(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) EP 4 300 002 A1

(12) **EUROPEAN PATENT APPLICATION**
published in accordance with Art. 153(4) EPC

(43) Date of publication:
03.01.2024 Bulletin 2024/01

(21) Application number: **21946778.4**

(22) Date of filing: **05.11.2021**

(51) International Patent Classification (IPC):
F24F 11/64 *(2018.01)* ***F24F 11/65*** *(2018.01)*
F24F 11/88 *(2018.01)* ***F24F 110/10*** *(2018.01)*

(86) International application number:
PCT/CN2021/129119

(87) International publication number:
WO 2022/267296 (29.12.2022 Gazette 2022/52)

(84) Designated Contracting States:
AL AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HR HU IE IS IT LI LT LU LV MC MK MT NL NO PL PT RO RS SE SI SK SM TR
Designated Extension States:
BA ME
Designated Validation States:
KH MA MD TN

(30) Priority: **22.06.2021 CN 202110690203**

(71) Applicants:
- **GD Midea Heating & Ventilating Equipment Co., Ltd.**
  Foshan, Guangdong 528311 (CN)
- **Shanghai Jiao Tong University**
  Shanghai 200240 (CN)

(72) Inventors:
- **LI, Bin**
  Foshan, Guangdong 528311 (CN)
- **YANG, Ruixian**
  Foshan, Guangdong 528311 (CN)
- **ZHENG, Chunyuan**
  Foshan, Guangdong 528311 (CN)
- **DING, Yunxiao**
  Foshan, Guangdong 528311 (CN)
- **ZHAI, Xiaoqiang**
  Foshan, Guangdong 528311 (CN)

(74) Representative: **RGTH Patentanwälte PartGmbB**
Neuer Wall 10
20354 Hamburg (DE)

(54) POSITION DETERMINATION METHOD AND APPARATUS, AND AIR CONDITIONING SYSTEM AND READABLE STORAGE MEDIUM

(57) The present disclosure provides a method and device for position determination, an air conditioning system, and a readable storage medium. The method for position determination includes: acquiring return air temperature information of each indoor unit; determining a first correlation coefficient between every two indoor units based on the return air temperature information; classifying a plurality of indoor units based on the first correlation coefficient to obtain a set number of classified groups; and generating relative position information in each classified group based on the first correlation coefficient by taking any one of the indoor units as a locating point. Maintenance personnel are not required to manually maintain a relative position relation of the plurality of indoor units. Therefore, the maintenance difficulty of the relative position relation of the plurality of indoor units is reduced, and a time cost and a labor cost required for maintenance are reduced accordingly.

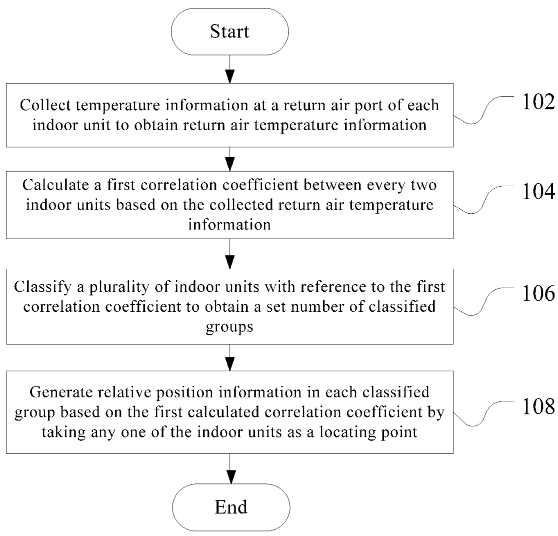

Fig. 2

EP 4 300 002 A1

Description

[0001] The present invention claims the priority to Chinese Patent Application No. "202110690203.8", filed with the China National Intellectual Property Administration on June 22, 2021 and entitled "POSITION DETERMINATION METHOD AND APPARATUS, AND AIR CONDITIONING SYSTEM AND READABLE STORAGE MEDIUM", which is incorporated in its entirety herein by reference.

FIELD

[0002] The present invention relates to the field of control, and in particular to a method and device for position determination, an air conditioning system, and a readable storage medium.

BACKGROUND

[0003] As shown in Fig. 1, a plurality of indoor units are under linkage control when being mounted indoors. Relative positions of the indoor units must be acquired before linkage control.

[0004] Those skilled in the art have found that maintenance of the relative positions of the indoor units is time-consuming, labor-consuming and costly in existing solutions, and therefore cannot satisfy current maintenance requirements.

SUMMARY

[0005] The present invention is intended to at least solve one problem in the prior art or the related art.

[0006] To this end, a method for position determination is provided in a first aspect of the present invention.

[0007] A device for position determination is provided in a second aspect of the present invention.

[0008] An air conditioning system is provided in a third aspect of the present invention.

[0009] A readable storage medium is provided in a fourth aspect of the present invention.

[0010] In view of that, in the first aspect, the present invention provides a method for position determination. The method comprises: acquiring a return air temperature information of each indoor unit; determining a first correlation coefficient between every two indoor units based on the return air temperature information; classifying a plurality of indoor units based on the first correlation coefficient to obtain a set number of classified groups; and generating a relative position information in each classified group and using any one of the air conditioning indoor units as a locating point based on the first correlation coefficient.

[0011] A method for position determination is provided according to the embodiment of the present invention. By running this method for position determination, relative positions of the plurality of indoor units can be measured. In this process, maintenance personnel are not required to manually maintain a relative position relation of the plurality of indoor units. Therefore, the maintenance difficulty of the relative position relation of the plurality of indoor units is reduced, and a time cost and a labor cost required for maintenance are reduced accordingly. Moreover, the relative position information determined through the above method for position determination of the present invention is acquired based on a measurement result, and is therefore more reliable.

[0012] The embodiment of the present invention is implemented based on the principles as follows: different indoor units are mounted at different positions, and a distance is formed between different indoor units and varies with different mounting positions. In the presence of the distance, the influence between different indoor units is inconsistent. In some embodiment, when one indoor unit is positioned in a first sealed environment and another indoor unit is positioned in a second sealed environment, no heat is transferred between the first sealed environment and the second sealed environment, and therefore no influence is generated between the indoor units in different sealed environments. However, when there are a plurality of indoor units in a sealed environment, influence is generated between different indoor units.

[0013] According to the embodiment of the present invention, the influence is collected, and the relative position information of different indoor units is estimated exactly through the collected influence and a correlation between the influence and the distance between different indoor units.

[0014] Considering that the indoor unit is an apparatus configured to adjust a temperature in a sealed environment and the indoor units influencing each other share a sealed environment, the above influence can be extracted by collecting the return air temperature information of the indoor unit. In an embodiment, return air temperature information of the plurality of indoor units is acquired through traversing. The closer the two indoor units are, the greater the influence between these two indoor units, and the greater the correlation coefficient between every two of the plurality of indoor units determined based on the acquired return air temperature information. Therefore, the distance between different indoor units can be represented through the correlation coefficient.

[0015] After a distance between every two indoor units is determined, whether the plurality of indoor units can be divided into the same classified group can be determined according to this distance.

[0016] Since the correlation coefficient between different indoor units can represent a distance condition between different indoor units, after division into the classified group is completed, any one of the indoor units in the classified group obtained through division can be taken as the locating point to obtain a relative position relation of the other indoor units in this classified group. After all the classified groups are traversed, a relative distribution condition of all the indoor units, that is, the relative position information in the present invention, can be obtained.

[0017] In any one of the above embodiments, the return air temperature information of the indoor unit can be a discrete temperature, that is, return air temperature information measured by the indoor unit at every fixed measurement time interval is expressed as a temperature sequence.

[0018] In one embodiment, it can be understood that the return air temperature information is temperature information at a return air inlet of the indoor unit.

[0019] In one embodiment, a temperature sensor can be arranged at the return air inlet of the indoor unit to acquire the temperature information at the return air inlet.

[0020] In addition, the method for position determination claimed by the present invention further has the following additional distinguishable features, and comprises:

In the above embodiment, the step of determining the first correlation coefficient between every two indoor units based on the return air temperature information comprises: determining a covariance of return air temperature information corresponding to every two indoor units; determining a variance of the return air temperature information corresponding to each indoor unit; and determining the first correlation coefficient based on the variance and the covariance.

[0021] In this embodiment, a determination solution for the first correlation coefficient is defined. A calculation formula for the first correlation coefficient is as follows:

$$r(X,Y) = \frac{cov(X,Y)}{\sqrt{Var[X] \cdot Var[Y]}}$$

where, X denotes one of every two indoor units, Y denotes the other of every two indoor units, $cov(X,Y)$ denotes a covariance of return air temperature information of X and Y, $Var[X]$ denotes a variance of the return air temperature information of X, and $Var[Y]$ denotes a variance of the return air temperature information of Y.

[0022] In any one of the above embodiments, the step of classifying the plurality of indoor units based on the first correlation coefficient to obtain a set number of classified groups comprises: dividing two indoor units with the largest first correlation coefficient into one class; taking the indoor units divided into one class as first indoor units, respectively determining second correlation coefficients between the first indoor units and remaining outdoor units of the plurality of indoor units other than the first indoor units, and dividing two indoor units with the largest second correlation coefficient into one class until the plurality of indoor units are divided into one class; setting a correlation coefficient threshold for the second correlation coefficient based on the set number of the classified groups; and dividing the plurality of indoor units based on the second correlation coefficient and the correlation coefficient threshold to obtain a set number of classified groups.

[0023] In this embodiment, the distance between different indoor units can be represented through the first correlation coefficient. Therefore, after the first correlation coefficients between every two of the plurality of indoor units are determined, the first correlation coefficients obtained can be ranked, and then the two indoor units with the largest correlation coefficient are determined. It can be seen from the above that the first correlation coefficient can be configured to represent the distance between different indoor units. Therefore, the two indoor units corresponding to the largest first correlation coefficient are two indoor units closest to each other.

[0024] After the two indoor units closest to each other are determined, whether the other indoor units have been classified is determined. Under the condition that after the other indoor units have been classified, whether the plurality of indoor units have been classified into one classified group, that is, whether there is only one classified group, is further determined; and if yes, the plurality of indoor units are arranged based on the first correlation coefficient.

[0025] In the above case, the set number is acquired. Since the set number is configured to represent the number of classified groups into which the plurality of indoor units are divided, the correlation coefficient threshold can be set based on the set number, and the indoor units in the classified group are divided based on the set correlation coefficient threshold, and finally a set number of classified groups are obtained.

[0026] In this process, through the above solution, unclassified indoor units are classified. Accordingly, the rationality of classifying and dividing the plurality of indoor units into the classified groups is improved, and the accuracy of the relative position information of the plurality of indoor units is ensured.

[0027] In any one of the embodiments, the method further comprises: acquiring a space partition information for the installed plurality of indoor units; and determining the set number of the classified groups based on the space partition information.

[0028] In this embodiment, the set number is determined based on the acquired space partition information, and therefore can be rationally set based on the space for mounting the indoor units. In this process, the influence on selection of a preset threshold caused by irrational setting of the set number is reduced, the accuracy of the relative position information of the plurality of indoor units is ensured, and finally the maintenance difficulty of the relative position information for maintenance personnel is reduced, in some embodiment, a human resource operation cost and a time cost are reduced.

[0029] In any of the above embodiments, the space partition information can be determined based on information collected by mounting personnel in a process of mounting the plurality of indoor units.

[0030] In any of the above embodiments, the space partition information can be room division information or office area division information.

[0031] In any one of the above embodiments, the step of generating relative position information and using any one of the air conditioning indoor units as a locating point based on the first correlation coefficient comprises: determining a quantitative value corresponding to the first correlation coefficient based on a preset quantitative relation; acquiring coordinate information of an indoor unit except for any one of the indoor units based on the quantitative value and the locating point; and generating the relative position information based on the locating point and the coordinate information.

[0032] In this embodiment, a generation manner of the relative position information is defined. It can be seen from the above that the correlation coefficient is correlated with the distance between different indoor units. Therefore, a mapping relation between the correlation coefficient and the distance between different indoor units can be pre-constructed, and the distance between different indoor units can be determined based on the mapping relation after the correlation coefficient is acquired.

[0033] In an embodiment, in the present invention, the preset quantitative relation is the mapping relation between the correlation coefficient and the distance between different indoor units. Therefore, coordinate information corresponding to the indoor unit corresponding to the quantitative value can be determined based on a locating point of any one of the indoor units in this classified group and the quantitative value after the quantitative value is determined. Accordingly, a relative position relation between any one of the indoor units and the other indoor units is obtained based on the locating point and the coordinate information.

[0034] In one embodiment, the locating point can be interpreted as a coordinate origin.

[0035] In any one of the above embodiments, in the preset quantitative relation, the correlation coefficient is negatively correlated with the quantitative value.

[0036] In any of the above embodiments, the relative position information is a topological graph.

[0037] In this embodiment, the expression form of the relative position information is defined. By defining the relative position information to be displayed in the form of the topological graph, a user can intuitively perceive a position distribution condition of different indoor units, to directly control different indoor units, ensuring a control effect.

[0038] In any one of the above embodiments, before the acquiring return air temperature information of each indoor unit, the method further comprises: controlling the plurality of indoor units to run in a refrigeration mode, a heating mode, or a dehumidification mode; and alternatively, controlling one of the plurality of indoor units to run in a refrigeration mode, a heating mode, or a dehumidification mode, and controlling the others of the plurality of indoor units to run in an air supply mode.

[0039] In this embodiment, the relative position information of different indoor units can be rapidly determined by defining running states of the plurality of indoor units.

[0040] In an embodiment, the plurality of indoor units can be controlled to simultaneously run in the refrigeration mode, the heating mode, or the dehumidification mode, to simultaneously adjust a temperature of an environment in which the indoor units are positioned, and determine the relative position information of different indoor units while rapid refrigeration, heating, or dehumidification is realized.

[0041] In one embodiment, before the acquiring return air temperature information of each indoor unit, the plurality of indoor units can further be controlled to run in a target running mode in sequence, and the other indoor units can be controlled to run in the air supply mode. The target running mode can be any one of the heating mode, the refrigeration mode, and the dehumidification mode.

[0042] In any one of the above embodiments, the method further comprises: acquiring absolute position information of any one of the indoor units, and determining actual position information based on the absolute position information and the relative position information.

[0043] In this embodiment, a process of converting the relative position information into the actual position information after the relative position information of the plurality of indoor units is acquired is defined. In an embodiment, the absolute position information of any one of the indoor units is acquired, and the actual position information is determined based on the absolute position information. In this process, the user can more intuitively determine positions of different indoor units and the distribution condition of different indoor units by converting the absolute position information, to control different indoor units based on the actual position information.

[0044] In any one of the above embodiments, the method further comprises: acquiring a return air temperature difference sequence of each indoor unit; determining an evaluation index based on a mean and a variance of return air temperature difference sequences of every two indoor units; and determining a preset number of indoor units around each indoor unit based on the evaluation index.

[0045] In one embodiment, the relative position information can be corrected based on the obtained position distribution condition of different indoor units. Therefore, the reliability of the obtained relative position information is improved, and the control accuracy of different indoor units based on the relative position information is improved accordingly.

[0046] In any of the above embodiments, the evaluation index is an absolute value of a product of the mean and the variance of the return air temperature difference sequences.

[0047] In the second aspect, the present invention provides a device for position determination. The device is configured for a plurality of indoor units and comprises: an acquisition device configured to acquire return air temperature information of each indoor unit; a determination device configured to determine a first correlation coefficient between every two indoor units based on the return air temperature information; a classification device configured to classify the plurality of indoor units based on the first correlation coefficient and a preset threshold to obtain a set number of classified groups; and a generation device configured to generate relative position information in each classified group and taking the first indoor units as a locating point based on the first correlation coefficient.

[0048] A device for position determination is provided according to the embodiment of the present invention. By applying the device for position determination to the plurality of indoor units, relative positions of the plurality of indoor units can be measured. In this process, maintenance personnel are not required to manually maintain a relative position relation of the plurality of indoor units. Therefore, the maintenance difficulty of the relative position relation of the plurality of indoor units is reduced, and a time cost and a labor cost required for maintenance are reduced accordingly. Moreover, the relative position information determined through the above method for position determination of the present invention is acquired based on a measurement result, and is therefore more reliable.

[0049] The embodiment of the present invention is implemented based on the principles as follows: different indoor units are mounted at different positions, and a distance is formed between different indoor units and varies with different mounting positions. In the presence of the distance, the influence between different indoor units is inconsistent. In some embodiment, when one indoor unit is positioned in a first sealed environment and another indoor unit is positioned in a second sealed environment, no heat is transferred between the first sealed environment and the second sealed environment, and therefore no influence is generated between the indoor units in different sealed environments. However, when there are a plurality of indoor units in a sealed environment, influence is generated between different indoor units.

[0050] According to the embodiment of the present invention, the influence is collected, and the relative position information of different indoor units is estimated exactly through the collected influence and a correlation between the influence and the distance between different indoor units.

[0051] Considering that the indoor unit is an apparatus configured to adjust a temperature in a sealed environment and the indoor units influencing each other share a sealed environment, the above influence can be extracted by collecting the return air temperature information of the indoor unit. In an embodiment, return air temperature information of the plurality of indoor units is acquired through traversing. The closer the two indoor units are, the greater the influence between these two indoor units, and the greater the correlation coefficient between every two of the plurality of indoor units determined based on the acquired return air temperature information. Therefore, the distance between different indoor units can be represented through the correlation coefficient.

[0052] After a distance between every two indoor units is determined, whether the plurality of indoor units can be divided into the same classified group can be determined based on this distance.

[0053] Since the correlation coefficient between different indoor units can represent a distance condition between different indoor units, after division into the classified group is completed, any one of the indoor units in the classified group obtained through division can be taken as the locating point to obtain a relative position relation of the other indoor units in this classified group. After all the classified groups are traversed, a relative distribution condition of all the indoor units, that is, the relative position information in the present invention, can be obtained.

[0054] In any one of the above embodiments, the return air temperature information of the indoor unit can be a discrete temperature, that is, return air temperature information measured by the indoor unit at every fixed measurement time interval is expressed as a temperature sequence.

[0055] In one embodiment, it can be understood that the return air temperature information is temperature information at a return air inlet of the indoor unit.

[0056] In one embodiment, a temperature sensor can be arranged at the return air inlet of the indoor unit to acquire the temperature information at the return air inlet.

[0057] In one embodiment, the determination device is configured to determine a covariance of return air temperature information corresponding to every two indoor units, determine a variance of the return air temperature information corresponding to each indoor unit, and determine the first correlation coefficient based on the variance and the covariance.

[0058] In one embodiment, the classification device is configured to divide two indoor units with the largest first correlation coefficient into one class; take the indoor units divided into one class as first indoor units, determine second correlation coefficients between the first indoor units and remaining indoor units, except for the first indoor units, of the plurality of outdoor units respectively, and divide two indoor units with the largest second correlation coefficient into one class until the plurality of indoor units are divided into one class; set a correlation coefficient threshold for the second correlation coefficient based on the set number of the classified groups; and divide the plurality of indoor units based on the second correlation coefficient and the correlation coefficient threshold to obtain a set number of classified groups.

[0059] In one embodiment, the classification device is further configured to acquire space partition information for the plurality of indoor units; and determine the set number of the classified groups based on the space partition information.

[0060] In one embodiment, the generation device is further configured to determine a quantitative value corresponding to the first correlation coefficient based on a preset quantitative relation; acquire coordinate information of an indoor unit except for any one of the indoor units based on the quantitative value and the locating point; and generate the relative position information based on the locating point and the coordinate information.

[0061] In one embodiment, in the preset quantitative relation, the correlation coefficient is negatively correlated with the quantitative value.

[0062] In one embodiment, the relative position information is a topological graph.

[0063] In one embodiment, the acquisition device is further configured to control the plurality of indoor units to run in a refrigeration mode, a heating mode, or a dehumidification mode; and alternatively, control one of the plurality of indoor units to run in a refrigeration mode, a heating mode, or a dehumidification mode, and control the others of the plurality of indoor units to run in an air supply mode.

[0064] In one embodiment, the generation device is further configured to acquire absolute position information of any one of the indoor units, and determine actual position information based on the absolute position information and the relative position information.

[0065] In one embodiment, the generation device is further configured to acquire a return air temperature difference sequence of each indoor unit; determine an evaluation index based on a mean and a variance of return air temperature difference sequences of every two indoor units; and determine a preset number of indoor units around each indoor unit based on the evaluation index.

[0066] In one embodiment, the evaluation index is an absolute value of a product of the mean and the variance of the return air temperature difference sequences.

[0067] In the third aspect, an air conditioning system is provided according to the embodiment of the present invention. The air conditioning system comprises: a plurality of indoor units; and a control device, where the control device communicates with the plurality of the indoor units and is configured to execute steps of any one of the methods for position determination in the first aspect.

[0068] An air conditioning system provided according to the embodiment of the present invention comprises the control device and the plurality of indoor units. The control device executes the steps of any one of the methods for position determination in the first aspect. Therefore, the air conditioning system has all the beneficial effects of any one of the methods for position determination, which will not be repeated herein.

[0069] In any one of the above embodiments, the air conditioning system further comprises: an outdoor unit, where the outdoor unit is connected to the indoor unit.

[0070] In the fourth aspect, the present invention provides a readable storage medium. The readable storage medium stores a program or an instruction, where the program or the instruction implements steps of any one of the methods for position determination in the first aspect.

[0071] Some additional aspects and advantages of the present invention will be set forth in the following description, and other additional aspects and advantages will be apparent from the following description, or learned by practice of the present invention.

BRIEF DESCRIPTION OF THE DRAWINGS

[0072] The above and/or additional aspects and advantages of the present invention will become apparent and readily appreciated from the following description of embodiments in conjunction with the accompanying drawings. In the figures:

Fig. 1 shows a distribution condition of a plurality of indoor units in an indoor mounting environment in the related embodiment;

Fig. 2 is a schematic flowchart of a method for position determination according to an embodiment of the present invention;

Fig. 3 is a schematic flowchart of a determination solution for a first correlation coefficient according to an embodiment of the present invention;

Fig. 4 is a schematic flowchart of a determination process of a set number of classified groups according to an embodiment of the present invention;

Fig. 5 is a schematic diagram of an actual use scenario in an embodiment of the present invention;

Fig. 6 is a schematic diagram of a correlation coefficient threshold in an embodiment of the present invention;
Fig. 7 is a schematic flowchart of generating relative position information according to an embodiment of the present invention;
Fig. 8 is a schematic diagram of a quantitative value of a relative distance between different indoor units according to an embodiment of the present invention;
Fig. 9 is a schematic diagram of relative position information of a plurality of indoor units according to an embodiment of the present invention;
Fig. 10 is a schematic form diagram of relative position information according to an embodiment of the present invention;
Fig. 11 shows one form of a topological graph according to an embodiment of the present invention;
Fig. 12 is a schematic diagram of an expression form of a preset quantitative relation according to an embodiment of the present invention; and
Fig. 13 is a schematic block diagram of a device for position determination according to an embodiment of the present invention.

DETAILED DESCRIPTION OF THE INVENTION

[0073] In order to provide a clearer understanding of the above aspects, features, and advantages of the present invention, the present invention is further described in detail below with reference to the accompanying drawings and particular embodiments. It should be noted that the embodiments of the present invention and the features in the embodiments can be mutually combined without conflicts.
[0074] In the following description, numerous specific details are set forth to provide a thorough understanding of the present invention. However, the present invention can further be implemented in other ways than those described herein. Therefore, the scope of protection of the present invention is not limited by the specific embodiments disclosed below.

Embodiment 1

[0075] As shown in Fig. 2, in an embodiment of the present invention, the present invention provides a method for position determination. The method comprises:

step 102, temperature information at a return air port of each indoor unit is collected to obtain return air temperature information;
step 104, a first correlation coefficient between every two indoor units is calculated based on the collected return air temperature information;
step 106, a plurality of indoor units are classified with reference to the first correlation coefficient to obtain a set number of classified groups; and
step 108, relative position information is generated in each classified group by taking any one of the indoor units as a locating point based on the first calculated correlation coefficient.

[0076] A method for position determination is provided according to the embodiment of the present invention. By running this method for position determination, relative positions of the plurality of indoor units can be measured. In this process, maintenance personnel are not required to manually maintain a relative position relation of the plurality of indoor units. Therefore, the maintenance difficulty of the relative position relation of the plurality of indoor units is reduced, and a time cost and a labor cost required for maintenance are reduced accordingly. Moreover, the relative position information determined through the above method for position determination of the present invention is acquired based on a measurement result, and is therefore more reliable.
[0077] The embodiment of the present invention is implemented based on the principles as follows: different indoor units are mounted at different positions, and a distance is formed between different indoor units and varies with different mounting positions. In the presence of the distance, the influence between different indoor units is inconsistent. In some embodiment, when one indoor unit is positioned in a first sealed environment and another indoor unit is positioned in a second sealed environment, no heat is transferred between the first sealed environment and the second sealed environment, and therefore no influence is generated between the indoor units in different sealed environments. However, when there are a plurality of indoor units in a sealed environment, influence is generated between different indoor units.
[0078] In the embodiment of the present invention, the influence is collected, and the relative position information of different indoor units is estimated exactly through the collected influence and a correlation between the influence and the distance between different indoor units.
[0079] Considering that the indoor unit is an apparatus configured to adjust a temperature in a sealed environment and the indoor units influencing each other share a sealed environment, the above influence can be extracted by collecting

the return air temperature information of the indoor unit. In an embodiment, return air temperature information of the plurality of indoor units is acquired through traversing. The closer the two indoor units are, the greater the influence between these two indoor units, and the greater the correlation coefficient between every two of the plurality of indoor units determined based on the acquired return air temperature information. Therefore, the distance between different indoor units can be represented through the correlation coefficient.

[0080] After a distance between every two indoor units is determined, whether the plurality of indoor units can be divided into the same classified group can be determined based on this distance.

[0081] Since the correlation coefficient between different indoor units can represent a distance condition between different indoor units, after division into the classified group is completed, any one of the indoor units in the classified group obtained through division can be taken as the locating point to obtain a relative position relation of the other indoor units in this classified group. After all the classified groups are traversed, a relative distribution condition of all the indoor units, that is, the relative position information in the present invention, can be obtained.

[0082] In any one of the above embodiments, the return air temperature information of the indoor unit can be a discrete temperature, that is, return air temperature information measured by the indoor unit at every fixed measurement time interval is expressed as a temperature sequence.

[0083] In one embodiment, it can be understood that the return air temperature information is temperature information at a return air inlet of the indoor unit.

[0084] In one embodiment, a temperature sensor can be arranged at the return air inlet of the indoor unit to acquire the temperature information at the return air inlet.

Embodiment 2

[0085] In this embodiment, a determination solution for a first correlation coefficient is defined. In an embodiment, as shown in Fig. 3, the determination solution comprises:

step 202, any two of a plurality of indoor units are selected, and a covariance of return air temperature information corresponding to the selected indoor units is calculated;
step 204: a variance of the return air temperature information corresponding to the selected indoor units is determined; and
step 206, a first correlation coefficient between the selected indoor units is acquired by performing an operation based on the variance and the covariance.

[0086] In this embodiment, the determination solution for the first correlation coefficient is defined. In an embodiment, a calculation formula for the first correlation coefficient is as follows:

$$r(X,Y) = \frac{cov(X,Y)}{\sqrt{Var[X]\cdot Var[Y]}}$$

[0087] Where, *X* denotes one of every two indoor units, *Y* denotes the other of every two indoor units, *cov*(*X, Y*) denotes a covariance of return air temperature information of *X and Y, Var*[X] denotes a variance of the return air temperature information of *X,* and *Var*[*Y*] denotes a variance of the return air temperature information of *Y.*

Embodiment 3

[0088] In this embodiment, a determination process of a set number of classified groups is defined. In an embodiment, as shown in Fig. 4, the determination process comprises:

step 302, first correlation coefficients are ranked, and two indoor units with the largest first correlation coefficient are selected and divided into one class;
step 304, the indoor units divided into one class are taken as first indoor units given that a plurality of indoor units are not divided into one class, second correlation coefficients between the first indoor units and remaining outdoor units, except for the first indoor units, of the plurality of indoor units are determined, the second correlation coefficients are ranked, and two indoor units with the largest second correlation coefficient are selected and divided into one class until the plurality of indoor units are classified into one class;
step 306, the set number of the classified groups is acquired, and a correlation coefficient threshold is selected for the second correlation coefficient based on the set number; and

step 308, the plurality of indoor units are classified and divided based on the second correlation coefficient and the correlation coefficient threshold to obtain a set number of classified groups.

[0089] In this embodiment, a distance between different indoor units can be represented through the first correlation coefficient. Therefore, after the first correlation coefficients between every two of the plurality of indoor units are determined, the first correlation coefficients obtained can be ranked, and then the two indoor units with the largest correlation coefficient are determined. It can be seen from the above that the first correlation coefficient can be configured to represent the distance between different indoor units. Therefore, the two indoor units corresponding to the largest first correlation coefficient are two indoor units closest to each other.

[0090] After the two indoor units closest to each other are determined, whether the other indoor units have been classified is determined. Under the condition that after the other indoor units have been classified, whether the plurality of indoor units have been classified into one classified group, that is, whether there is only one classified group, is further determined; and if yes, the plurality of indoor units are arranged based on the first correlation coefficient.

[0091] In the above case, the set number is acquired. Since the set number is configured to represent the number of classified groups into which the plurality of indoor units are divided, the correlation coefficient threshold can be set based on the set number, and the indoor units in the classified group are divided based on the set correlation coefficient threshold, and finally a set number of classified groups are obtained.

[0092] Considering that two or more or three or more indoor units are provided, that is, after the two indoor units corresponding to the largest first correlation coefficient obtained after ranking are divided into one class, some indoor units are still not classified, in this case, the indoor units that have been divided into one class are taken as a whole, that is, the first indoor units in the present invention, and the second correlation coefficients between the first indoor unit and the indoor units that are unclassified are determined. Therefore, the plurality of indoor unit can be aggregated through the second correlation coefficients, and can finally be aggregated into one class.

[0093] In an embodiment, in some embodiment, as shown in Fig. 5, there are 9 indoor units, which can be divided into 4 areas: an office area, conference area 1, conference area 2, and a corridor area on the basis of building planar partition.

[0094] The indoor units comprise indoor unit 1, indoor unit 2, indoor unit 3, indoor unit 4, indoor unit 5, indoor unit 6, indoor unit 7, indoor unit 8, and indoor unit 9. Indoor unit 1 is denoted by 1#, indoor unit 2 is denoted by 2#, indoor unit 3 is denoted by 3#, indoor unit 4 is denoted by 4#, indoor unit 5 is denoted by 5#, indoor unit 6 is denoted by 6#, indoor unit 7 is denoted by 7#, indoor unit 8 is denoted by 8#, and indoor unit 9 is denoted by 9#. Calculation results of the first correlation coefficients between every two of the plurality of indoor units are shown in Table 1.

Table 1

		1#	2#	3#	4#	5#	6#	7#	8#	9#
1#	First correlation coefficient	0	0.9356	0.9192	0.9025	0.8787	0.8581	0.6604	0.3823	0.7991
2#	First correlation coefficient	0.9356	0	0.9305	0.9511	0.8722	0.8966	0.7134	0.4081	0.8497
3#	First correlation coefficient	0.9192	0.9305	0	0.9728	0.9617	0.9522	0.7519	0.4081	0.8497
4#	First correlation coefficient	0.9025	0.9511	0.9728	0	0.9344	0.9693	0.8038	0.3965	0.8732
5#	First correlation coefficient	0.8787	0.8722	0.9617	0.9344	0	0.9373	0.7431	0.3517	0.814
6#	First correlation coefficient	0.8581	0.8966	0.9522	0.9693	0.9373	0	0.8545	0.4023	0.8646
7#	First correlation coefficient	0.6604	0.7134	0.7519	0.8038	0.7431	0.8545	0	0.4667	0.7488
8#	First correlation coefficient	0.3823	0.4081	0.4081	0.3965	0.3517	0.4023	0.4667	0	0.4821
9#	First correlation coefficient	0.7991	0.8497	0.8497	0.8732	0.814	0.8646	0.7488	0.4821	0
Maximum		0.9356	0.9511	0.9728	0.9728	0.9617	0.9693	0.8545	0.4821	0.8732

[0095] As can be seen from Table 1, the two indoor units corresponding to the largest first correlation coefficient are #3 and #4. Therefore, #3 and #4 are divided into one class and taken as one indoor unit, and the second correlation coefficients between this indoor unit and the other indoor units are calculated to obtain Table 2.

Table 2

		1#	2#	Class 1	5#	6#	7#	8#	9#
1#	Second correlation coefficient	0	0.9356	0.91085	0.8787	0.8581	0.6604	0.3823	0.7991
2#	Second correlation coefficient	0.9356	0	0.9408	0.8722	0.8966	0.7134	0.4081	0.8497
3#	Second correlation coefficient	0.91085	0.9408	0	0.94805	0.96075	0.77785	0.4023	0.86145
5#	Second correlation coefficient	0.8787	0.8722	0.94805	0	0.9373	0.7431	0.3517	0.814
6#	Second correlation coefficient	0.8581	0.8966	0.96075	0.9373	0	0.8545	0.4023	0.8646
7#	Second correlation coefficient	0.6604	0.7134	0.77785	0.7431	0.8545	0	0.4667	0.7488
8#	Second correlation coefficient	0.3823	0.4081	0.4023	0.3517	0.4023	0.4667	0	0.4821
9#	Second correlation coefficient	0.7991	0.8497	0.86145	0.814	0.8646	0.7488	0.4821	0
Maximum		0.9356	0.9408	0.96075	0.94805	0.96075	0.8545	0.4821	0.8646

[0096] As can be seen from Table 2, the second correlation coefficient between 3# and 6# is the largest, and therefore, 3# and 6# are deemed as belonging to the same class. The above steps are repeated to obtain Table 3.

Table 3

		1#	2#	Class 1	5#	7#	8#	9¥
1#	Correlation coefficient	0	0.9356	0.884475	0.8787	0.6604	0.3823	0.7991
2#	Correlation coefficient	0.9356	0	0.9187	0.8722	0.7134	0.4081	0.8497
Class 1	Correlation coefficient	0.884475	0.9187	0	0.942675	0.816175	0.4023	0.863025
5#	Correlation coefficient	0.8787	0.8722	0.942675	0	0.7431	0.3517	0.814
7#	Correlation coefficient	0.6604	0.7134	0.816175	0.7431	0	0.4667	0.7488
8#	Correlation coefficient	0.3823	0.4081	0.4023	0.3517	0.4667	0	0.4821
9#	Correlation coefficient	0.7991	0.8497	0.863025	0.814	0.7488	0.4821	0

[0097] As can be seen from Table 3, the correlation coefficient between class 1# and class 5# is the largest, and therefore, class 1# and class 5# are divided into one class. The above steps are repeated to obtain Table 4.

Table 4

		1#	2#	Class 1	7#	8#	9#
		Correlation coefficient	Correlation coefficient	Correlation coefficient	Correlation coefficient	Correlation coefficient	Correlation coefficient
1#	Correlation coefficient	0	0.9356	0.8815875	0.6604	0.3823	0.7991
2#	Correlation coefficient	0.9356	0	0.89545	0.7134	0.4081	0.8497
Class 1	Correlation coefficient	0.884475	0.9187	0	0.816175	0.4023	0.863025
7#	Correlation coefficient	0.6604	0.7134	0.7796375	0	0.4667	0.7488
8#	Correlation coefficient	0.3823	0.4081	0.377	0.4667	0	0.4821
9#	Correlation coefficient	0.7991	0.8497	0.8385125	0.7488	0.4821	0
	Maximum	0.9356	0.9356	0.89545	0.816175	0.4821	0.863025

[0098] As can be seen from Table 4, the correlation coefficient between 1# and 2# is the largest, and therefore, 1# and 2# are divided into one class. The above steps are repeated to obtain Table 5.

Table 5

		Class 2	Class 1	7#	8#	9#
		Correlation coefficient	Correlation coefficient	Correlation coefficient	Correlation coefficient	Correlation coefficient
Class 2	Correlation coefficient	0	0.9015875	0.6869	0.3952	0.8244
Class 1	Correlation coefficient	0.901588	0	0.816175	0.4023	0.863025
7#	Correlation coefficient	0.6869	0.7796375	0	0.4667	0.7488
8#	Correlation coefficient	0.3952	0.377	0.4667	0	0.4821
9#	Correlation coefficient	0.8244	0.8385125	0.7488	0.4821	0
	Maximum	0.901588	0.9015875	0.816175	0.4821	0.863025

[0099] The above steps are repeated to obtain Table 6.

Table 6

		Class 1	7#	8#	9#
		Correlation coefficient	Correlation coefficient	Correlation coefficient	Correlation coefficient
Class 1	Correlation coefficient	0	0.73326875	0.3861	0.83145625
7#	Correlation coefficient	0.733269	0	0.4667	0.7488

(continued)

		Class 1	7#	8#	9#
		Correlation coefficient	Correlation coefficient	Correlation coefficient	Correlation coefficient
8#	Correlation coefficient	0.3861	0.4667	0	0.4821
9#	Correlation coefficient	0.831456	0.7488	0.4821	0
	Maximum	0.831456	0.7488	0.4821	0.83145625

[0100] In one embodiment, the second correlation coefficient can be a mean of the first correlation coefficients between the indoor units divided into one class and the first indoor unit.

[0101] In an embodiment, as shown in Fig. 6, the correlation coefficient threshold is further a set correlation coefficient. As can be seen from the above table, the correlation coefficient threshold is selected from 0.8314 to 0.9016.

[0102] In one embodiment, the correlation coefficient threshold is set for the second correlation coefficient based on the set number of the classified groups. It can be understood that the correlation coefficient threshold is rationally selected based on the set number, and the plurality of indoor units are divided into a set number of classified groups.

[0103] In this process, through the above solution, unclassified indoor units are classified. Accordingly, the rationality of classifying and dividing the plurality of indoor units into the classified groups is improved, and the accuracy of the relative position information of the plurality of indoor units is ensured.

[0104] In one embodiment, the process further comprises: space partition information for the plurality of indoor units is acquired; and the set number is determined based on the space partition information.

[0105] In this embodiment, the set number is determined based on the acquired space partition information, and therefore can be rationally set based on the space for mounting the indoor units. In this process, the influence on selection of a preset threshold caused by irrational setting of the set number is reduced, the accuracy of the relative position information of the plurality of indoor units is ensured, and finally the maintenance difficulty of the relative position information for maintenance personnel is reduced, in some embodiment, a human resource operation cost and a time cost are reduced.

[0106] In any of the above embodiments, the space partition information can be determined based on information collected by mounting personnel in a process of mounting the plurality of indoor units.

[0107] In any of the above embodiments, the space partition information can be room division information or office area division condition.

Embodiment 4

[0108] In this embodiment, a specific generation process of relative position information is defined. As shown in Fig. 7, the process comprises:

step 502, a preset quantitative relation is acquired to determine a quantitative value corresponding to a first correlation coefficient based on the preset quantitative relation;
step 504, coordinate information of an indoor unit except for any one of selected indoor units is acquired in a classified group based on the quantitative value and a locating point; and
step 506, the relative position information is generated based on the locating point and the coordinate information.

[0109] In this embodiment, a generation manner of the relative position information is defined. In an embodiment, it can be seen from the above that the correlation coefficient is correlated with a distance between different indoor units. Therefore, a mapping relation between the correlation coefficient and the distance between different indoor units can be pre-constructed, and the distance between different indoor units can be determined based on the mapping relation after the correlation coefficient is acquired.

[0110] In an embodiment, in the present invention, the preset quantitative relation is the mapping relation between the correlation coefficient and the distance between different indoor units. Therefore, coordinate information corresponding to the indoor unit corresponding to the quantitative value can be determined based on a locating point of any one of the indoor units in this classified group and the quantitative value after the quantitative value is determined. Accordingly, a relative position relation between any one of the indoor units and the other indoor units is obtained based on the locating point and the coordinate information.

[0111] In one embodiment, the locating point can be interpreted as a coordinate origin.

[0112] In one embodiment, in the preset quantitative relation, the correlation coefficient is negatively correlated with the quantitative value.

[0113] In one embodiment, a correspondence relation between thecorrelation coefficient and the quantitative value is shown in Table 7.

Table 7

		1#	2#	3#	4#	5#	6#	7#	8#	9#
11#	Correlation coefficient	0	0.9356	0.9192	0.9025	0.8787	0.8581	0.6604	0.3823	0.7991
	Quantitative distance	0	0.5796	0.7272	0.8775	1.0917	1.2771	3.0564	5.5593	1.8081
22#	Correlation coefficient	0.9356	0	0.9305	0.9511	0.8722	0.8966	0.7134	0.4081	0.8497
	Quantitative distance	0.5796	0	0.6255	0.4401	1.1502	0.9306	2.5794	5.3271	1.3527
33#	Correlation coefficient	0.9192	0.9305	0	0.9728	0.9617	0.9522	0.7519	0.4081	0.8497
	Quantitative distance	0.7272	0.6255	0	0.2448	0.3447	0.4302	2.2329	5.3271	1.3527
44#	Correlation coefficient	0.9025	0.9511	0.9728	0	0.9344	0.9693	0.8038	0.3965	0.8732
	Quantitative distance	0.8775	0.4401	0.2448	0	0.5904	0.2763	1.7658	5.4315	1.1412
55#	Correlation coefficient	0.8787	0.8722	0.9617	0.9344	0	0.9373	0.7431	0.3517	0.814
	Quantitative distance	1.0917	1.1502	0.3447	0.5904	0	0.5643	2.3121	5.8347	1.674
66#	Correlation coefficient	0.8581	0.8966	0.9522	0.9693	0.9373	0	0.8545	0.4023	0.8646
	Quantitative distance	1.2771	0.9306	0.4302	0.2763	0.5643	0	1.3095	5.3793	1.2186
77#	Correlation coefficient	0.6604	0.7134	0.7519	0.8038	0.7431	0.8545	0	0.4667	0.7488
	Quantitative distance	3.0564	2.5794	2.2329	1.7658	2.3121	1.3095	0	4.7997	2.2608
88#	Correlation coefficient	0.3823	0.4081	0.4081	0.3965	0.3517	0.4023	0.4667	0	0.4821
	Quantitative distance	5.5593	5.3271	5.3271	5.4315	5.8347	5.3793	4.7997	0	4.6611
99#	Correlation coefficient	0.7991	0.8497	0.8497	0.8732	0.814	0.8646	0.7488	0.4821	0
	Quantitative distance	1.8081	1.3527	1.3527	1.1412	1.674	1.2186	2.2608	4.6611	0

[0114] In one embodiment, Fig. 8 is a schematic diagram of a quantitative relative distance between different indoor units.

[0115] In one embodiment, the relative position information can be expressed in the form of Table 8.

Table 8

	x	y
1#	0	0
2#	0	0.5796
3#	0.601637	0.408476
4#	0.388183	0.786969
5#	1.077311	0.176661
6#	0.853836	0.949709
7#	1.592272	2.608879
8#	4.980227	2.470463
9#	0.961043	1.531543

[0116] In Table 8, x and y denote coordinates on coordinate axes perpendicular to each other respectively.

[0117] As shown in Fig. 9, the relative position information of the plurality of indoor units can be obtained based on Table 8.

[0118] In one embodiment, Fig. 10 is one schematic form diagram of the relative position information.

[0119] In one embodiment, the relative position information is a topological graph.

[0120] In this embodiment, the expression form of the relative position information is defined. By defining the relative position information to be displayed in the form of the topological graph, a user can intuitively perceive a position distribution condition of different indoor units, to directly control different indoor units, ensuring a control effect.

[0121] In one embodiment, Fig. 11 is one form of a topological graph.

[0122] In one embodiment, Fig. 12 is a schematic diagram of an expression form of a preset quantitative relation.

[0123] In one embodiment, the process further comprises: a return air temperature difference sequence of each indoor unit is acquired; an evaluation index is determined based on a mean and a variance of return air temperature difference sequences between every two indoor units; and a preset number of indoor units around each indoor unit are determined based on the evaluation index.

[0124] In an embodiment, for an indoor environment, the closer the distance between two indoor units having the same running condition is, the more obvious the mutual influence degree of return air states of the two indoor units is, the more consistent the overall return air temperature fluctuation curves are, and the smaller the mean of the return air temperature difference sequence is. However, considering that there may be an apparatus running in an independent space, a return air temperature curve of the apparatus may be similar with that of any indoor unit in the same running state. A mean of the return air temperature difference obtained in this case is very small and cannot be used for determination. However, in this case, because of a low actual correlation and a low consistency of the temperature change trend, the return air temperature difference sequence will fluctuate greatly. Therefore, the variance of the return air temperature difference sequences is calculated additionally, and a large variance of the return air temperature sequence will be obtained in this case.

[0125] The mean and the variance (square_d) of the return air temperature difference sequence of each indoor unit are calculated to construct an evaluation index ms=abs(mean×square_d); the index is configured to measure a real distance between two of all the apparatuses; and therefore, more accurate position distribution of each indoor unit can be obtained based on classification results.

[0126] In one embodiment, a mean and a variance of return air temperature differences between the indoor units are calculated based on collected data, and data shown in Table 9 are obtained as the evaluation index. Based on the data in Table 9, x indoor units having the most similar evaluation indexes with each indoor unit are searched for to obtain an adjacent indoor unit group having x indoor units of each indoor unit.

Table 9

reflect	Ms×100	reflect	ms×100
5#_4#	0.0598	8#_3#	1.7914
9#_6#	0.0607	3#_1#	1.9423
4#_3#	0.0855	7#_4#	2.1904
3#_2#	0.1162	7#_5#	2.6424
6#_4#	0.1462	4#_1#	2.7475
5#_3#	0.1857	7#_3#	3.6615
4#_2#	0.2374	5#_1#	3.8646
6#_5#	0.2740	8#_4#	4.0014
6#_3#	0.3702	6#_1#	4.6805
9#_4#	0.6215	7#_2#	4.8638
7#_6#	0.7590	8#_2#	4.8690
5#_2#	0.7971	8#_5#	5.8419
9#_5#	0.8551	9#_1#	6.0566
6#_2#	0.9902	9#_8#	12.2646
9#_7#	1.0892	8#_6#	12.5563
9#_3#	1.1470	7#_1#	15.5748

(continued)

reflect	Ms×100	reflect	ms×100
9#_2#	1.3748	8#_7#	18.5582
2#_1#	1.4805	8#_1#	48.3287

[0127] In some embodiment, if x is set to 3, Table 10 can be obtained.

Table 10

Indoor unit No.	Adjacent indoor unit No.
1#	[2#,3#,4#]
2#	[3#,4#,5#]
3#	[4#,2#,5#]
4#	[5#,3#,6#]
5#	[4#,3#,6#]
6#	[9#,4#,5#]
7#	[6#,9#,4#]
8#	[3#,4#,2#]
9#	[6#,4#,5#]

[0128] Based on Table 10, the distribution condition of the plurality of indoor units can be obtained. The position distribution condition of different indoor units can be obtained based on the above distribution condition.

[0129] In one embodiment, the relative position information can be corrected based on the position distribution condition of different indoor units obtained based on Table 10. Therefore, the reliability of the obtained relative position information can be improved, and the control accuracy of different indoor units based on the relative position information can be improved accordingly.

[0130] In any of the above embodiments, the evaluation index is the absolute value of a product of the mean and the variance of the return air temperature difference sequences.

[0131] In one embodiment, before the step that return air temperature information of each indoor unit is acquired, the process further comprises: the plurality of indoor units are controlled to run in a refrigeration mode, a heating mode, or a dehumidification mode; and alternatively, one of the plurality of indoor units is controlled to run in a refrigeration mode, a heating mode, or a dehumidification mode, and the others of the plurality of indoor units are controlled to run in an air supply mode.

[0132] In this embodiment, the relative position information of different indoor units can be rapidly determined by defining running states of the plurality of indoor units.

[0133] In an embodiment, the plurality of indoor units can be controlled to simultaneously run in the refrigeration mode, the heating mode, or the dehumidification mode, to simultaneously adjust a temperature of an environment in which the indoor units are positioned, and determine the relative position information of different indoor units while rapid refrigeration, heating, or dehumidification is realized.

[0134] In one embodiment, before the step that return air temperature information of each indoor unit is acquired, the plurality of indoor units can further be controlled to run in a target running mode in sequence, and the other indoor units can be controlled to run in the air supply mode. The target running mode can be any one of the heating mode, the refrigeration mode, and the dehumidification mode.

Embodiment 5

[0135] In one embodiment, the method further comprises: absolute position information of any one of the indoor units is acquired, and actual position information is determined based on the absolute position information and the relative position information.

[0136] In this embodiment, a process of converting the relative position information into the actual position information after the relative position information of the plurality of indoor units is acquired is defined. In an embodiment, the absolute position information of any one of the indoor units is acquired, and the actual position information is determined based on the absolute position information. In this process, the user can more intuitively determine positions of different indoor units and the distribution condition of different indoor units by converting the absolute position information, to control different indoor units based on the actual position information.

Embodiment 6

[0137] In one embodiment of the present invention, as shown in Fig. 13, the present invention provides a device 600 for position determination. The device is configured for a plurality of indoor units and comprises: an acquisition device 602 configured to acquire return air temperature information of each indoor unit; a determination device 604 configured to determine a first correlation coefficient between every two indoor units based on the return air temperature information; a classification device 606 configured to classify the plurality of indoor units based on the first correlation coefficient and a preset threshold to obtain a set number of classified groups; and a generation device 608 configured to generate relative position information in each classified group based on the first correlation coefficient by takingthe first indoor units as a locating point.

[0138] A device 600 for position determination is provided based on the embodiment of the present invention. By applying the device 600 for position determination to the plurality of indoor units, relative positions of the plurality of indoor units can be measured. In this process, maintenance personnel are not required to manually maintain a relative position relation of the plurality of indoor units. Therefore, the maintenance difficulty of the relative position relation of the plurality of indoor units is reduced, and a time cost and a labor cost required for maintenance are reduced accordingly. Moreover, the relative position information determined through the above method for position determination of the present invention is acquired based on a measurement result, and is therefore more reliable.

[0139] The embodiment of the present invention is implemented based on the principles as follows: different indoor units are mounted at different positions, and a distance is formed between different indoor units and varies with different mounting positions. In the presence of the distance, the influence between different indoor units is inconsistent. In some embodiment, when one indoor unit is positioned in a first sealed environment and another indoor unit is positioned in a second sealed environment, no heat is transferred between the first sealed environment and the second sealed environment, and therefore no influence is generated between the indoor units in different sealed environments. However, when there are a plurality of indoor units in a sealed environment, influence is generated between different indoor units.

[0140] In the embodiment of the present invention, the influence is collected, and the relative position information of different indoor units is estimated exactly through the collected influence and a correlation between the influence and the distance between different indoor units.

[0141] Considering that the indoor unit is an apparatus configured to adjust a temperature in a sealed environment and the indoor units influencing each other share a sealed environment, the above influence can be extracted by collecting the return air temperature information of the indoor unit. In an embodiment, return air temperature information of the plurality of indoor units is acquired through traversing. The closer the two indoor units are, the greater the influence between these two indoor units, and the greater the correlation coefficient between every two of the plurality of indoor units determined based on the acquired return air temperature information. Therefore, the distance between different indoor units can be represented through the correlation coefficient.

[0142] After a distance between every two indoor units is determined, whether the plurality of indoor units can be divided into the same classified group can be determined based on this distance.

[0143] Since the correlation coefficient between different indoor units can represent a distance condition between different indoor units, after division into the classified group is completed, any one of the indoor units in the classified group obtained through division can be taken as the locating point to obtain a relative position relation of the other indoor units in this classified group. After all the classified groups are traversed, a relative distribution condition of all the indoor units, that is, the relative position information in the present invention, can be obtained.

[0144] In any one of the above embodiments, the return air temperature information of the indoor unit can be a discrete temperature, that is, return air temperature information measured by the indoor unit at every fixed measurement time interval is expressed as a temperature sequence.

[0145] In one embodiment, it can be understood that the return air temperature information is temperature information at a return air inlet of the indoor unit.

[0146] In one embodiment, a temperature sensor can be arranged at the return air inlet of the indoor unit to acquire the temperature information at the return air inlet.

Embodiment 7

[0147] In one embodiment, the present invention provides an air conditioning system. The air conditioning system comprises: a plurality of indoor units; and a control device, where the control device communicates with the plurality of the indoor units and is configured to execute steps of any method for position determination.

[0148] An air conditioning system is provided in this embodiment of the present invention. The air conditioning system comprises the control device and the plurality of indoor units. The control device executes the steps of any one of the above methods for position determination. Therefore, the air conditioning system has all the beneficial effects of any one of the above methods for position determination.

[0149] In some embodiment, relative positions of the plurality of indoor units can be measured. In this process, maintenance personnel are not required to manually maintain a relative position relation of the plurality of indoor units. Therefore, the maintenance difficulty of the relative position relation of the plurality of indoor units is reduced, and a time cost and a labor cost required for maintenance are reduced accordingly. Moreover, the relative position information determined through the above method for position determination of the present invention is acquired based on a measurement result, and is therefore more reliable. Other effects will not be repeated herein.

[0150] In one embodiment, the air conditioning system further comprises: an outdoor unit, where the outdoor unit is connected to the indoor unit.

[0151] In this embodiment, a refrigerant interaction is performed between the outdoor unit and the indoor unit to exchange heat.

Embodiment 8

[0152] In one embodiment, a readable storage medium is provided. The readable storage medium stores a program or an instruction, where the program or the instruction implements steps of any one of the above methods for position determination when executed by a processor.

[0153] The program or the instruction stored on the readable storage medium provided by the present invention can implement the steps of any one of the above methods for position determination when executed. Therefore, the readable storage medium has all the beneficial effects of any one of the above methods for position determination, which will not be repeated herein.

[0154] In the description of the present invention, the term "a plurality of" means two or more; unless expressly defined otherwise, the orientation or position relations indicated by the terms "upper", "lower", etc. are based on the orientation or position relations shown in the accompanying drawings, merely for facilitating the description of the present invention and simplifying the description, rather than indicating or implying that the device or element referred to must have a particular orientation or be constructed and operated in a particular orientation, and therefore cannot be interpreted as limiting the present invention; and the terms "connection", "mounting", "fixed", etc. should be understood in a broad sense. In some embodiment, a "connection" can be a fixed connection, a detachable connection, an integrated connection, a direct connection, or an indirect connection via an intermediate medium. For those of ordinary skill in the art, the specific meanings of the above terms in the present invention can be understood based on specific circumstances.

[0155] In the description of the present invention, the description with reference to the terms "one embodiment", "some embodiments", "a specific embodiment", etc. means that a specific feature, structure, material, or characteristic described in connection with this embodiment or instance is encompassed in at least one embodiment or instance of the present invention. In the present invention, the schematic expressions of the above terms do not refer to the same embodiment or instance necessarily. Moreover, the specific feature, structure, material, or characteristic described can be combined in any suitable way in one or more embodiments or instances.

[0156] What are described above are merely some embodiments of the present invention, but are not intended to limit the present invention. Those skilled in the art can make various changes and variations to the present invention. Any modifications, equivalent replacements, improvements, etc. made within the spirit and principles of the present invention should fall within the scope of protection of the present invention.

Claims

1. A method for position determination, configured for a plurality of indoor units, comprising:

   acquiring a return air temperature information of each indoor unit;
   determining a first correlation coefficient between every two indoor units based on the return air temperature information;
   classifying the plurality of indoor units based on the first correlation coefficient to obtain a set number of classified groups; and
   generating a relative position information in each classified group based on the first correlation coefficient and using any one of the air conditioning indoor units as a locating point.

2. The method for position determination according to claim 1, wherein the step of determining the first correlation

coefficient between every two indoor units based on the return air temperature information further comprises:

determining a covariance of return air temperature information corresponding to every two indoor units;
determining a variance of return air temperature information corresponding to each indoor unit; and
determining the first correlation coefficient based on the variance and the covariance.

3. The method for position determination according to claim 1, wherein the step of classifying the plurality of indoor units based on the first correlation coefficient to obtain the set number of classified groups further comprises:

dividing two indoor units with a largest first correlation coefficient into one class;
taking the indoor units divided into one class as first indoor units, respectively determining second correlation coefficients between the first indoor units and remaining indoor units of the plurality of indoor units other than the first indoor units, and dividing two indoor units with a largest second correlation coefficient into one class until the plurality of indoor units are divided into one class;
setting a correlation coefficient threshold for the second correlation coefficient based on the set number of the classified groups; and
dividing the plurality of indoor units based on the second correlation coefficient and the correlation coefficient threshold to obtain the set number of classified groups.

4. The method for position determination according to claim 3, further comprising:

acquiring a space partition information for the installed plurality of indoor units; and
determining the set number of the classified groups based on the space partition information.

5. The method for position determination according to any one of claims 1 to 4, wherein the step of generating the relative position information based on the first correlation coefficient and taking any one of the indoor units as a locating point further comprises:

determining a quantitative value corresponding to the first correlation coefficient based on a preset quantitative relation;
acquiring a coordinate information of an indoor unit except for said any one of the indoor units based on the quantitative value and the locating point; and
generating the relative position information based on the locating point and the coordinate information.

6. The method for position determination according to claim 5, wherein in the preset quantitative relation, the first correlation coefficient is negatively correlated with the quantitative value.

7. The method for position determination according to any one of claims 1 to 4, wherein the relative position information is a topological graph.

8. The method for position determination according to any one of claims 1 to 4, wherein before the step of acquiring the return air temperature information of each indoor unit, the method further comprises:

controlling the plurality of indoor units to run in a refrigeration mode, a heating mode, or a dehumidification mode; or
controlling one of the plurality of indoor units to run in a refrigeration mode, a heating mode, or a dehumidification mode, and controlling the others of the plurality of indoor units to run in an air supply mode.

9. The method for position determination according to any one of claims 1 to 4, further comprising:
acquiring an absolute position information of any one of the indoor units, and determining an actual position information based on the absolute position information and the relative position information.

10. The method for position determination according to any one of claims 1 to 4, further comprising:

acquiring a return air temperature difference sequence of each indoor unit;
determining an evaluation index based on a mean and a variance of return air temperature difference sequences of every two indoor units; and
determining a preset number of indoor units around each indoor unit based on the evaluation index.

11. The method for position determination according to claim 10, wherein
the evaluation index is an absolute value of a product of the mean and the variance of the return air temperature difference sequences.

12. A device for position determination, configured for a plurality of indoor units and comprising:

an acquisition device configured to acquire a return air temperature information of each indoor unit;
a determination device configured to determine a first correlation coefficient between every two indoor units based on the return air temperature information;
a classification device configured to classify the plurality of indoor units based on the first correlation coefficient to obtain a set number of classified groups; and
a generation device configured to generate relative position information in each classified group based on the first correlation coefficient and taking any one of the indoor units as a locating point.

13. An air conditioning system, comprising:

a plurality of indoor units; and
a control device, wherein the control device communicates with the plurality of the indoor units and is configured to execute a step of a method for position determination according to any one of claims 1 to 11.

14. The air conditioning system according to claim 13, further comprising:
an outdoor unit, wherein the outdoor unit is connected to the indoor unit.

15. A readable storage medium, storing a program or an instruction, wherein the program or the instruction implements a step of a method for position determination according to any one of claims 1 to 11 when executed by a processor.

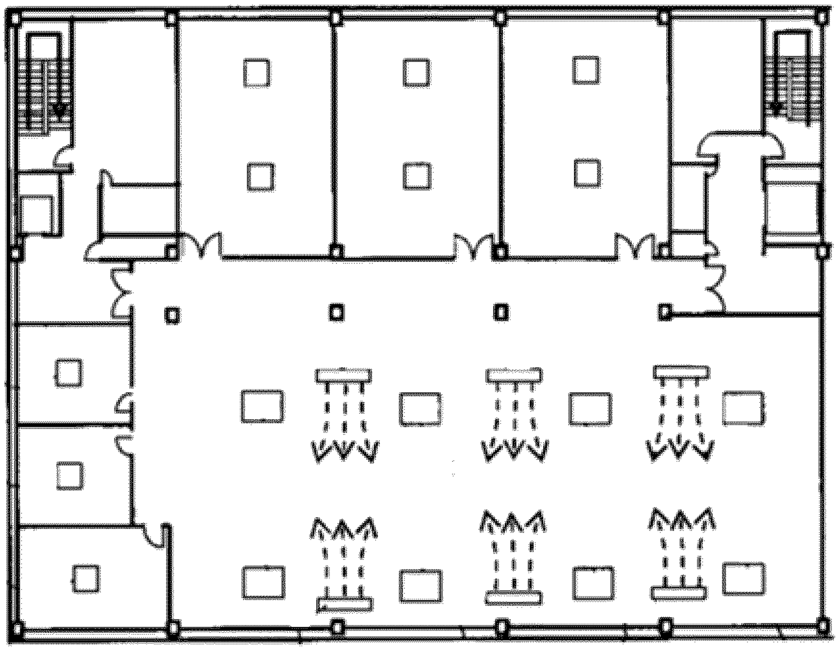

Fig. 1

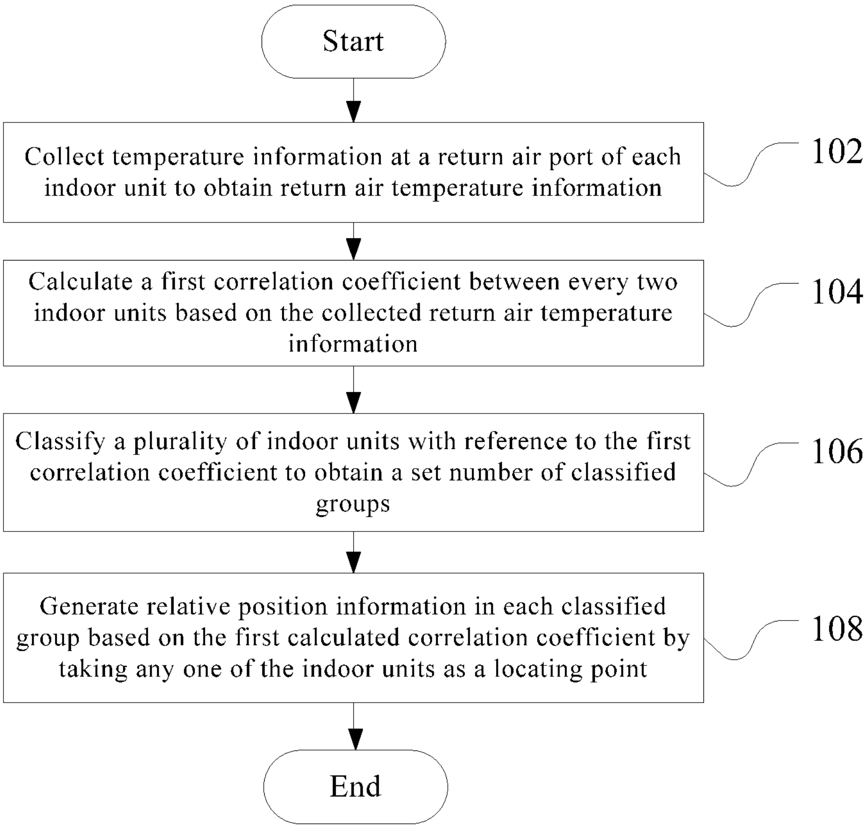
Start
Collect temperature information at a return air port of each indoor unit to obtain return air temperature information
102
Calculate a first correlation coefficient between every two indoor units based on the collected return air temperature information
104
Classify a plurality of indoor units with reference to the first correlation coefficient to obtain a set number of classified groups
106
Generate relative position information in each classified group based on the first calculated correlation coefficient by taking any one of the indoor units as a locating point
108
End

Fig. 2

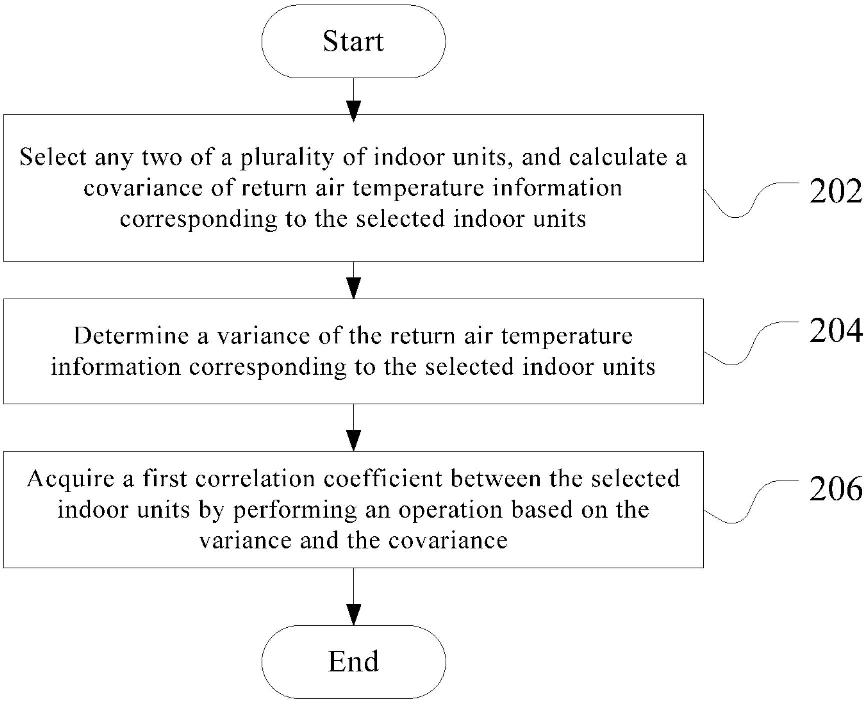
Start
Select any two of a plurality of indoor units, and calculate a covariance of return air temperature information corresponding to the selected indoor units
202
Determine a variance of the return air temperature information corresponding to the selected indoor units
204
Acquire a first correlation coefficient between the selected indoor units by performing an operation based on the variance and the covariance
206
End

Fig. 3

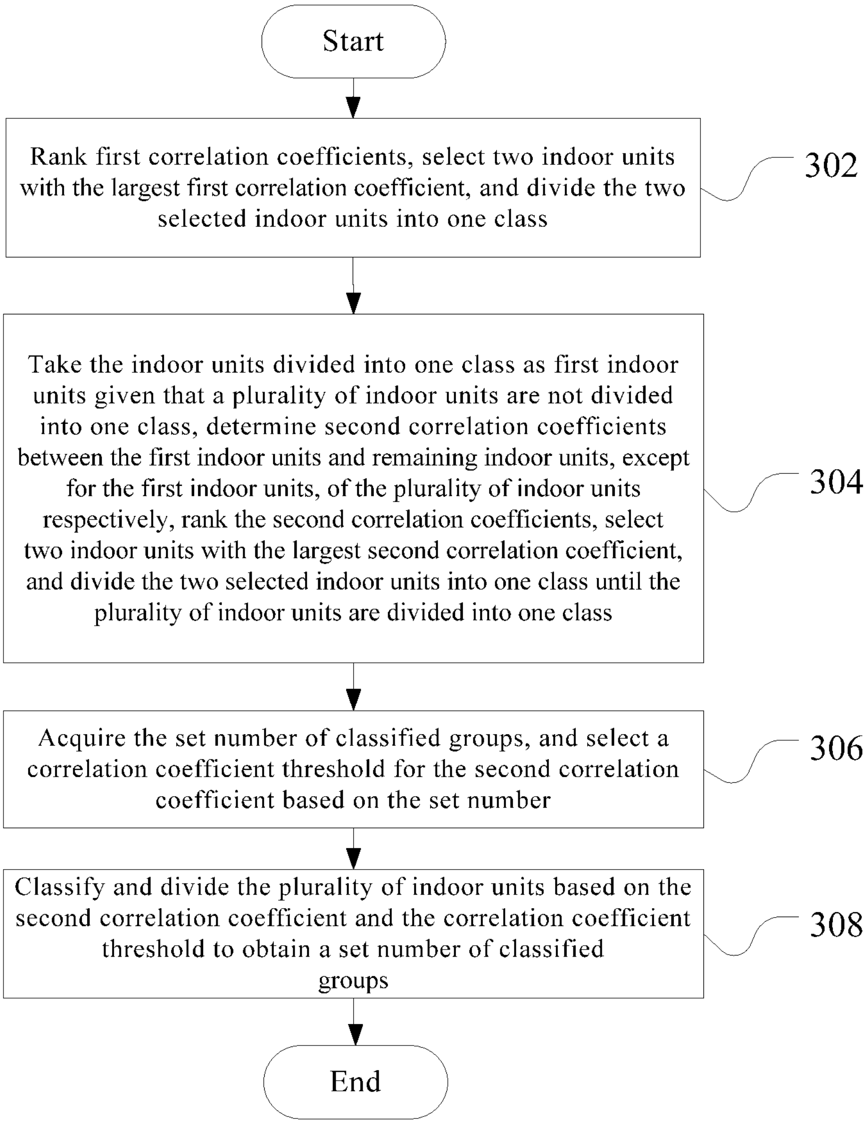
Start
Rank first correlation coefficients, select two indoor units with the largest first correlation coefficient, and divide the two selected indoor units into one class
302
Take the indoor units divided into one class as first indoor units given that a plurality of indoor units are not divided into one class, determine second correlation coefficients between the first indoor units and remaining indoor units, except for the first indoor units, of the plurality of indoor units respectively, rank the second correlation coefficients, select two indoor units with the largest second correlation coefficient, and divide the two selected indoor units into one class until the plurality of indoor units are divided into one class
304
Acquire the set number of classified groups, and select a correlation coefficient threshold for the second correlation coefficient based on the set number
306
Classify and divide the plurality of indoor units based on the second correlation coefficient and the correlation coefficient threshold to obtain a set number of classified groups
308
End

Fig. 4

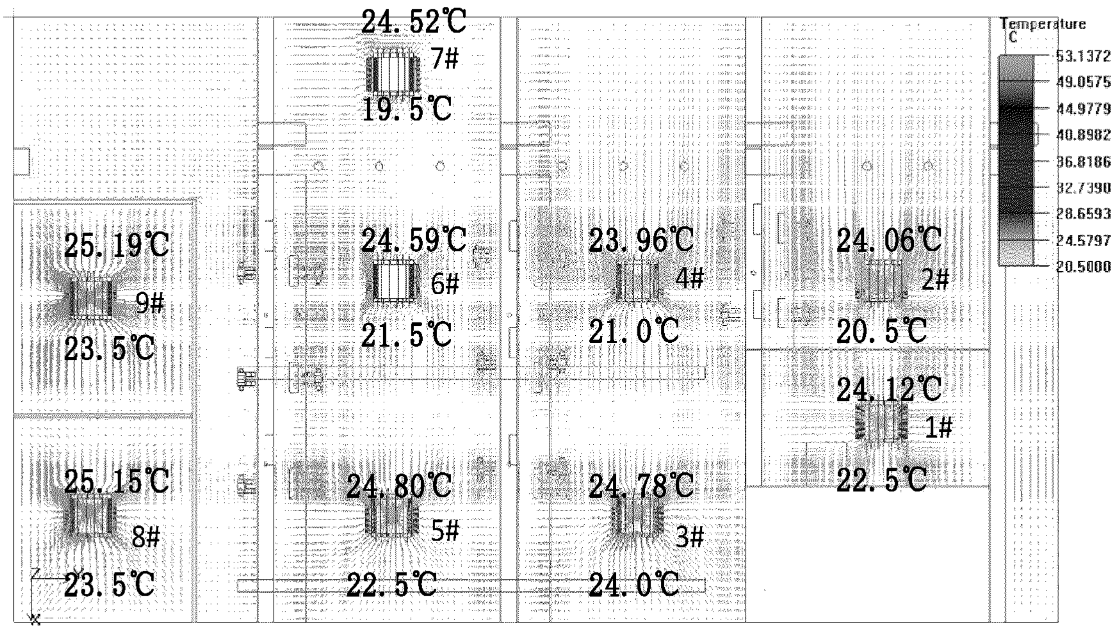
24. 52℃
7#
19. 5℃
25. 19℃
9#
23. 5℃
24. 59℃
6#
21. 5℃
23. 96℃
4#
21. 0℃
24. 06℃
2#
20. 5℃
24. 12℃
1#
22. 5℃
25. 15℃
8#
23. 5℃
24. 80℃
5#
22. 5℃
24. 78℃
3#
24. 0℃
Temperature
C
53.1372
49.0575
44.9779
40.8982
36.8186
32.7390
28.6593
24.5797
20.5000

Fig. 5

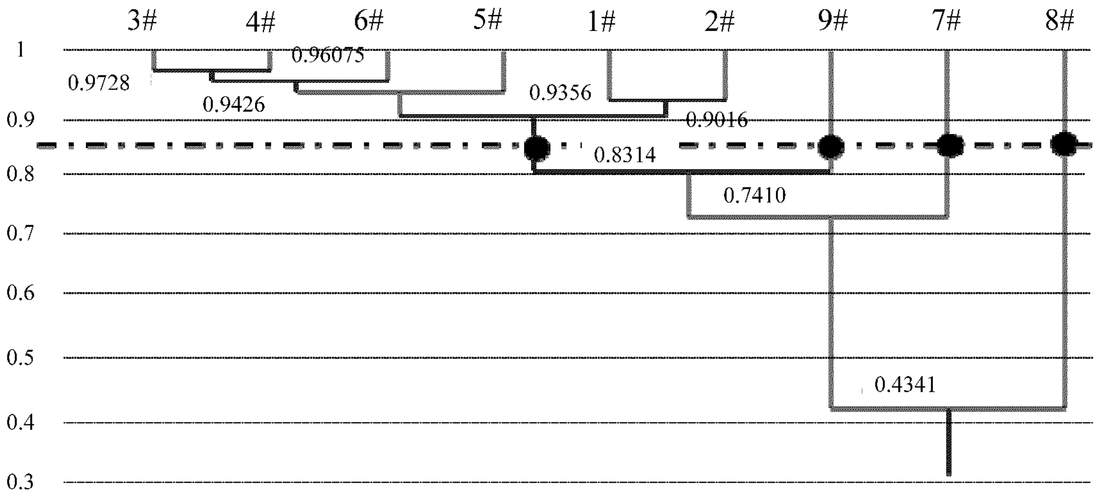
3#
4#
6#
5#
1#
2#
9#
7#
8#
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.9728
0.96075
0.9426
0.9356
0.9016
0.8314
0.7410
0.4341

Fig. 6

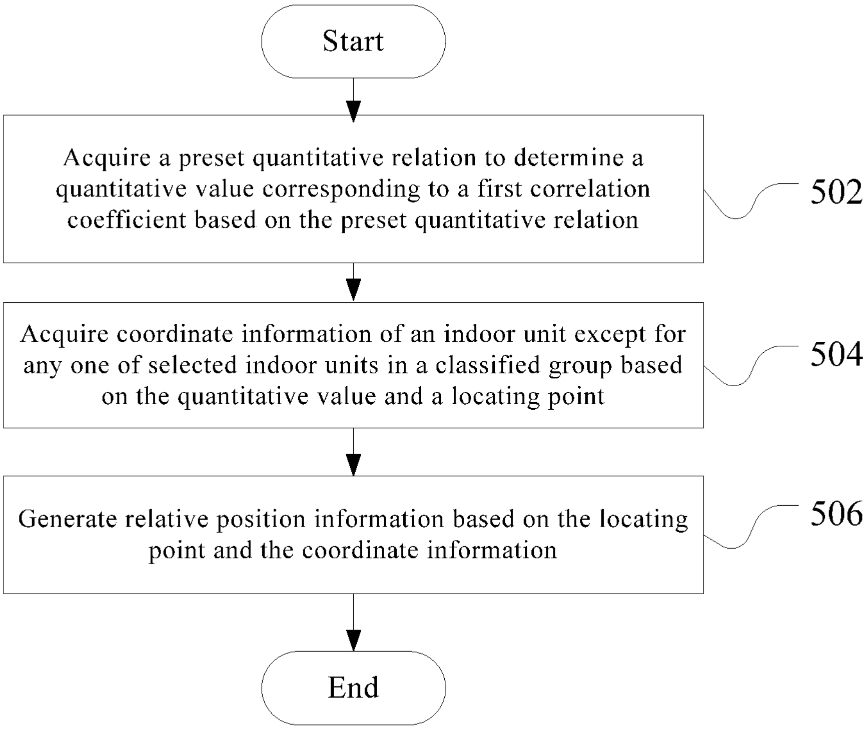
Start
Acquire a preset quantitative relation to determine a quantitative value corresponding to a first correlation coefficient based on the preset quantitative relation
502
Acquire coordinate information of an indoor unit except for any one of selected indoor units in a classified group based on the quantitative value and a locating point
504
Generate relative position information based on the locating point and the coordinate information
506
End

Fig. 7

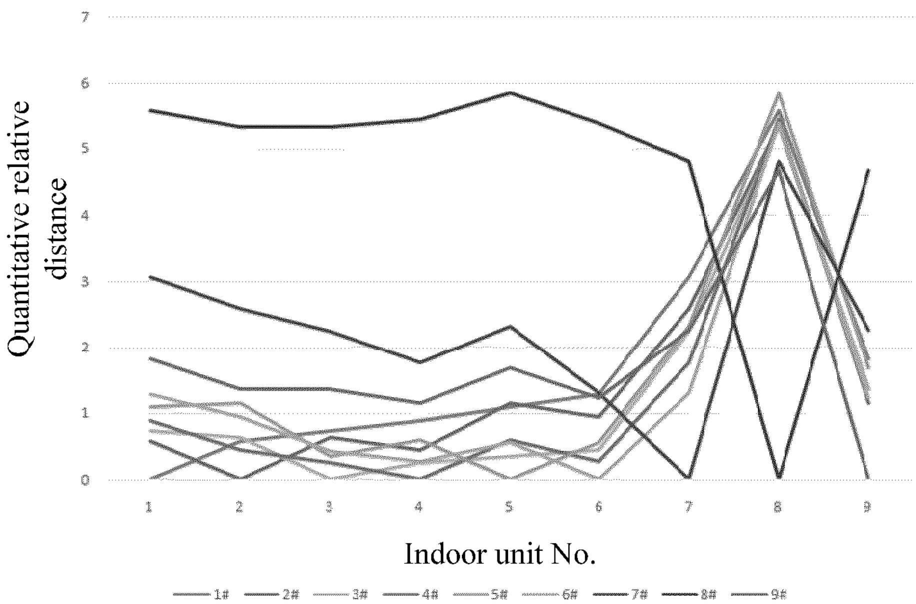
Quantitative relative distance
7
6
5
4
3
2
1
0
1
2
3
4
5
6
7
8
9
Indoor unit No.
1#
2#
3#
4#
5#
6#
7#
8#
9#

Fig. 8

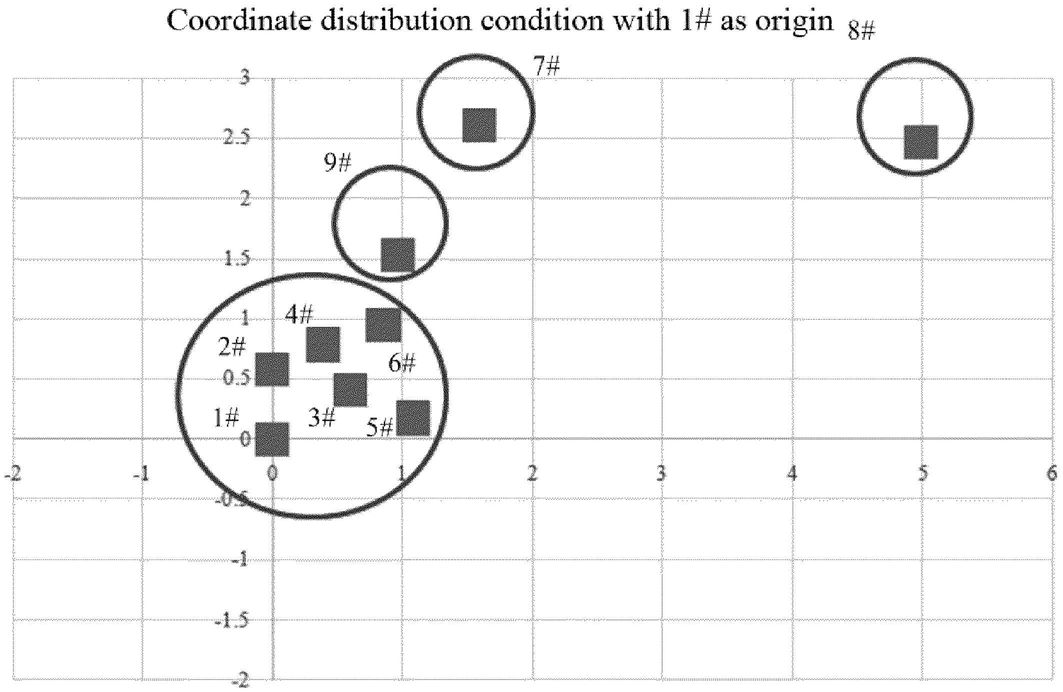

Fig. 9

Class 1	4#
	3#
	6#
	5#
	2#
	1#
Class 2	9#
Class 3	7#
Class 4	8#

Fig. 10

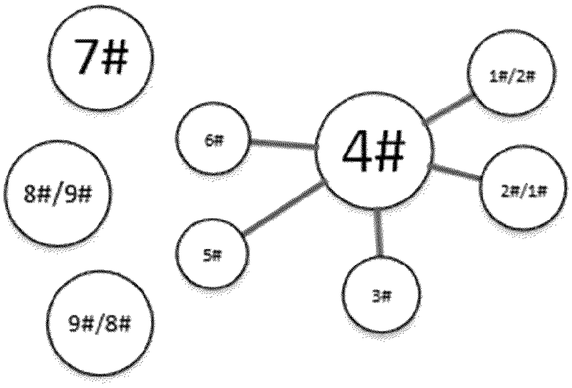

Fig. 11

Relative distance	Farther ←------------→ Closer									
Correlation coefficient	0	0.1	0.2	0.3	0.4	0.5	0.7	0.8	0.9	1.0
Quantitative value corresponding to distance	9	8	7	6	5	4	3	2	1	0

Fig. 12

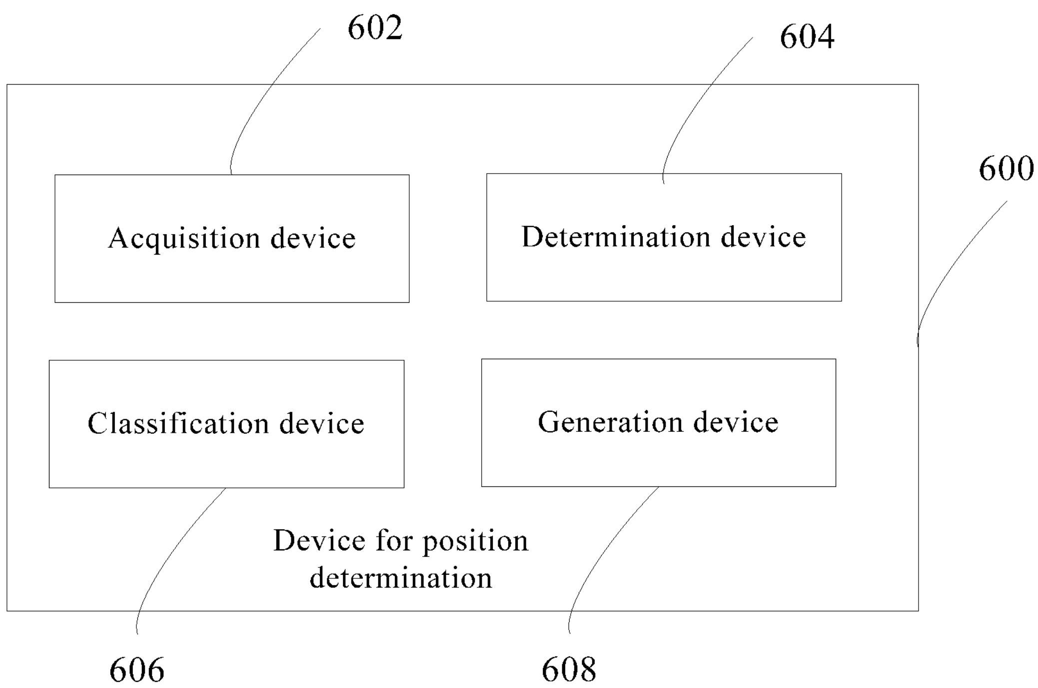
602
604
600
Acquisition device
Determination device
Classification device
Generation device
Device for position
determination
606
608

Fig. 13

INTERNATIONAL SEARCH REPORT

International application No.
PCT/CN2021/129119

A. CLASSIFICATION OF SUBJECT MATTER

F24F 11/64(2018.01)i；F24F 11/65(2018.01)i；F24F 11/88(2018.01)i；F24F 110/10(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, DWPI, VEN: 空调, 室内机, 位置确定, 回风温度, 相关系数, 分类, 组, 相对位置, air conditioner, indoor unit, location determination, return air temperature, correlation coefficient, classification, group, relative position

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
PX	CN 113237202 A (GUANGDONG MIDEA HEATING & VENTILATION EQUIPMENT CO., LTD. et al.) 10 August 2021 (2021-08-10) claims 1-15	1-15
A	CN 109695935 A (SHANGHAI STEP ELECTRIC CORP. et al.) 30 April 2019 (2019-04-30) description, paragraphs [0021]-[0063]	1-15
A	CN 112229041 A (HITACHI BUILDING TECHNOLOGY (GUANGZHOU) CO., LTD.) 15 January 2021 (2021-01-15) entire document	1-15
A	CN 112378059 A (FOSHAN SHUNDE MIDEA ELECTRONIC TECHNOLOGY CO., LTD. et al.) 19 February 2021 (2021-02-19) entire document	1-15
A	CN 103486692 A (QINGDAO HISENSE HITACHI AIR CONDITIONING SYSTEM CO., LTD.) 01 January 2014 (2014-01-01) entire document	1-15
A	KR 20070030076 A (LG ELECTRONICS INC.) 15 March 2007 (2007-03-15) entire document	1-15

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

* Special categories of cited documents:
- "A" document defining the general state of the art which is not considered to be of particular relevance
- "E" earlier application or patent but published on or after the international filing date
- "L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
- "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
15 March 2022	**21 March 2022**

Name and mailing address of the ISA/CN	Authorized officer
China National Intellectual Property Administration (ISA/CN) **No. 6, Xitucheng Road, Jimenqiao, Haidian District, Beijing 100088, China**	
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/CN2021/129119

Patent document cited in search report	Publication date (day/month/year)	Patent family member(s)	Publication date (day/month/year)
CN 113237202 A	10 August 2021	None	
CN 109695935 A	30 April 2019	None	
CN 112229041 A	15 January 2021	None	
CN 112378059 A	19 February 2021	None	
CN 103486692 A	01 January 2014	CN 103486692 B	28 October 2015
KR 20070030076 A	15 March 2007	KR 101203559 B1	21 November 2012

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

REFERENCES CITED IN THE DESCRIPTION

This list of references cited by the applicant is for the reader's convenience only. It does not form part of the European patent document. Even though great care has been taken in compiling the references, errors or omissions cannot be excluded and the EPO disclaims all liability in this regard.

Patent documents cited in the description

- CN 202110690203 **[0001]**