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(54) **ARRANGEMENT AND METHOD FOR AIR MANAGEMENT OF A ROOM**

ANORDNUNG UND VERFAHREN ZUR LUFTREGELUNG EINES RAUMES

AGENCEMENT ET PROCÉDÉ POUR LA GESTION D'AIR D'UNE PIÈCE

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(73) Proprietor: **Koninklijke Philips N.V.**
5656 AE Eindhoven (NL)

(72) Inventors:
- **SU, Jing**
  5656 AE Eindhoven (NL)
- **CHEN, Weizhong**
  5656 AE Eindhoven (NL)

(74) Representative: **Freeke, Arnold**
Philips Intellectual Property & Standards
High Tech Campus 5
5656 AE Eindhoven (NL)

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Description

FIELD OF THE INVENTION

[0001] The invention relates to an arrangement and a method for air management of a room.

BACKGROUND OF THE INVENTION

[0002] Indoor air quality is an important issue which is closely related to human health and comfort. Pollution of indoor air constitutes a significant risk factor for various health problems in view of the fact that many people spend most of their time, for example, more than 90% of their time, indoors. In general, air pollutants can be one or more of particle pollutants, gas pollutants and micro-organisms.

[0003] Many buildings are equipped with a so-called HVAC system, i.e. a Heating, Ventilation and Air Conditioning system, for providing thermal comfort and acceptable indoor air quality. However, in some surroundings, particularly metropolitan cities, outdoor air pollution can be extremely severe, and it has been found that in such surroundings, the current HVAC systems are not capable of performing filtration of all particles to a sufficient extent, wherein the systems are particularly not effective in removing relatively small particles from the input air. Furthermore, most HVAC systems are not capable of removing various gas pollutants such as formaldehyde and other VOCs (volatile organic compounds) from the indoor air, because the filters used in those systems are not suitable for doing so. Another shortcoming of HVAC systems is that the systems consume a lot of energy, especially when the systems are continually switched on for maintaining the air quality, which is often the case in practice.

[0004] In the field of managing quality of indoor air, in order to complement the shortcomings of HVAC systems, stand-alone air purifiers have been developed. An example of such an air purifier is known from WO 2012/066453 A1. Stand-alone air purifiers are to be placed inside a room and are very useful to people living in highly polluted cities, as they help a great deal in removing various kinds of pollution from indoor air. Operation of a stand-alone air purifier requires considerably less power than operation of a HVAC system. Also, a stand-alone air purifier is capable of removing both large particles and small particles from the air, due to the fact that the fan which is part of the air purifier and which serves for forcing air to flow through the air purifier is powerful enough to enable the application of a high efficiency filter in the air purifier. Another advantage of the stand-alone air purifier resides in the fact that the air purifier can be used for removing indoor gas pollutants.

[0005] It is generally recommended to keep a room in which a stand-alone air purifier is applied closed, so that it is possible to have good air cleaning efficiency. If a stand-alone air purifier would be operated in an open room, the indoor air would be hard to clean by means of the air purifier as the source strength would be too high. However, operating a stand-alone air purifier in a closed room involves an increase of the carbon dioxide level in the room in case one or more human beings are present in the room. For example, if two human beings are present in a closed room of 50 m^3, carbon dioxide will accumulate in the room and the carbon dioxide level rises up over 1,000 ppm in half an hour. Hence, the carbon dioxide level can become too high in a relatively short period of time, wherein it is no longer possible to comply with national and/or global standards, which are often based on a value of 1,000 ppm as a threshold.

[0006] A stand-alone air purifier is not capable of removing carbon dioxide from air. Therefore, a room in which such an air purifier is present needs to be ventilated, at least from time to time. In general, assuming that the room has windows, ventilation can be realized by opening a window, but this may worsen the indoor air quality if the outdoor quality is very bad. It cannot be left up to a user to determine the right time to open the window and to determine an appropriate duration of the ventilation action.

[0007] It is known from JPH11201511 to provide an air cleaning system comprising a a blower for circulating and filtering air in a room and a ventilator for introducing outside air into the room. The ventilator is activated to introduce outside air into the room when a gas detector detects that the gas level in the room has exceeded a prescribed reference range.

SUMMARY OF THE INVENTION

[0008] It is an object of the invention to alleviate the dilemma of the need of good indoor quality on the one hand and the need of ventilation on the other hand. In view thereof, according to the invention, an arrangement for air management of a room according to claim 1 is provided, which comprises ventilating means for enabling exchange of air between the inside environment of the room and the outside environment of the room; a stand-alone air purifier, which is arranged separately from the ventilating means, and which is adapted to remove pollutants from the air in the inside environment of the room; and a control system, which is in communication with both the ventilating means and the air purifier, and which is adapted to control operation of the ventilating means and the air purifier in dependence of air quality data relating to the inside environment of the room and the outside environment of the room, the control system being configured to control the ventilating means and the air purifier differently depending on whether the air quality data relating to the outside environment of the room is above or below a predetermined reference. Preferably, the control system is adapted to process air quality data relating to both the inside environment of the room and the outside environment of the room.

[0009] In the context of the invention, indications like

"inside environment" and "indoor" should be understood such as to be related to the air which is present inside the room, whereas indications like "outside environment" and "outdoor" should be understood such as to be related to the air which is present outside the room and which can be let in to the room by means of the ventilating means, which in most cases is air from the open air which is present outside the building of which the room is part.

[0010] On the basis of the invention, it is possible to realize optimal operation of an arrangement comprising both ventilating means and a stand-alone air purifier, so that the indoor air quality is continually at the best possible level and energy consumption can be at a minimum. Also, the controlling algorithms underlying the functioning of the control system can be chosen such as to take a predetermined threshold in respect of the carbon dioxide level in the room into account. Thus, the invention provides a way of avoiding a situation in which the carbon dioxide level in the room can become dangerously high as a result of long term operation of the stand-alone air purifier, avoiding a situation in which energy is wasted, and avoiding a situation in which air cleaning only takes place at a low rate.

[0011] As mentioned in the foregoing, the arrangement according to the invention comprises three main components, namely ventilating means, a stand-alone air purifier and a control system. It is practical for the ventilating means to be installed on the wall of the room, or to be fixed on a window or air conditioner as may be present in the room. The ventilating means may comprise a bi-directional fan, a set of fans, wherein one fan serves for discharging air from the room and another fan serves for supplying air to the room, automatically controlled windows or any other mechanical structure which may have a function in exchanging air between the inside environment of the room and the outside environment of the room, for discharging dirty air from the room and introducing fresh air to the room. The main function of the stand-alone air purifier is cleaning dirty indoor air. In particular, the air purifier may be adapted to remove at least one of gas pollutants and particle pollutants from the indoor air. Ideally, the air flow of at least one of the ventilating means and the air purifier can be adjusted.

[0012] The control system provides for communication between the ventilating means and the air purifier, so that the operation of these components of the arrangement according to the invention can be adapted to each other in order to obtain the best possible air cleaning results at minimum power consumption. Control of the ventilating means and the air purifier includes determining when the ventilating means and the air purifier should be switched on and off, and may also include setting a rate of the air flow, for example. In any case, the control system is adapted to use both air quality data relating to at least one of the inside environment of the room and the outside environment of the room. The air quality data may be collected from suitable sensing means and/or a general data source, wherein the latter is especially applicable to air quality data relating to the outside environment of the room. In general, the data may be obtained through a data collector, which may be a sensor situated at any appropriate position inside the room and/or a website data collector. In a practical embodiment of the arrangement according to the invention, a suitable controller may be applied, which is situated on or near the ventilating means, wherein the controller is arranged to receive information from a sensor situated on or near the ventilating means for detecting carbon dioxide, particles or gas pollutants, and also from a data collector which is adapted to collect data from an official website regarding actual outdoor air quality. Communication between the controller and at least one of the ventilating means and the air purifier may take place in a wireless fashion. In any case, a suitable controller is a controller which is adapted to follow certain algorithms which are aimed at realizing operation of the ventilating means and the air purifier in such a way that the indoor air quality is always at its best under the given circumstances and waste of energy is avoided.

[0013] For the sake of completeness, it is noted that it is preferred for the control system to be capable to automatically run a program. However, that does not alter the fact that the invention also covers a situation in which the operation of the control system can be set by a user, i.e. a situation in which the arrangement according to the invention comprises a user interface and in which a user can determine the status of the ventilating means and the air purifier through the user interface, assuming that the user does not take arbitrary action, but takes into account actual aspects of the air quality, indoor and/or outdoor. In this text, the most practical option of having automatic air management of a room is taken as a starting point.

[0014] In the following, various options in respect of the control system will be mentioned and elucidated.

[0015] In the first place, the control system may be adapted to compare air quality data relating to the inside environment of the room to predetermined reference data. For example, the control system may be adapted to compare an actual level of formaldehyde of the indoor air, as can be detected by means of a suitable sensor, to a maximum allowable level. Starting with such comparison and depending on the outcome of the comparison, the control system is capable of determining suitable control of the operation of the ventilating means and the air purifier. In case it is found that the indoor air quality is equal to or better than an acceptable standard, there is no need for operating the ventilating means and the air purifier, so that they can be kept in a switched off mode, whereby energy can be saved. Hence, it is advantageous for the control system to be adapted to set an inactive status of both the ventilating means and the air purifier in case it is found that the air quality of the inside environment of the room is equal to or better than the predetermined reference. In case it is found that the indoor air quality is worse than an acceptable standard,

control of the operation of the ventilating means and the air purifier is aimed at improving the indoor air quality. Hence, it is advantageous for the control system to be adapted to run a program for activating at least one of the ventilating means and the air purifier in case it is found that the air quality of the inside environment of the room is worse than the predetermined reference.

[0016] In case it is found that the air quality of the inside environment of the room is worse than the predetermined reference, it is practical if the control system is furthermore adapted to compare air quality data relating to the outside environment of the room to predetermined reference data. If the outdoor air quality is good enough, it is no problem to operate either one of the ventilating means and the air purifier. However, if the outdoor air quality is bad, an optimum has to be found in respect of two conflicting requirements, namely the requirement to have clean indoor air and the requirement to prevent the carbon dioxide level of the indoor air from rising to an unacceptable value.

[0017] The control system is adapted to alternate an active status of the ventilating means with an active status of the air purifier in case it is found that the air quality of the outside environment of the room is equal to or better than a predetermined reference. There is no need for operating the ventilating means and the air purifier at the same time, so that energy may be saved. When the air purifier is operated, it is achieved that the indoor air quality is improved. When the ventilating means are operated, carbon dioxide which has accumulated in the room during operation of the air purifier can be discharged from the room. After allowing for exchange between indoor air and outdoor air through the ventilating means, the air purifier may be switched on again.

[0018] The alternating operation of the ventilating means and the air purifier can be repeated over and over again. In the process, it is practical to make a comparison between indoor air quality and outdoor air quality in order to determine whether it is best to operate the ventilating means, or to operate the air purifier. Hence, it is advantageous for the control system to be adapted to make a comparison between air quality data relating to the inside environment of the room and air quality data relating to the outside environment of the room, to set an active status of the ventilating means and an inactive status of the air purifier in case it is found that the air quality of the outside environment of the room is better than the air quality of the inside environment of the room, and to set an inactive status of the ventilating means and an active status of the air purifier in case it is found that the air quality of the outside environment of the room is worse than the air quality of the inside environment of the room.

[0019] According to an alternative, the control system may be adapted to run a time counter program for controlling the duration of the operation of the ventilating means and the air purifier, respectively. In that respect, it is advantageous if the arrangement comprises a user interface for enabling a user to supply the control system with information regarding characteristics of the room, wherein the control system is adapted to determine the duration of the operation of the ventilating means and the air purifier, respectively, on the basis of the information. In this way, the duration of the operation of the ventilating means and the air purifier, respectively, can be chosen such as to be optimal in view of the characteristics of the room, which include the size of the room and the number of people present in the room.

[0020] According to another alternative, the arrangement comprises a flow meter for measuring the ventilated air amount, wherein the control system is adapted to stop the operation of the ventilating means as soon as it is found that the ventilated air amount has reached a predetermined reference level. Also in that case, it is advantageous if the arrangement comprises a user interface for enabling a user to supply the control system with information regarding characteristics of the room. The information may then be used by the control system for determining the reference level of the ventilated air amount.

[0021] The above options in respect of the control system are related to the situation in which a comparison of the outdoor air quality and a predetermined reference shows that the outdoor quality is equal to or better than the reference. Preferably, the control system is furthermore adapted to set an inactive status of the ventilating means and an active status of the air purifier in case it is found that the air quality of the outside environment of the room is worse than the predetermined reference. In that way, a situation in which air of bad quality is supplied to the room is avoided, while the air purifier is used for improving the indoor air quality. However, in order to prevent the carbon dioxide level in the room from getting too high, it is advantageous if the arrangement comprises sensing means for sensing the carbon dioxide level in the room, and if the control system is adapted to change the inactive status of the ventilating means to an active status as long as it is found that the carbon dioxide level in the room is higher than a predetermined reference. In that way, the room is ventilated to a minimum extent, just enough for keeping the carbon dioxide level in the room at an acceptable value.

[0022] It is noted that the air quality data relating to the inside environment of the room may comprise at least one of carbon dioxide level data, particles level data and gas pollutants level data, and that the air quality data relating to the outside environment of the room may comprise at least one of particles level data and gas pollutants level data. Other types of air quality data are also feasible in respect of the indoor air quality and/or the outdoor air quality. Air quality data relating to the outside environment of the room may be obtained on the basis of detection, but it is also possible to retrieve such data from a general data source such as the Internet.

[0023] According to an option existing within the framework of the invention, the flow rate of at least one of the ventilating means and the air purifier is adjustable,

wherein the control system is adapted to set the flow rate of the at least one of the ventilating means and the air purifier. Consequently, the way in which the arrangement according to the invention realizes/maintains good indoor air quality can be even further optimized.

[0024] The invention relates to both an arrangement for air management of a room and a method for air management of a room. It follows from the foregoing that the method according to claim 15 can be defined as a method for air management of a room which is equipped with ventilating means for enabling exchange of air between the inside environment of the room and the outside environment of the room, and a stand-alone air purifier, which is arranged separately from the ventilating means, and which is adapted to remove pollutants from the air in the inside environment of the room, wherein operation of the ventilating means and the air purifier are controlled in dependence of air quality data relating to the inside environment of the room and the outside environment of the room, the ventilating means and the air purifier being controlled differently depending on whether air quality data relating to the outside environment of the room is above or below a predetermined reference.

[0025] In conformity with the options as described in the foregoing with respect to the arrangement according to the invention, the following options are applicable to the method according to the invention, wherein it is noted that the options are listed in a logical order which more or less reflects successive control steps:

- the air quality data relating to the inside environment of the room are compared to predetermined reference data;
- an inactive status of both the ventilating means and the air purifier is set in case it is found that the air quality of the inside environment of the room is equal to or better than a predetermined reference;
- a program for activating at least one of the ventilating means and the air purifier is run in case it is found that the air quality of the inside environment of the room is worse than a predetermined reference;
- air quality data relating to the outside environment of the room are compared to predetermined reference data;
- an active status of the ventilating means is alternated with an active status of the air purifier in case it is found that the air quality of the outside environment of the room is equal to or better than a predetermined reference;
- a comparison is made between air quality data relating to the inside environment of the room and air quality data relating to the outside environment of the room, an active status of the ventilating means and an inactive status of the air purifier are set in case it is found that the air quality of the outside environment of the room is better than the air quality of the inside environment of the room, and an inactive status of the ventilating means and an active status of the air purifier are set in case it is found that the air quality of the outside environment of the room is worse than the air quality of the inside environment of the room;
- an inactive status of the ventilating means and an active status of the air purifier are set in case it is found that the air quality of the outside environment of the room is worse than a predetermined reference; and
- sensing means are applied for sensing the carbon dioxide level in the room, and the inactive status of the ventilating means is changed to an active status as long as it is found that the carbon dioxide level in the room is higher than a predetermined reference.

[0026] The following options as mentioned in respect of the arrangement according to the invention are also applicable to the method according to the invention:

- a time counter program is run for controlling the duration of the operation of the ventilating means and the air purifier, respectively;
- the duration of the operation of the ventilating means and the air purifier, respectively, is determined on the basis of information supplied by a user;
- a flow meter is applied for measuring the ventilated air amount, and the operation of the ventilating means is stopped as soon as it is found that the ventilated air amount has reached a predetermined reference level;
- the air quality data relating to the inside environment of the room comprise at least one of carbon dioxide level data, particles level data and gas pollutants level data, and the air quality data relating to the outside environment of the room comprise at least one of particles level data and gas pollutants level data;
- air quality data relating to the outside environment of the room are retrieved from a general data source; and
- assuming that the flow rate of at least one of the ventilating means and the air purifier is adjustable, the flow rate of the at least one of the ventilating means and the air purifier is set.

[0027] The above-described and other aspects of the invention will be apparent from and elucidated with reference to the following detailed description of a room which is equipped with an arrangement for air management of the room, comprising a ventilator, a stand-alone air purifier and a control system, and of various options in respect of control of the operation of the ventilator and the air purifier.

BRIEF DESCRIPTION OF THE DRAWINGS

[0028] The invention will now be explained in greater detail with reference to the figures, in which:

Fig. 1 diagrammatically shows a room which is equipped with an arrangement for air management of the room, comprising a ventilator, a stand-alone air purifier and a control system;

Fig. 2 is a flow chart which is applicable to the way in which the operation of the ventilator and the air purifier is controlled in case the outside air quality is good; and

Fig. 3 is a flow chart which is applicable to the way in which the operation of the ventilator and the air purifier is controlled in case the outside air quality is bad.

DETAILED DESCRIPTION OF EMBODIMENTS

[0029] Fig. 1 diagrammatically shows a room 100 which is equipped with an arrangement 1 for air management of the room 100, comprising a ventilator 10, a stand-alone air purifier 20 and a control system 30. The air purifier 20 is situated at an appropriate position in the room 100, and can easily be replaced by a user to another position in the room 100 if so desired. In the shown example, the ventilator 10 is installed on the wall 101 of the room 100, and is a bi-directional fan for exhausting dirty air from the inside environment 102 of the room 100 to the outside environment 103 of the room 100 and supplying fresh air from the outside environment 103 of the room 100 to the inside environment 102 of the room 100. The exchange of air is diagrammatically depicted by means of a set of two opposite arrows in Fig. 1.

[0030] The air purifier 20 serves for cleaning dirty air in the inside environment 102 of the room 100. Among other things, the air purifier 20 comprises a fan (not shown) for forcing air to be purified to flow through the air purifier 20 during operation thereof. The flow of air to and from the air purifier 20 is diagrammatically depicted by means of bent arrows in Fig. 1. In the shown example, the air purifier 20 is capable of receiving and transmitting data in a wireless fashion, particularly data in respect of operation characteristics. Wireless communication between the air purifier 20 and the control system 30 is diagrammatically depicted by means of a dashed double-headed arrow in Fig. 1.

[0031] The control system 30 is adapted to run a control program which is aimed at having air of the best possible quality in the inside environment 102 of the room 100, in any case having air which meets certain standards. In the shown example, the control system 30 comprises a controller 31 and a data collector 32 which may be a sensor which can provide real-time indoor air quality data and/or software which can download daily outdoor air quality data from an official website. For example, the sensor may be a carbon dioxide sensor, a particles sensor or a gas pollutants sensor. The control program serves for switching the ventilator 10 and the air purifier 20 on and off at appropriate moments, taking into account the air quality data obtained from the data collector 32. The controller 31 and the data collector 32 may be integrated into the ventilator 10 as shown in Fig. 1, but another positioning of the controller 31 and the data collector 32 is also possible, including a positioning on the air purifier 20.

[0032] Figs. 2 and 3 illustrate possible aspects of the control program, wherein Fig. 2 relates to an algorithm which is applicable in case the outdoor air quality is good, and wherein Fig. 3 relates to an algorithm which is applicable in case the outdoor air quality is bad. In short, when the outdoor air quality is good, the ventilator 10 and the air purifier 20 are alternately operated, and when the outdoor air quality is bad, the ventilator 10 and the air purifier 20 are first operated simultaneously for a few minutes, after which only the air purifier 20 is operated for putting the indoor air quality to an acceptable level.

[0033] In the following, various options in respect of the arrangement 1 for air management of the room 100 will be described. It is noted that combinations of the options are possible within the framework of the invention.

[0034] According to a first option, the arrangement 1 is a sensor assisted arrangement. A sensor may be placed at either the ventilator 10, the air purifier 20 or another appropriate position in the room 100 for performing timely measurements of the indoor air quality. The ventilator 10 and the air purifier 20 will be alternately operated according to the sensor data. It is possible to use both a gas sensor and a particle sensor. In the following, by way of example, it will be assumed that the arrangement 1 for air management of the room 100 comprises a formaldehyde sensor and a carbon dioxide sensor.

[0035] The formaldehyde sensor is installed on the air purifier 20. When it is found that the formaldehyde concentration is two/three times higher than a reference value (e.g. a national standard), the air purifier 20 is switched on and the ventilator 10 is kept in an inactive status. After the air purifier 20 has been running for a while, the formaldehyde sensor will collect new data. If it is found that the formaldehyde concentration is lower than the reference value, the air purifier 20 will be put to the inactive status and the ventilator 10 will be put to the active status for about three minutes in order to supply fresh air from the outside environment 103 of the room 100 to the inside environment 102 of the room 100. When it is found that the formaldehyde concentration is much higher than the reference value, for example, four/five times higher, the ventilator 10 is switched on for ten minutes, including five minutes of exhaust of air from the inside environment 102 of the room 100 to the outside environment 103 of the room 100, followed by five minutes of supply of fresh air from the outside environment 103 of the room 100 to the inside environment 102 of the room 100. When the operation of the ventilator 10 is stopped, the sensor data are interpreted and the air purifier 20 is switched on in order to decrease the formaldehyde concentration. After the air purifier 20 has been running for a certain time, for example, half an hour to one hour, the operation of the air purifier 20 is stopped and the ventilator 10 is restarted for ten minutes. The running time of the ventilator 10 and

the air purifier 20 can be adjustable according to both indoor air quality and outdoor air quality.

[0036] The carbon dioxide sensor can be installed on the ventilator 10, and serves for indicating the running time of the ventilator 10 and the air purifier 20. When the carbon dioxide sensor detects that the carbon dioxide level is higher than a predetermined reference value, for example, a value of 1,600 ppm while the air purifier 20 is in the active status, the operation of the air purifier 20 is stopped and the ventilator 10 is put to the active status in order to have air exchange for a few minutes until the carbon dioxide level is at a lower value, for example, a value of 500 ppm. As long as the carbon dioxide level measures in the inside environment 102 of the room 100 is lower than 1,600 ppm while the air purifier 20 is in the active status, the ventilator 10 is kept in the inactive status.

[0037] According to a second option, the arrangement 1 for air management of the room 100 is a big data assisted arrangement. Information about the outdoor air quality can be obtained from an official website by a suitable data collector at any position where the Internet is accessible. In that case, the data collector could be installed on one of the ventilator 10, the air purifier 20 and the control system 30, or at another appropriate position in the room 100. If the outdoor quality is bad, the ventilator 10 will be kept in the inactive status, while the air purifier 20 will be kept in the active status. After the air purifier 20 has been running for a certain time, for example, one hour or two hours, the ventilator 10 will be put to the active state for a few minutes in order to keep the carbon dioxide concentration at the acceptable level. Subsequently, ventilation will be stopped and the air purifier 20 will be kept in the active status. If the outdoor air quality is good, the ventilator 10 will start air exchange without the air purifier 20 being in the active status as well.

[0038] According to a third option, the arrangement 1 for air management of the room 100 is a time counter assisted arrangement, wherein a time counter program is used to control the duration of ventilation and air purification. In particular, the time counter program may be used for setting the time interval of alternating ventilation and air purification. For example, ventilation can be performed during five minutes, each time after air purification has taken place during one hour. A predetermined relation may be used for determining which duration of ventilation and air purification is appropriate for a certain size of the room 100 and a certain amount of people present in the room 100. After the ventilator 10 has been operated during a certain time which is appropriate in view of room size and number of people present in the room 100, the ventilator 10 will be put to the inactive condition and the air purifier 20 will automatically be switched on. After a certain time, the air purifier 20 will be switched off and the ventilator 10 will be switched on again, which is advantageous for bringing the carbon dioxide level in the room 100 down, which has become higher and higher in the meantime due to the presence of people in the room 100 and the room 100 being kept closed.

[0039] According to a fourth option, the arrangement 1 for air management of the room 100 is a flow meter assisted arrangement. A flow meter can be used for measuring the ventilated air amount and for assisting the control system 30 in determining the time interval of alternating the operation of the ventilator 10 and the air purifier 20. After the air purifier 20 has continuously been in the active status for one hour, while the room 100 has been kept closed, the ventilator 10 will be put to the active status in order to reduce the carbon dioxide level to an acceptable value. The flow meter on the ventilator 10 is used for determining when the ventilation can be stopped, while the flow rate is adjustable according to the room size. In general, it will be practical and sufficient to exchange the air in the inside environment 102 of the room 100 with air from the outside environment 103 of the room 100 once per hour.

[0040] It will be clear to a person skilled in the art that the scope of the invention is not limited to the examples discussed in the foregoing, but that several amendments and modifications thereof are possible without deviating from the scope of the invention as defined in the attached claims. While the invention has been illustrated and described in detail in the figures and the description, such illustration and description are to be considered illustrative or exemplary only, and not restrictive. The invention is not limited to the disclosed embodiments.

[0041] Variations to the disclosed embodiments can be understood and effected by a person skilled in the art in practicing the claimed invention, from a study of the figures, the description and the attached claims. In the claims, the word "comprising" does not exclude other steps or elements, and the indefinite article "a" or "an" does not exclude a plurality. The mere fact that certain measures are recited in mutually different dependent claims does not indicate that a combination of these measures cannot be used to advantage. For example, the fact that the flow rate of at least one of the ventilating means and the air purifier may be adjustable, wherein the control system is adapted to set the flow rate of the at least one of the ventilating means and the air purifier, is not only applicable to the main concept of the invention as reflected in claim 1, but may very well be combined with one or more further aspects of the invention. Any reference signs in the claims should not be construed as limiting the scope of the invention.

Claims

1. Arrangement (1) for air management of a room (100), comprising

    - ventilating means (10) for enabling exchange of air between the inside environment (102) of the room (100) and the outside environment (103) of the room (100);

- a stand-alone air purifier (20), which is arranged separately from the ventilating means (10), and which is adapted to remove pollutants from the air in the inside environment (102) of the room (100); and **characterised by** comprising
- a control system (30, 31, 32), which is in communication with both the ventilating means (10) and the air purifier (20), and which is adapted to control operation of the ventilating means (10) and the air purifier (20) in dependence of air quality data relating to the inside environment (102) of the room (100) and the outside environment (103) of the room (100), the control system (30,31,32) being configured to control the ventilating means (10) and the air purifier (20) differently depending on whether the air quality data relating to the outside environment (103) of the room (100) is above or below a predetermined reference.

2. Arrangement (1) according to claim 1, wherein the control system (30, 31, 32) is adapted to compare air quality data relating to the inside environment (102) of the room (100) to predetermined reference data.

3. Arrangement (1) according to claim 2, wherein the control system (30, 31, 32) is adapted to set an inactive status of both the ventilating means (10) and the air purifier (20) in case it is found that the air quality of the inside environment (102) of the room (100) is equal to or better than a predetermined reference.

4. Arrangement (1) according to claim 2, wherein the control system (30, 31, 32) is adapted to run a program for activating at least one of the ventilating means (10) and the air purifier (20) in case it is found that the air quality of the inside environment (102) of the room (100) is worse than a predetermined reference.

5. Arrangement (1) according to claim 4, wherein the control system (30, 31, 32) is adapted to compare air quality data relating to the outside environment (103) of the room (100) to predetermined reference data.

6. Arrangement (1) according to claim 5, wherein the control system (30, 31, 32) is adapted to alternate an active status of the ventilating means (10) with an active status of the air purifier (20) in case it is found that the air quality of the outside environment (103) of the room (100) is equal to or better than a predetermined reference.

7. Arrangement (1) according to claim 6, wherein the control system (30, 31, 32) is adapted to make a comparison between air quality data relating to the inside environment (102) of the room (100) and air quality data relating to the outside environment (103) of the room (100), to set an active status of the ventilating means (10) and an inactive status of the air purifier (20) in case it is found that the air quality of the outside environment (103) of the room (100) is better than the air quality of the inside environment (102) of the room (100), and to set an inactive status of the ventilating means (10) and an active status of the air purifier (20) in case it is found that the air quality of the outside environment (103) of the room (100) is worse than the air quality of the inside environment (102) of the room (100).

8. Arrangement (1) according to claim 6, wherein the control system (30, 31, 32) is adapted to run a time counter program for controlling the duration of the operation of the ventilating means (10) and the air purifier (20), respectively.

9. Arrangement (1) according to claim 8, comprising a user interface for enabling a user to supply the control system (30, 31, 32) with information regarding characteristics of the room (100), wherein the control system (30, 31, 32) is adapted to determine the duration of the operation of the ventilating means (10) and the air purifier (20), respectively, on the basis of the information.

10. Arrangement (1) according to claim 6, comprising a flow meter for measuring the ventilated air amount, wherein the control system (30, 31, 32) is adapted to stop the operation of the ventilating means (10) as soon as it is found that the ventilated air amount has reached a predetermined reference level.

11. Arrangement (1) according to claim 5, wherein the control system (30, 31, 32) is adapted to set an inactive status of the ventilating means (10) and an active status of the air purifier (20) in case it is found that the air quality of the outside environment (103) of the room (100) is worse than said predetermined reference.

12. Arrangement (1) according to claim 11, comprising sensing means (32) for sensing the carbon dioxide level in the room, wherein the control system (30, 31, 32) is adapted to change the inactive status of the ventilating means (10) to an active status as long as it is found that the carbon dioxide level in the room (100) is higher than a predetermined reference.

13. Arrangement (1) according to claim 1, wherein the air quality data relating to the inside environment (102) of the room (100) comprise at least one of carbon dioxide level data, particles level data and gas

pollutants level data, and wherein the air quality data relating to the outside environment (103) of the room (100) comprise at least one of particles level data and gas pollutants level data.

14. Arrangement (1) according to claim 1, wherein the control system (30, 31, 32) is adapted to retrieve air quality data relating to the outside environment (103) of the room (100) from a general data source.

15. Method for air management of a room (100) which is equipped with ventilating means (10) for enabling exchange of air between the inside environment (102) of the room (100) and the outside environment (103) of the room (100), and a stand-alone air purifier (20), which is arranged separately from the ventilating means (10), and which is adapted to remove pollutants from the air in the inside environment (102) of the room (100), **characterised in that** operation of the ventilating means (10) and the air purifier (20) are controlled in dependence of air quality data relating to the inside environment (102) of the room (100) and the outside environment (103) of the room (100), the ventilating means (10) and the air purifier (20) being controlled differently depending on whether air quality data relating to the outside environment of the room is above or below a predetermined reference.

Patentansprüche

1. Anordnung (1) zur Luftregelung eines Raumes (100), umfassend:

- Ventilationsmittel (10), um einen Luftaustausch zwischen der inneren Umgebung (102) des Raumes (100) und der äußeren Umgebung (103) des Raumes (100) zu ermöglichen;
- einen selbstständig arbeitenden Luftreiniger (20), der von den Ventilationsmitteln (10) getrennt angeordnet und so eingerichtet ist, dass er Verunreinigungen aus der Luft in der inneren Umgebung (102) des Raumes (100) entfernt; und

dadurch gekennzeichnet, dass sie umfasst:

- ein Steuersystem (30, 31, 32), das in Kommunikation mit sowohl den Ventilationsmitteln (10) als auch dem Luftreiniger (20) steht und das so eingerichtet ist, dass es den Betrieb der Ventilationsmittel (10) und des Luftreinigers (20) in Abhängigkeit von Luftqualitätsdaten steuert, die auf die innere Umgebung (102) des Raumes (100) und die äußere Umgebung (103) des Raumes (100) bezogen sind, wobei das Steuersystem (30, 31, 32) so konfiguriert ist, dass es die Ventilationsmittel (10) und den Luftreiniger (20), je nachdem, ob die sich auf die äußere Umgebung (103) des Raumes (100) beziehenden Luftqualitätsdaten oberhalb oder unterhalb einer vorgegebenen Empfehlung liegen, unterschiedlich steuert.

2. Anordnung (1) nach Anspruch 1, wobei das Steuersystem (30, 31, 32) so eingerichtet ist, dass es auf die innere Umgebung (102) des Raumes (100) bezogene Luftqualitätsdaten mit vorgegebenen Referenzdaten vergleicht.

3. Anordnung (1) nach Anspruch 2, wobei das Steuersystem (30, 31, 32) so eingerichtet ist, dass es einen inaktiven Status von sowohl den Ventilationsmitteln (10) als auch dem Luftreiniger (20) einstellt, im Falle es sich herausstellt, dass die Luftqualität der inneren Umgebung (102) des Raumes (100) gleich oder besser als eine vorgegebene Empfehlung ist.

4. Anordnung (1) nach Anspruch 2, wobei das Steuersystem (30, 31, 32) so eingerichtet ist, dass es ein Programm zur Aktivierung von zumindest den Ventilationsmitteln (10) oder dem Luftreiniger (20) ausführt, im Falle festgestellt wird, dass die Luftqualität der inneren Umgebung (102) des Raumes (100) schlechter als eine vorgegebene Empfehlung ist.

5. Anordnung (1) nach Anspruch 4, wobei das Steuersystem (30, 31, 32) so eingerichtet ist, dass es auf die äußere Umgebung (103) des Raumes (100) bezogene Luftqualitätsdaten mit vorgegebenen Referenzdaten vergleicht.

6. Anordnung (1) nach Anspruch 5, wobei das Steuersystem (30, 31, 32) so eingerichtet ist, dass es einen aktiven Status der Ventilationsmittel (10) im Wechsel mit einem aktiven Status des Luftreinigers (20) anwendet, im Falle ermittelt wird, dass die Luftqualität der äußeren Umgebung (103) des Raumes (100) gleich oder besser als eine vorgegebene Empfehlung ist.

7. Anordnung (1) nach Anspruch 6, wobei das Steuersystem (30, 31, 32) so eingerichtet ist, dass es einen Vergleich zwischen der auf die innere Umgebung (102) des Raumes (100) bezogenen Luftqualität und der auf die äußere Umgebung (103) des Raumes (100) bezogenen Luftqualität durchführt, um einen aktiven Status der Ventilationsmittel (10) und einen inaktiven Status des Luftreinigers (20) einzustellen, im Falle ermittelt wird, dass die Luftqualität der äußeren Umgebung (103) des Raumes (100) besser als die Luftqualität der inneren Umgebung (102) des Raumes (100) ist, und um einen inaktiven Status der Ventilationsmittel (10) und einen aktiven Status des Luftreinigers (20) einzustellen, im Falle festgestellt

wird, dass die Luftqualität der äußeren Umgebung (103) des Raumes (100) schlechter als die Luftqualität der inneren Umgebung (102) des Raumes (100) ist.

8. Anordnung (1) nach Anspruch 6, wobei das Steuersystem (30, 31, 32) so eingerichtet ist, dass es ein Zeitmessungsprogramm zur Steuerung der Dauer des Betriebs der Ventilationsmittel (10) beziehungsweise des Luftreinigers (20) ausführt.

9. Anordnung (1) nach Anspruch 8, umfassend eine Bedienoberfläche, um einem Benutzer die Möglichkeit zu geben, dem Steuersystem (30, 31, 32) Informationen bezüglich Charakteristiken des Raumes (100) zuzuführen, wobei das Steuersystem (30, 31, 32) so eingerichtet ist, dass es die Dauer des Betriebs der Ventilationsmittel (10) beziehungsweise des Luftreinigers (20) auf der Grundlage der Informationen ermittelt.

10. Anordnung (1) nach Anspruch 6, umfassend einen Strömungsmesser zum Messen der ventilierten Luftmenge, wobei das Steuersystem (30, 31, 32) so eingerichtet ist, dass es den Betrieb der Ventilationsmittel (10) stoppt, sobald ermittelt wird, dass die ventilierte Luftmenge einen vorgegebenen Referenzlevel erreicht hat.

11. Anordnung (1) nach Anspruch 5, wobei das Steuersystem (30, 31, 32) so eingerichtet ist, dass es einen inaktiven Status der Ventilationsmittel (10) und einen aktiven Status des Luftreinigers (20) einstellt, im Falle ermittelt wird, dass die Luftqualität der äußeren Umgebung (103) des Raumes (100) schlechter als die vorgegebene Empfehlung ist.

12. Anordnung (1) nach Anspruch 11, umfassend Abtastmittel (32), um den Kohlendioxidlevel in dem Raum abzutasten, wobei das Steuersystem (30, 31, 32) so eingerichtet ist, dass es den inaktiven Status der Ventilationsmittel (10) in einen aktiven Status ändert, solange ermittelt wird, dass der Kohlendioxidlevel in dem Raum (100) höher als eine vorgegebene Empfehlung ist.

13. Anordnung (1) nach Anspruch 1, wobei die sich auf die innere Umgebung (102) des Raumes (100) beziehenden Luftqualitätsdaten zumindest Kohlendioxidleveldaten, Partikelleveldaten oder Gasverunreinigungsleveldaten umfassen, und wobei die auf die äußere Umgebung (103) des Raumes (100) bezogenen Luftqualitätsdaten zumindest Partikelleveldaten oder Gasverunreinigungsleveldaten umfassen.

14. Anordnung (1) nach Anspruch 1, wobei das Steuersystem (30, 31, 32) so eingerichtet ist, dass es auf die äußere Umgebung (103) des Raumes (100) bezogene Luftqualitätsdaten von einer allgemeinen Datenquelle abruft.

15. Verfahren zur Luftregelung eines Raumes (100), der mit Ventilationsmitteln (10) zum Ermöglichen eines Luftaustauschs zwischen der inneren Umgebung (102) des Raumes (100) und der äußeren Umgebung (103) des Raumes (100) sowie einem selbstständig arbeitenden Luftreiniger (20) ausgestattet ist, der von den Ventilationsmitteln (10) getrennt angeordnet und so eingerichtet ist, dass er Verunreinigungen aus der Luft in der inneren Umgebung (102) des Raumes (100) entfernt,
dadurch gekennzeichnet, dass
der Betrieb der Ventilationsmittel (10) und des Luftreinigers (20) in Abhängigkeit von Luftqualitätsdaten gesteuert wird, die auf die innere Umgebung (102) des Raumes (100) und die äußere Umgebung (103) des Raumes (100) bezogen sind, wobei die Ventilationsmittel (10) und der Luftreiniger (20), je nachdem, ob die sich auf die äußere Umgebung des Raumes beziehenden Luftqualitätsdaten oberhalb oder unterhalb einer vorgegebenen Empfehlung liegen, unterschiedlich gesteuert werden.

Revendications

1. Agencement (1) pour la gestion de l'air d'une pièce (100) comprenant

- des moyens de ventilation (10) pour permettre un échange d'air entre l'environnement interne (102) de la pièce (100) et l'environnement externe (103) de la pièce (100) ;
- un purificateur d'air (20) autonome qui est agencé séparément des moyens de ventilation (10) et qui est à même d'éliminer des polluants de l'air de l'environnement intérieur (102) de la pièce (100) ; et

caractérisé en ce qu'il comprend
un système de commande (30, 31, 32) qui est en communication avec à la fois les moyens de ventilation (10) et le purificateur d'air (20) et qui est à même de commander le fonctionnement des moyens de ventilation (10) et du purificateur d'air (20) en fonction de données de qualité d'air se rapportant à l'environnement interne (102) de la pièce (100) et à l'environnement externe (103) de la pièce (100), le système de commande (30, 31, 32) étant configuré pour commander les moyens de ventilation (10) et le purificateur d'air (20) différemment en fonction du fait que les données de qualité d'air se rapportant à l'environnement externe (103) de la pièce (100) se trouvent au-dessus ou au-dessous d'une référence prédéterminée.

2. Agencement (1) selon la revendication 1, dans lequel le système de commande (30, 31, 32) est à même de comparer les données de qualité d'air se rapportant à l'environnement interne (102) de la pièce (100) à des données de référence prédéterminées.

3. Agencement (1) selon la revendication 2, dans lequel le système de commande (30, 31, 32) est à même de régler un état inactif à la fois des moyens de ventilation (10) et du purificateur d'air (20) dans le cas où l'on constate que la qualité de l'air de l'environnement interne (102) de la pièce (100) est égale ou supérieure à une référence prédéterminée.

4. Agencement (1) selon la revendication 2, dans lequel le système de commande (30, 31, 32) est à même de faire tourner un programme pour activer au moins l'un des moyens de ventilation (10) et du purificateur d'air (20) dans le cas où l'on constate que la qualité de l'air de l'environnement interne (102) de la pièce (100) est moindre qu'une référence prédéterminée.

5. Agencement (1) selon la revendication 4, dans lequel le système de commande (30, 31, 32) est à même de comparer des données de qualité d'air se rapportant à l'environnement externe (103) de la pièce (100) à des données de référence prédéterminées.

6. Agencement (1) selon la revendication 5, dans lequel le système de commande (30, 31, 32) est à même d'alterner un état actif des moyens de ventilation (10) avec un état actif du purificateur d'air (20) dans le cas où l'on constate que la qualité de l'air de l'environnement externe (103) de la pièce (100) est égale ou supérieure à une référence prédéterminée.

7. Agencement (1) selon la revendication 6, dans lequel le système de commande (30, 31, 32) est à même d'établir une comparaison entre des données de qualité d'air se rapportant à l'environnement interne (102) de la pièce (100) et des données de qualité d'air se rapportant à l'environnement externe (103) de la pièce (100), de régler un état actif des moyens de ventilation (10) et un état inactif du purificateur d'air (20) dans le cas où l'on constate que la qualité de l'air de l'environnement externe (103) de la pièce (100) est meilleure que la qualité d'air de l'environnement interne (102) de la pièce (100) et de régler un état inactif des moyens de ventilation (10) et un état actif du purificateur d'air (20) dans le cas où l'on constate que la qualité de l'air de l'environnement externe (103) de la pièce (100) est moindre que la qualité de l'air de l'environnement interne (102) de la pièce (100).

8. Agencement (1) selon la revendication 6, dans lequel le système de commande (30, 31, 32) est à même de faire tourner un programme de minuterie pour commander la durée du fonctionnement des moyens de ventilation (10) et du purificateur d'air (20), respectivement.

9. Agencement (1) selon la revendication 8, comprenant une interface utilisateur pour permettre à un utilisateur d'alimenter le système de commande (30, 31, 32) en informations regardant les caractéristiques de la pièce (100), dans lequel le système de commande (30, 31, 32) est à même de déterminer la durée du fonctionnement des moyens de ventilation (10) et du purificateur d'air (20), respectivement, sur la base des informations.

10. Aménagement (1) selon la revendication 6, comprenant un débitmètre pour mesurer la quantité d'air ventilé, dans lequel le système de commande (30, 31, 32) est à même d'arrêter le fonctionnement des moyens de ventilation (10) aussitôt que l'on constate que la quantité d'air ventilé a atteint un niveau de référence prédéterminé.

11. Agencement (1) selon la revendication 5, dans lequel le système de commande (30, 31, 32) est à même de régler un état inactif des moyens de ventilation (10) et un état actif du purificateur d'air (20) dans le cas où l'on constate que la qualité de l'air de l'environnement externe (103) de la pièce (100) est moindre que celle de ladite référence prédéterminée.

12. Agencement (1) selon la revendication 11, comprenant des moyens de détection (32) pour détecter le niveau de dioxyde de carbone dans la pièce, dans lequel le système de commande (30, 31, 32) est à même de changer l'état inactif des moyens de ventilation (10) en un état actif aussi longtemps que l'on constate que le niveau de dioxyde de carbone dans la pièce (100) est supérieur à une référence prédéterminée.

13. Agencement (1) selon la revendication 1, dans lequel les données de qualité d'air se rapportant à l'environnement interne (102) de la pièce (100) comprennent au moins l'une de données de niveau de dioxyde de carbone, de données de niveau de particules et de données de niveau de gaz polluants et dans lequel les données de qualité d'air se rapportant à l'environnement externe (103) de la pièce (100) comprennent au moins l'une de données de niveau de particules et de données de niveau de gaz polluants.

14. Agencement (1) selon la revendication 1, dans lequel le système de commande (30, 31, 32) est à

même de récupérer des données de qualité d'air se rapportant à l'environnement externe (103) de la pièce (100) à partir d'une source de données générale.

15. Procédé de gestion de l'air d'une pièce (100) qui est équipée de moyens de ventilation (10) pour permettre un échange d'air entre l'environnement interne (102) de la pièce (100) et l'environnement externe (103) de la pièce (100), et un purificateur d'air (20) autonome qui est agencé séparément des moyens de ventilation (10) et qui est à même d'éliminer les polluants de l'air dans l'environnement interne (102) de la pièce (100), **caractérisé en ce que** le fonctionnement des moyens de ventilation (10) et du purificateur d'air (20) est commandé en fonction de données de qualité d'air se rapportant à l'environnement interne (102) de la pièce (100) et de l'environnement externe (103) de la pièce (100), les moyens de ventilation (10) et le purificateur d'air (20) étant commandés différemment en fonction du fait que les données de qualité d'air se rapportant à l'environnement externe de la pièce se situent au-dessus au-dessous d'une référence prédéterminée.

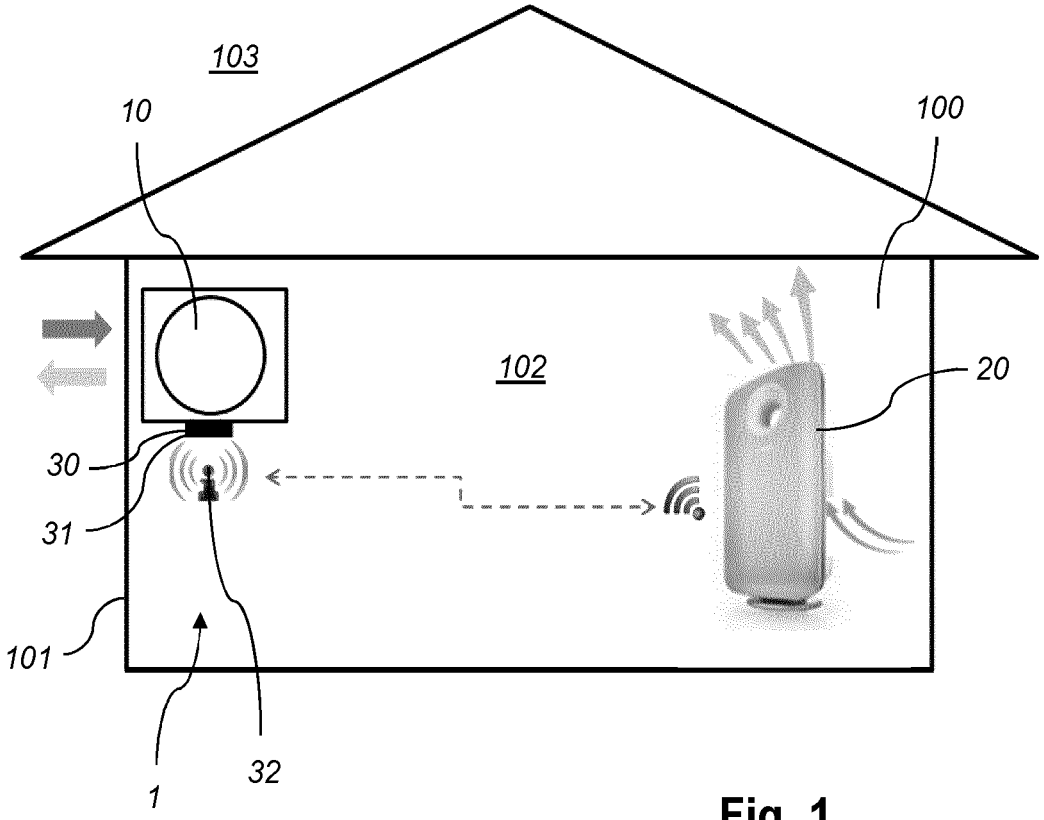

Fig. 1

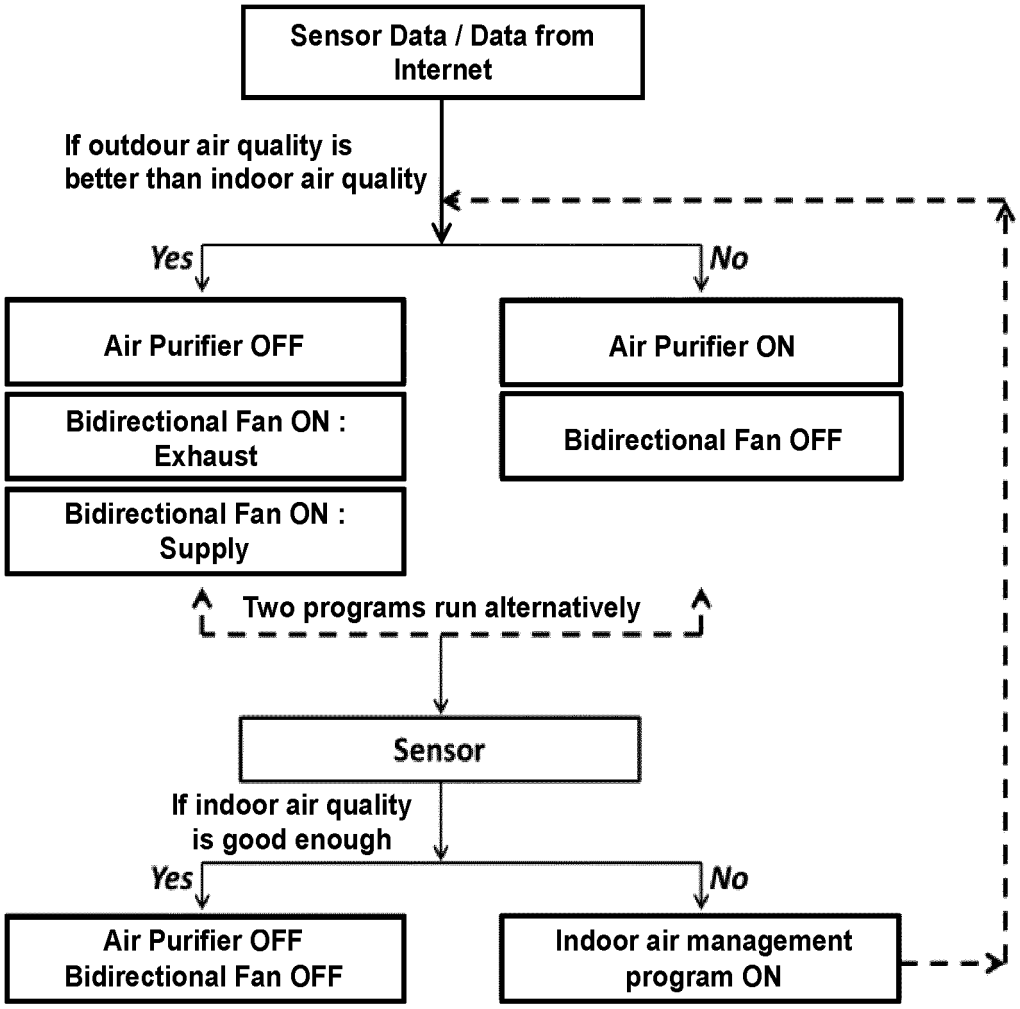
Sensor Data / Data from Internet
If outdour air quality is better than indoor air quality
Yes
No
Air Purifier OFF
Bidirectional Fan ON : Exhaust
Bidirectional Fan ON : Supply
Air Purifier ON
Bidirectional Fan OFF
Two programs run alternatively
Sensor
If indoor air quality is good enough
Yes
No
Air Purifier OFF
Bidirectional Fan OFF
Indoor air management program ON

Fig. 2

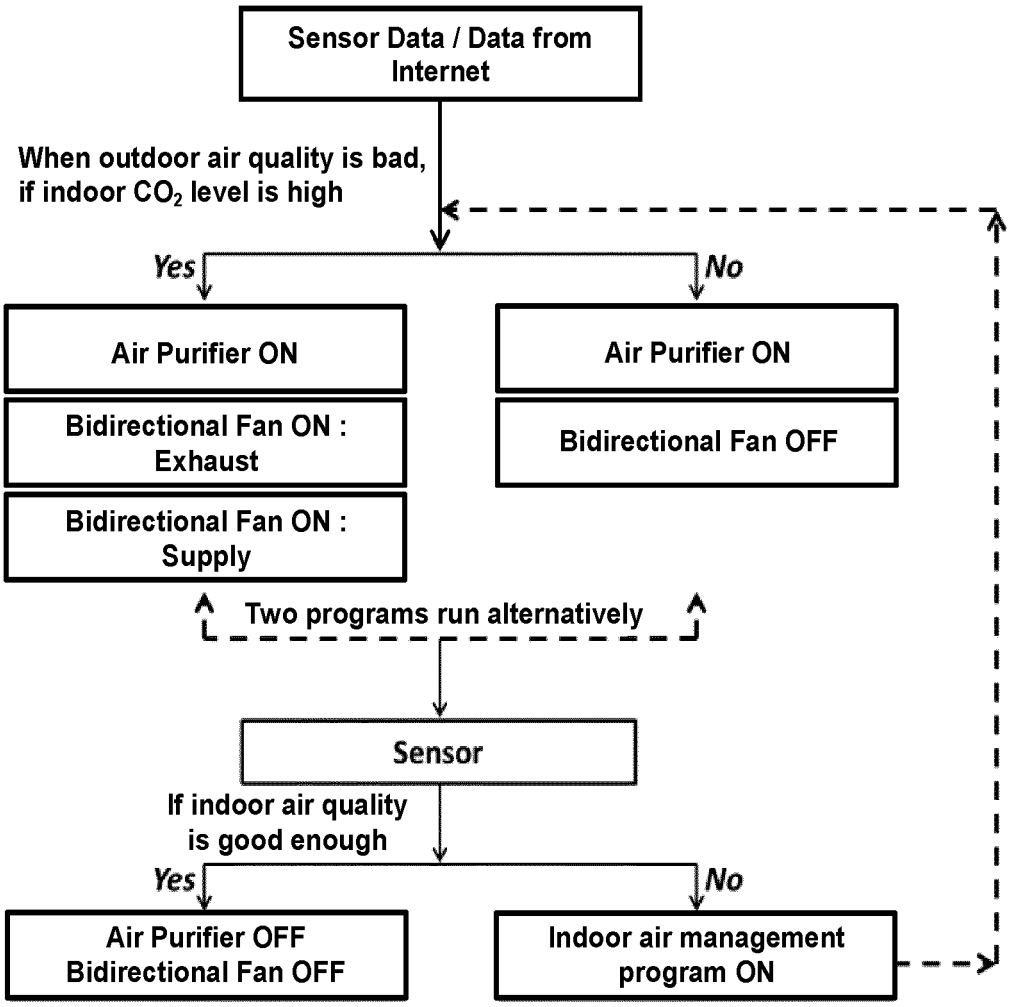
Sensor Data / Data from Internet
When outdoor air quality is bad, if indoor CO_2 level is high
Yes
No
Air Purifier ON
Bidirectional Fan ON : Exhaust
Bidirectional Fan ON : Supply
Air Purifier ON
Bidirectional Fan OFF
Two programs run alternatively
Sensor
If indoor air quality is good enough
Yes
No
Air Purifier OFF
Bidirectional Fan OFF
Indoor air management program ON

Fig. 3

REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

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