim 2, wherein before the operation of obtaining the thermal comfort impact parameters and the preset relative humidity interval corresponding to the user in the action space of the regulation device, the method further comprises:

   obtaining an outdoor ambient temperature corresponding to a space where the regulation device is located;
   wherein the operation of obtaining the thermal comfort impact parameters and the preset relative humidity interval corresponding to the user in the action space of the regulation device comprises:

      determining the dressing index according to the outdoor ambient temperature; and
      obtaining the preset relative humidity interval.

4. The method for comprehensively regulating temperature and humidity according to claim 3, wherein the operation of determining the dressing index according to the outdoor ambient temperature comprises:
   determining the obtained dressing index corresponding to the outdoor ambient temperature according to a pre-stored corresponding relationship between the outdoor ambient temperature and the dressing index.

5. The method for comprehensively regulating temperature and humidity according to claim 3, wherein the operation of obtaining the outdoor ambient temperature corresponding to the space where the regulation device is located comprises:

   obtaining position information of the regulation device and weather forecast data; and
   determining the outdoor ambient temperature according to the position information and the weather forecast data.

6. The method for comprehensively regulating temperature and humidity according to claim 5, wherein the operation of determining the dressing index according to the outdoor ambient temperature comprises:

   obtaining a current time; and
   determining a current season and/or a current seasonal weather corresponding to the space where the regulation device is located according to the current time and the position information;
   wherein the operation of determining the dressing index according to the outdoor ambient temperature comprises:
   determining the dressing index according to the current time, the outdoor ambient temperature, and at least one of the current season and the current seasonal weather.

7. The method for comprehensively regulating temperature and humidity according to claim 2, wherein before the operation of obtaining the thermal comfort impact parameters and the preset relative humidity interval corresponding to the user in the action space of the regulation device, the method further comprises:

obtaining temperature detection data detected by an infrared detection sensor in the space where the regulation device is located;
wherein the operation of obtaining the thermal comfort impact parameters and the preset relative humidity interval corresponding to the user in the action space of the regulation device comprises:
determining the activity amount corresponding to the user in the action space of the regulation device according to the temperature detection data, and obtaining the preset relative humidity interval.

8. The method for comprehensively regulating temperature and humidity according to claim 1, wherein the operation of determining the target temperature interval according to the preset relative humidity interval and at least one of the dressing index and the activity amount comprises:

obtaining a first heat-sensing index and a second heat-sensing index that are pre-stored, wherein the first heat-sensing index is lower than the second heat-sensing index;
determining a first temperature curve according to the first heat-sensing index, the preset relative humidity interval, and at least one of the dressing index and the activity amount;
determining a second temperature curve according to the second heat-sensing index, the preset relative humidity interval, and at least one of the dressing index and the activity amount; and
determining the target temperature interval according to the first temperature curve and the second temperature curve.

9. The method for comprehensively regulating temperature and humidity according to claim 1, wherein before the operation of determining the target moisture content interval according to the preset relative humidity interval, the method further comprises:

obtaining a vapor partial pressure value in the action space of the regulation device;
wherein the operation of determining the target moisture content interval according to the preset relative humidity interval comprises:

determining a moisture content curve according to the vapor partial pressure value, the target temperature interval, and the preset relative humidity interval; and
determining the target moisture content interval according to the moisture content curve.

10. The method for comprehensively regulating temperature and humidity according to claim 1, wherein before the operation of determining the operating parameters of the regulation device according to the current temperature, the current moisture content, the target moisture content interval, and the target temperature interval in the action space, and controlling the regulation device to operate according to the determined operating parameters, the method further comprises:
obtaining the current temperature and the current moisture content in an action space of an air conditioner.

11. The method for comprehensively regulating temperature and humidity according to claim 10, wherein the operation of determining the operating parameters of the regulation device according to the current temperature, the current moisture content, the target moisture content interval, and the target temperature interval in the action space, and controlling the regulation device to operate according to the determined operating parameters comprises:

determining a first corresponding relationship between the current temperature and the target temperature interval, and a second corresponding relationship between the current moisture content and the target moisture content interval;
determining operating parameters of the regulation device according to the first corresponding relationship and the second corresponding relationship; and
controlling the regulation device to operate according to the determined operating parameters.

12. The method for comprehensively regulating temperature and humidity according to claim 1, wherein the regulation device comprises a temperature regulation assembly and a humidity regulation assembly, and the temperature regulation assembly and the humidity regulation assembly are separated or integrated together.

13. A regulation device, **characterized by** comprising: a memory, a processor and a program for comprehensively regulating temperature and humidity that is stored on the memory and operable on the processor, wherein the program for comprehensively regulating temperature and humidity when executed by the processor implements the

method for comprehensively regulating temperature and humidity according to any one of claims 1 to 12.

14. The regulation device according to claim 13, wherein the regulation device is an air conditioner having a humidity regulation function and a temperature regulation function.

15. A regulation system, **characterized by** comprising: a humidity regulation device, a temperature regulation device and a control unit, wherein the control unit comprises a memory, a processor and a program for comprehensively regulating temperature and humidity that is stored on the memory and operable on the processor, wherein the program for comprehensively regulating temperature and humidity when executed by the processor implements the method for comprehensively regulating temperature and humidity according to any one of claims 1 to 12.

16. A computer readable storage medium, **characterized in that**, the computer readable storage medium stores a program for comprehensively regulating temperature and humidity, wherein the program for comprehensively regulating temperature and humidity when executed by the processor implements the method for comprehensively regulating temperature and humidity according to any one of claims 1 to 12.

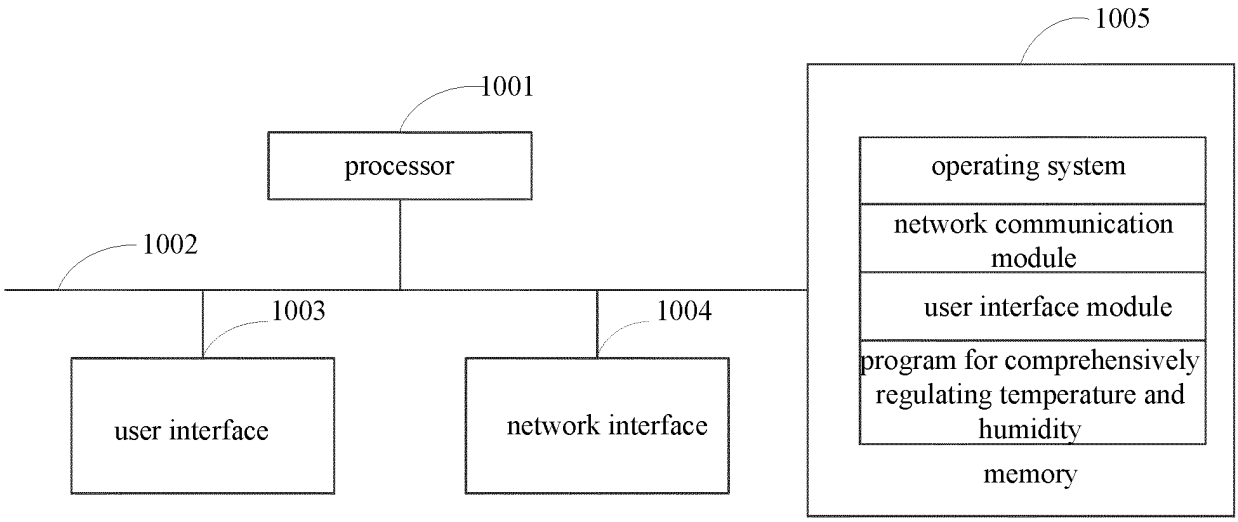
1005
1001
processor
operating system
network communication module
1002
user interface module
1003
1004
program for comprehensively regulating temperature and humidity
user interface
network interface
memory

FIG. 1

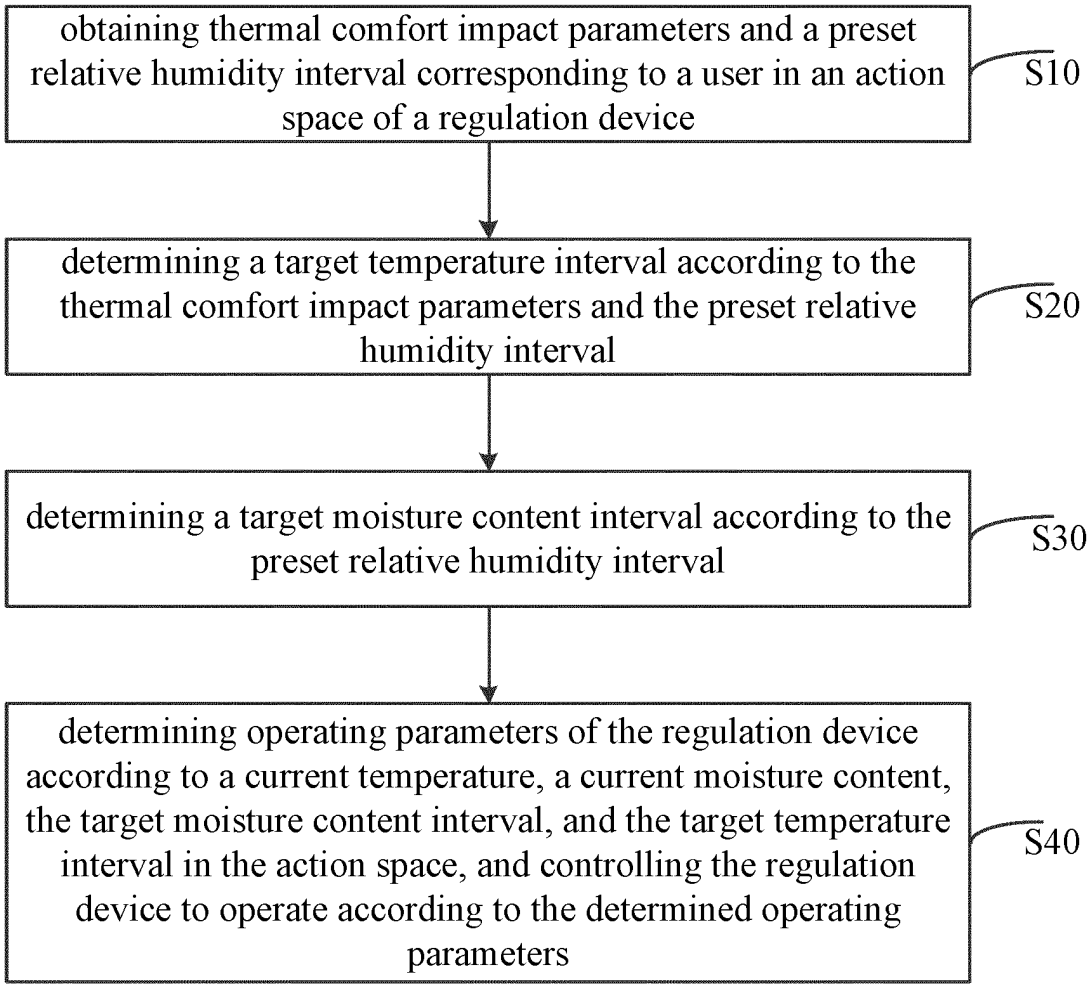
obtaining thermal comfort impact parameters and a preset relative humidity interval corresponding to a user in an action space of a regulation device
S10
determining a target temperature interval according to the thermal comfort impact parameters and the preset relative humidity interval
S20
determining a target moisture content interval according to the preset relative humidity interval
S30
determining operating parameters of the regulation device according to a current temperature, a current moisture content, the target moisture content interval, and the target temperature interval in the action space, and controlling the regulation device to operate according to the determined operating parameters
S40

FIG. 2

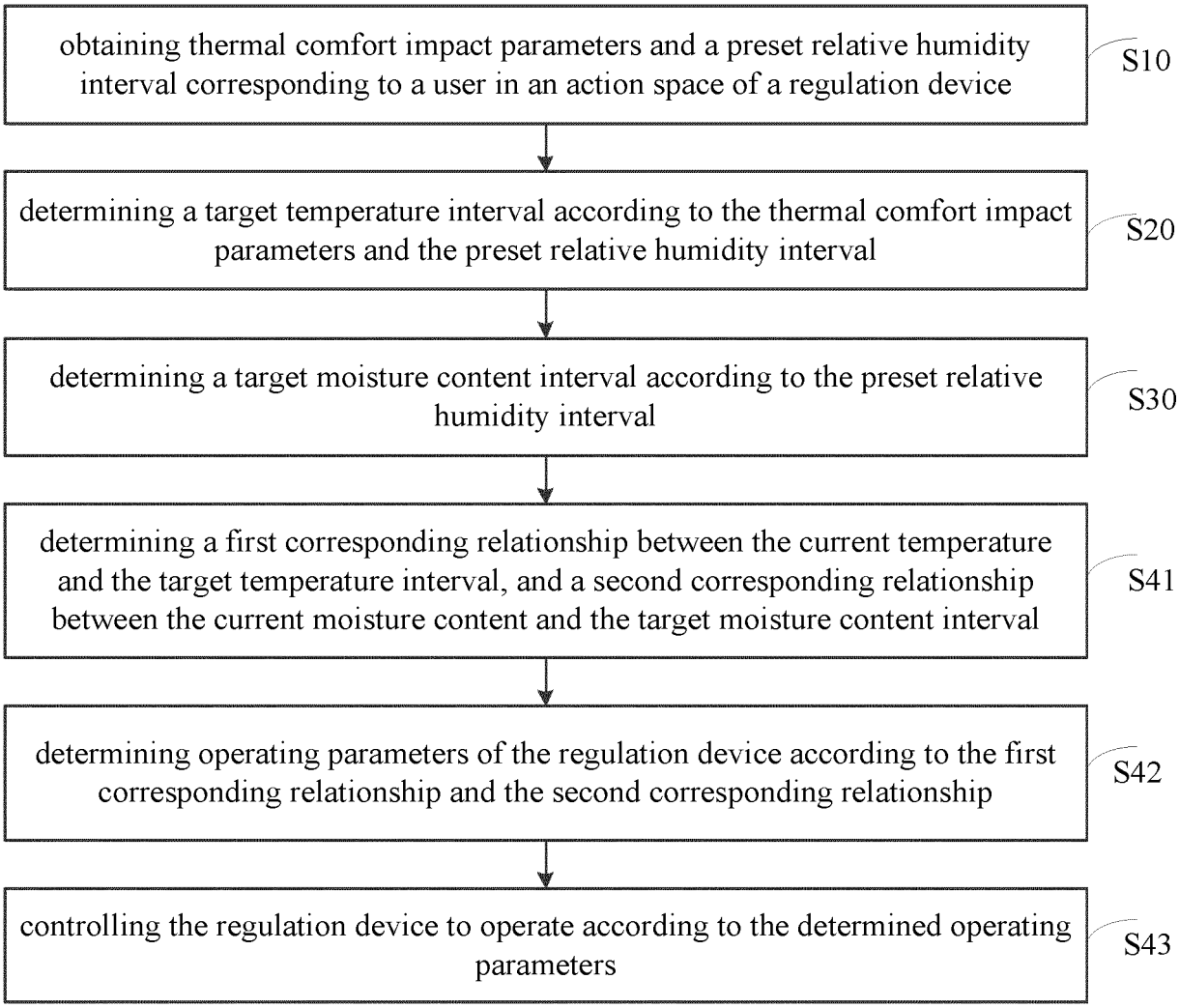
obtaining thermal comfort impact parameters and a preset relative humidity interval corresponding to a user in an action space of a regulation device
S10
determining a target temperature interval according to the thermal comfort impact parameters and the preset relative humidity interval
S20
determining a target moisture content interval according to the preset relative humidity interval
S30
determining a first corresponding relationship between the current temperature and the target temperature interval, and a second corresponding relationship between the current moisture content and the target moisture content interval
S41
determining operating parameters of the regulation device according to the first corresponding relationship and the second corresponding relationship
S42
controlling the regulation device to operate according to the determined operating parameters
S43

FIG. 3

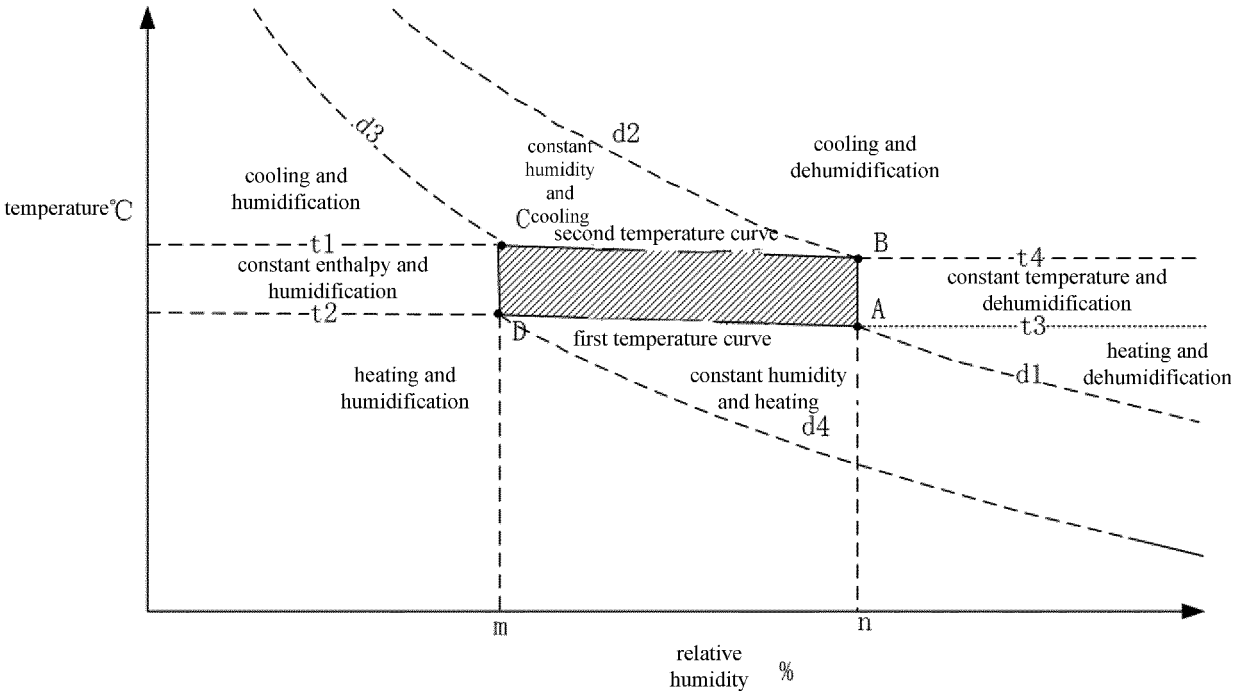
temperature℃
d3
d2
cooling and humidification
constant humidity and cooling
cooling and dehumidification
C
second temperature curve
B
t1
t4
constant enthalpy and humidification
constant temperature and dehumidification
t2
A
t3
D
first temperature curve
heating and dehumidification
heating and humidification
constant humidity and heating
d1
d4
m
n
relative humidity %

FIG. 4

INTERNATIONAL SEARCH REPORT

International application No.
PCT/CN2021/096574

A. CLASSIFICATION OF SUBJECT MATTER

F24F 11/64(2018.01)i; F24F 11/80(2018.01)i; F24F 110/20(2018.01)i

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

F24F

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

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

CNABS; CNKI; CNTXT; VEN: 温度, 湿度, 热舒适, 环境, 目标, 设定, humidity, temperature, PMV, ambient, environment, target, setting

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	CN 110454930 A (TECHNICAL INSTITUTE OF PHYSICS AND CHEMISTRY, CHINESE ACADEMY OF SCIENCES) 15 November 2019 (2019-11-15) description, pages 4-14	1-7, 10-16
X	CN 110030699 A (GREE ELECTRIC APPLIANCES, INC. OF ZHUHAI) 19 July 2019 (2019-07-19) description, pages 3-8	1-7, 10-16
A	CN 104456841 A (CHONGQING UNIVERSITY) 25 March 2015 (2015-03-25) entire document	1-16
A	CN 109323409 A (GUANGDONG MEDIA REFRIGERATION EQUIPMENT CO., LTD. et al.) 12 February 2019 (2019-02-12) entire document	1-16
A	CN 106016620 A (HUNAN UNIVERSITY) 12 October 2016 (2016-10-12) entire document	1-16
A	JP 2010151337 A (DAIKIN INDUSTRIES, LTD.) 08 July 2010 (2010-07-08) entire document	1-16
A	JP 2010133589 A (PANASONIC CORP.) 17 June 2010 (2010-06-17) entire document	1-16

☐ Further documents are listed in the continuation of Box C. ☑ See patent family annex.

* Special categories of cited documents:
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"O" document referring to an oral disclosure, use, exhibition or other means
"P" document published prior to the international filing date but later than the priority date claimed
"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
05 August 2021	**24 August 2021**
Name and mailing address of the ISA/CN **China National Intellectual Property Administration (ISA/CN)** **No. 6, Xitucheng Road, Jimenqiao, Haidian District, Beijing 100088** **China**	Authorized officer
Facsimile No. **(86-10)62019451**	Telephone No.

Form PCT/ISA/210 (second sheet) (January 2015)

INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.
PCT/CN2021/096574

Patent document cited in search report	Publication date (day/month/year)	Patent family member(s)	Publication date (day/month/year)
CN 110454930 A	15 November 2019	CN 110454930 B	30 October 2020
CN 110030699 A	19 July 2019	None	
CN 104456841 A	25 March 2015	CN 104456841 B	25 January 2017
CN 109323409 A	12 February 2019	None	
CN 106016620 A	12 October 2016	CN 106016620 B	19 February 2019
JP 2010151337 A	08 July 2010	None	
JP 2010133589 A	17 June 2010	JP 5012777 B2	29 August 2012

Form PCT/ISA/210 (patent family annex) (January 2015)

REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- CN 202010793953 **[0001]**