

[DESCRIPTION]

[Title of Invention] AIR QUALITY CONTROL SYSTEM, AIR QUALITY CONTROL METHOD, AND PROGRAM

[Technical Field]

5 [0001]

The present disclosure relates to an air quality control system, an air quality control method, and a program in which the air quality control method is used.

[Background Art]

10 [0002]

As a conventional technology of an air quality control system, a technology for improving comfortability of an indoor space has been proposed. For example, Patent Literature (PTL) 1 discloses a built structure management system that includes an air conditioning control support device that includes a processing unit that determines a setting value of air conditioning control of a room to adjust temperature and humidity to predetermined temperature and predetermined humidity, and a building control controller that controls an air conditioning device, based on the determined setting value and the result obtained by a sensor measuring an air environment.

[Citation List]

[Patent Literature]

[0003]

25 [PTL 1] Japanese Patent No. 5848674

[Summary of Invention]

[Technical Problem]

[0004]

Normally, windows and ventilators, for instance, are provided in indoor spaces of a building, for example. In this case, outdoor air flows into an indoor space by a user opening a window and causing a ventilator to operate. If the outdoor air flows in the indoor space through the window or by the operation of the ventilator, for instance, the temperature in the indoor space changes.

[0005]

In this case, a conventional built structure management system according to PTL 1 controls an air conditioner that is an air conditioning device to adjust the temperature and humidity of air in the indoor space to predetermined temperature and predetermined humidity. However, this built structure management system often controls the air conditioner after the temperature and the humidity of air in the indoor space have greatly changed. Accordingly, a comfortable indoor environment may not be provided.

[0006]

Embodiments of the present disclosure provide an air quality control system, an air quality control method, and a program that provide a more comfortable indoor environment than the environment that a conventional technology provides.

[Solution to Problem]

[0007]

An air quality control system according to an aspect of the present disclosure includes: an air conditioner that adjusts temperature and humidity of air in a first indoor space in a building; a first ventilator that supplies outdoor air to the first indoor space and discharges the air in the first indoor space to outside of the first indoor space; a first air cleaner that cleans the outdoor air by removing a pollutant contained in the outdoor air when the first ventilator supplies the outdoor air to the first indoor space; an indoor sensor that detects an environment of the first indoor space; a control device; a second ventilator that discharges air in a second indoor space in the building to outside of the second indoor space, the second indoor space being different from the first indoor space; a second air cleaner that at least deodorizes or disinfects the air in the second indoor space; and a second occupancy sensor that detects a user present in the second indoor space, wherein the first indoor space and the second indoor space are connected, the control device controls the air conditioner and the first ventilator and causes the air conditioner and the first ventilator to cooperate with each other to adjust quality of the air in the first indoor space, based on the environment of the first indoor space that is a result of detection by the indoor sensor, the control device decreases output of the second air cleaner and an air discharge quantity of the second ventilator to adjust quality of the air in the second indoor space by causing the second ventilator and the second air cleaner to cooperate with each other when the control device obtains, from the second occupancy sensor, a result of detection indicating that a user is present in the second indoor space, and the control device further controls the first ventilator and the first air cleaner when the quality of the air in the second indoor space is to be adjusted.

[0008]

An air quality control method according to an aspect of the present disclosure includes: adjusting, by an air conditioner, temperature and humidity of air in a first indoor space in a building; supplying, by a first ventilator, outdoor air to the first indoor space and discharging the air in the first indoor space to outside of the first indoor space; cleaning the outdoor air by removing a pollutant contained in the outdoor air to be supplied to the first indoor space; detecting an environment of the first indoor

space; providing a control device; discharging, by a second ventilator, air in a second indoor space in the building to outside of the second indoor space, the second indoor space being different from the first indoor space; at least deodorizing or disinfecting, by a second air cleaner, the air in the second indoor space; and detecting, by a second occupancy sensor, a user present in the second indoor space, wherein the first indoor space and the second indoor space are connected, the controlling device controls the air conditioner and the first ventilator and causes the air conditioner and the first ventilator to cooperate with each other to adjust quality of the air in the first indoor space, based on the environment of the first indoor space that is a result of detection by the indoor sensor, the control device decreases output of the second air cleaner and an air discharge quantity of the second ventilator to adjust quality of the air in the second indoor space by causing the second ventilator and the second air cleaner to cooperate with each other when the control device obtains, from the second occupancy sensor, a result of detection indicating that a user is present in the second indoor space, the control device further controls the first ventilator and the first air cleaner when the quality of the air in the second indoor space is to be adjusted.

[0009]

A program according to an aspect of the present disclosure is a program for causing a computer to execute the air quality control method.

[Advantageous Effects of Invention]

[0010]

The air quality control system and others according to the embodiments of the present disclosure can provide a more comfortable indoor environment than the environment that a conventional technology provides.

[Brief Description of Drawings]

[0011]

[FIG. 1]

FIG. 1 is a block diagram illustrating an air quality control system according to an embodiment.

[FIG. 2]

FIG. 2 illustrates control commands in the air quality control system according to the embodiment.

[FIG. 3]

FIG. 3 illustrates information indicating an environment of a first indoor space, which is displayed on an operation terminal of the air quality control system according to the embodiment.

[FIG. 4]

FIG. 4 is a flowchart illustrating operation of a first ventilator and an air conditioner according to a concentration of a pollutant contained in air in the first indoor space.

[FIG. 5]

FIG. 5 is a flowchart illustrating operation of the first

ventilator and the air conditioner according to whether a user is present or absent in the first indoor space.

[FIG. 6]

FIG. 6 is a flowchart illustrating operation of the air quality control system according to the embodiment, which is a combination of FIG. 4 and FIG. 5.

[FIG. 7]

FIG. 7 is a flowchart illustrating operation of a second ventilator and a second air cleaner according to temperature and humidity of air in a second indoor space.

[FIG. 8]

FIG. 8 is a flowchart illustrating operation of the second ventilator and the second air cleaner according to whether a user is present or absent in the second indoor space.

[FIG. 9]

FIG. 9 is a flowchart illustrating operation of the air quality control system according to the embodiment, which is a combination of FIG. 7 and FIG. 8.

[Description of Embodiments]

[0012]

The following describes embodiments with reference to the drawings. Note that the embodiments described below each show a general or particular example. The numerical values, shapes, materials, elements, the arrangement and connection of the elements, steps, and the order of processing the steps, for instance, described in the following embodiments are examples, and thus are not intended to limit the present disclosure. Further, among the elements in the following embodiments, elements not recited in any of the independent claims are described as arbitrary elements.

[0013]

Note that the diagrams are schematic diagrams, and do not necessarily provide strict illustration. In the drawings, the same numeral is given to the substantially same configuration, and a redundant description thereof may be omitted or

simplified.

[0014]

The following describes an air quality control system, an air quality control method, and a program in which the air
5 quality control method is used.

[0015]

[Embodiment]

[Configuration: Air quality control system 1]

FIG. 1 is a block diagram illustrating air quality control
10 system 1 according to an embodiment.

[0016]

As illustrated in FIG. 1, air quality control system 1 can
adjust an indoor environment of an indoor environment in
building 10 such as a house. For example, air quality control
15 system 1 controls air conditioner 21 and first ventilator 22, for
instance, that are disposed in each of indoor spaces, to adjust
temperature (Celsius temperature) and humidity (relative
humidity) to predetermined temperature and predetermined
humidity in the indoor space inside building 10. Further, air
20 quality control system 1 controls first ventilator 22, for instance,
disposed in each of the indoor spaces, to adjust a concentration
of a pollutant in the air in the indoor space to a predetermined
concentration or lower. In the present embodiment, air quality
control system 1 is provided in building 10 located in a region in
25 which temperature and humidity are high, such as a region
having a torrid climate, for instance, but may be provided in
building 10 located in a cold region.

[0017]

In the present embodiment, building 10 has a plurality of
30 rooms. Specifically, building 10 has first room 11 that defines
first indoor space 11a, and second room 12 that is different from
first room 11 and defines second indoor space 12a, out of the
rooms that define a plurality of indoor spaces. Air quality
control system 1 adjusts temperature and humidity of first room
35 11 and second room 12, and adjust a concentration of a pollutant

in each room.

[0018]

Air quality control system 1 includes air conditioner 21, first ventilator 22, first air cleaner 23, first air quality sensor 24a included in indoor sensor 24, first occupancy sensor 24b included in indoor sensor 24, second ventilator 31, second air cleaner 32, second air quality sensor 33a, second occupancy sensor 33b, control device 40, operation terminal 50, and outdoor sensor 60.

10 [0019]

<Air conditioner 21>

Air conditioner 21 is disposed on the wall or ceiling, for instance, of first room 11 of building 10, and adjusts temperature and humidity in first indoor space 11a inside first room 11. Air conditioner 21 performs air conditioning control to adjust temperature and humidity in first indoor space 11a to predetermined temperature and predetermined humidity, in response to a control command obtained from control device 40. Note that air conditioner 21 may be able to independently adjust temperature and humidity in first indoor space 11a, according to operation of a user (a person).

[0020]

<First ventilator 22>

First ventilator 22 is a ventilation device disposed on the wall or ceiling of first room 11 in building 10, and has both functions of supplying outdoor air to first indoor space 11a and discharging air in first indoor space 11a to the outdoor space. First ventilator 22 ventilates first indoor space 11a, in response to a control command obtained from control device 40. The term "outdoor" means outside of first room 11, and indicates, for example, a room different from first room 11 and an outdoor area that is outside of building 10. In the present embodiment, first room 11 is a bedroom, and first ventilator 22 is disposed on the wall or ceiling, for instance, of the bedroom.

35 [0021]

In the present embodiment, first ventilator 22 is a heat-exchange ventilation device. The first ventilation device includes an air supply duct that connects an outdoor inlet port to an indoor supply port, an air discharge duct that connects an indoor discharge port to an outdoor discharge port, and a heat-exchange element that exchanges heat between the indoor air and the outdoor air. The heat-exchange element has functions of collecting heat in the indoor air passing through the air discharge duct, and giving the collected heat to the outdoor air passing through the air supply duct.

[0022]

Note that first ventilator 22 is not limited to a heat-exchange ventilation device. Thus, first ventilator 22 may include an air supply fan that supplies outdoor air to first indoor space 11a. In this case, air quality control system 1 may be used in a region other than a region in which temperature and humidity are high. The air in first indoor space 11a may be naturally discharged by the air supply fan supplying outdoor air. Thus, the air supply fan naturally discharges air in first indoor space 11a by supplying outdoor air. Note that first ventilator 22 may further include an air discharge fan that discharges air in first indoor space 11a.

[0023]

<First air cleaner 23>

First air cleaner 23 has a function of cleaning, when first ventilator 22 supplies outdoor air to first indoor space 11a, the outdoor air by removing a pollutant contained in the outdoor air. Here, a pollutant is a substance that causes air pollution in an indoor space, and is at least one of CO₂, particulate matter (PM), volatile organic compounds (VOC), NO_x (nitrogen oxide), SO_x (sulfur oxide), O₃ (ozone), mold, bacteria, deodorization virus, and dust. Note that first air cleaner 23 may have a deodorizing and/or disinfecting function.

[0024]

First air cleaner 23 is disposed on the upstream of the

outdoor inlet port of first ventilator 22, for example. First air cleaner 23 includes an air filter, for example. The air filter is a high efficiency particulate air (HEPA) filter, for example. Note that the air filter may be a different filter as appropriate, depending on a region where air quality control system 1 is disposed.

[0025]

First ventilator 22 supplies and discharges air, so that when outdoor air is supplied to first indoor space 11a via first ventilator 22, first air cleaner 23 removes a pollutant by the air filter filtering the outdoor air. The outdoor air cleaned by first air cleaner 23 removing a pollutant therefrom is supplied to first indoor space 11a through the air supply duct of first ventilator 22.

[0026]

<Indoor sensor 24>

Indoor sensor 24 detects an environment of first indoor space 11a. The environment of first indoor space 11a is a condition with regard to air in first indoor space 11a, which is indicated by temperature, humidity, and a concentration of a pollutant, for instance, in first indoor space 11a. Also, the environment of first indoor space 11a includes whether a user is present or absent in first indoor space 11a.

[0027]

Indoor sensor 24 includes first air quality sensor 24a and first occupancy sensor 24b.

[0028]

<First air quality sensor 24a>

First air quality sensor 24a measures air quality in first indoor space 11a. Here, the air quality is a concentration of a pollutant in the air, and is the concentration(s) of one or more pollutants such as a CO₂ concentration and a PM concentration in the present embodiment.

[0029]

Specifically, first air quality sensor 24a detects a

concentration of a pollutant in the air in first indoor space 11a, and outputs, to control device 40, first information indicating the obtained detection result. The first information that is the detection result includes at least one of a CO₂ concentration, a PM concentration, a VOC concentration, an NO_x concentration, an SO_x concentration, an O₃ concentration, a mold count, a virus amount, and a dust count, for instance. Also, the first information includes temperature and humidity of air in first indoor space 11a. First air quality sensor 24a can communicate with control device 40, and outputs first information to control device 40. First air quality sensor 24a outputs first information to control device 40 every predetermined period.

[0030]

First air quality sensor 24a includes at least one of, for instance, a semiconductor gas sensor that can sense a concentration of a pollutant, a temperature sensor, a humidity sensor, an air current sensor, and an image sensor such as a camera. In the present embodiment, first air quality sensor 24a includes at least one of a PM concentration sensor, a CO₂ concentration sensor, a temperature sensor, and a humidity sensor.

[0031]

<First occupancy sensor 24b>

First occupancy sensor 24b detects a user present in first indoor space 11a. First occupancy sensor 24b can communicate with control device 40, and outputs second information indicating the obtained detection result to control device 40 if first occupancy sensor 24b detects a user present in first indoor space 11a. First occupancy sensor 24b is a microphone, a sonar sensor, an infrared imaging device, an image sensor such as a camera, or a pyroelectric infrared sensor, for instance. Note that first occupancy sensor 24b may estimate a user present in first indoor space 11a, based on a change in a CO₂ concentration detected by first air quality sensor 24a. First occupancy sensor 24b outputs second

information indicating a detection result to control device 40 every predetermined period.

[0032]

<Second ventilator 31>

5 Second ventilator 31 is a ventilation device having a function of discharging air in second indoor space 12a that is different from first indoor space 11a to the outdoor space. Second ventilator 31 discharges air in second indoor space 12a, in response to a control command obtained from control device
10 40. Second ventilator 31 is achieved by a blower (fan), for example. The term "outdoor" means outside of second room 12, and indicates, for example, a room different from second room 12 and an outdoor area that is outside of building 10. In the present embodiment, second room 12 is a bathroom and/or a
15 lavatory, for instance, and second ventilator 31 is disposed on the wall or ceiling, for instance, of the bathroom and/or the lavatory.

[0033]

<Second air cleaner 32>

20 Second air cleaner 32 has a function of cleaning air in second indoor space 12a by deodorizing and/or disinfecting the air (removing a pollutant therefrom). Thus, second air cleaner 32 has a function of decreasing a concentration of a pollutant contained in the air in second indoor space 12a. Second air
25 cleaner 32 cleans air in second indoor space 12a by deodorizing and/or disinfecting the air according to a control command obtained from control device 40.

[0034]

 In the present embodiment, second air cleaner 32
30 deodorizes and/or disinfects air using electrolyzed water that contains, for instance, hypochlorous acid. For example, second air cleaner 32 is a spray device that atomizes and sprays electrolyzed water having a deodorizing effect, a sterilizing effect, and/or a disinfecting effect. Note that second air
35 cleaner 32 may detect mold, bacteria, and virus, for instance,

that are present in second indoor space 12a, and spray the atomized electrolyzed water to a position where mold, bacteria, and virus are detected.

[0035]

5 <Second air quality sensor 33a>

Second air quality sensor 33a measures air quality in second indoor space 12a. In the present embodiment, second air quality sensor 33a measures temperature and humidity in second indoor space 12a.

10 [0036]

Specifically, second air quality sensor 33a detects temperature and humidity of air in second indoor space 12a, and outputs third information indicating the obtained detection result. The third information that indicates a detection result includes temperature and humidity of air in second indoor space 12a, but may further include at least one of a CO₂ concentration, a PM concentration, a VOC concentration, an NO_x concentration, an SO_x concentration, an O₃ concentration, a hypochlorous acid concentration, a mold count, a bacteria count, an amount of virus, and a dust count, for instance.

20 [0037]

Second air quality sensor 33a can communicate with control device 40, and outputs third information that indicates the obtained detection result to control device 40. Second air quality sensor 33a outputs third information to control device 40 every predetermined period.

25 [0038]

Second air quality sensor 33a includes at least one of a temperature sensor and a humidity sensor, for instance. Note that second air quality sensor 33a may further include at least one of a semiconductor gas sensor that can detect a concentration of a pollutant, a PM concentration sensor, a CO₂ concentration sensor, an odor sensor, an air current sensor, and an image sensor, for instance.

35 [0039]

<Second occupancy sensor 33b>

Second occupancy sensor 33b detects a user present in second indoor space 12a. Second occupancy sensor 33b can communicate with control device 40, and if second occupancy
5 sensor 33b detects a user present in second indoor space 12a, outputs fourth information that indicates the obtained detection result to control device 40. Second occupancy sensor 33b is a microphone, a sonar sensor, an infrared imaging device, an image sensor such as a camera, or a pyroelectric infrared sensor,
10 for instance. Note that second occupancy sensor 33b may estimate a user present in second indoor space 12a, based on a change in a CO₂ concentration detected by second air quality sensor 33a. Second occupancy sensor 33b outputs fourth information to control device 40 every predetermined period.

15 [0040]

<Control device 40>

First, air quality control in first indoor space 11a by control device 40 is to be described.

[0041]

20 Control device 40 controls air conditioner 21 and first ventilator 22 and causes air conditioner 21 and first ventilator 22 to cooperate with each other, based on results of detection by indoor sensor 24 (first information and second information).

[0042]

25 Control device 40 includes controller 41, storage 42, and communicator 43.

[0043]

Specifically, controller 41 obtains first information indicating a result of detection by first air quality sensor 24a, via
30 communicator 43. Controller 41 determines whether a concentration of a pollutant indicated by the first information detected by first air quality sensor 24a is higher than or equal to a first concentration. Controller 41 transmits, to each of first ventilator 22 and air conditioner 21 via communicator 43, a
35 control command for increasing an air supply quantity and an air

discharge quantity of first ventilator 22 (hereinafter, referred to as air supply and discharge quantities of first ventilator 22) and also increasing output of air conditioner 21. Thus, control device 40 increases the air supply and discharge quantities of first ventilator 22 and furthermore increases output of air conditioner 21, when the concentration of a pollutant contained in air in first indoor space 11a is higher than or equal to the first concentration. The first concentration and a second concentration are examples of predetermined concentrations.

10 [0044]

For example, controller 41 determines the air supply and discharge quantities of first ventilator 22 and the output of air conditioner 21, according to a concentration of a pollutant contained in the air in first indoor space 11a. Controller 41 may output, to first ventilator 22 and air conditioner 21 via communicator 43, a control command for changing the air supply and discharge quantities of first ventilator 22 and the output of air conditioner 21 to "high" (hereinafter, referred to as a first control command), when the concentration of a pollutant contained in the air in first indoor space 11a is higher than or equal to a second concentration that is higher than the first concentration. Controller 41 may output, to first ventilator 22 and air conditioner 21 via communicator 43, a control command for changing the air supply and discharge quantities of first ventilator 22 and the output of air conditioner 21 to "low" (hereinafter, referred to as a second control command), when the concentration of a pollutant contained in the air in first indoor space 11a is higher than or equal to the first concentration and lower than the second concentration. Note that the above has described changing the air supply and discharge quantities of first ventilator 22 and the output of air conditioner 21 to two levels of "high" and "low", yet they may be set to three or more levels or may be set to one level. Accordingly, a threshold for a concentration may be further provided.

[0045]

Note that controller 41 may output, to first ventilator 22 and air conditioner 21, a control command (hereinafter, referred to as a stop command) for stopping operation of first ventilator 22 and air conditioner 21 via communicator 43, when the concentration of a pollutant contained in the air in first indoor space 11a is lower than the first concentration.

[0046]

Here, details of control commands are to be described with reference to FIG. 2. FIG. 2 illustrates control commands in air quality control system 1 according to the embodiment.

[0047]

As illustrated in FIG. 2, the control commands include information specifying "indoor space", information specifying "devices" that are target devices to be controlled, information indicating a "scene" when a user is present in the indoor space, and information indicating "details of control" for controlling the target devices, for instance, in building 10. Such a control command may be set in advance or may be generated by operation terminal 50.

[0048]

As illustrated in FIG. 1, when control device 40 obtains, from first occupancy sensor 24b, a detection result indicating that a person is present in first indoor space 11a, control device 40 increases the air supply and discharge quantities of first ventilator 22, and furthermore increases the output of air conditioner 21.

[0049]

Specifically, when controller 41 obtains second information from first occupancy sensor 24b via communicator 43, even if the air supply and discharge quantities of first ventilator 22 and the output of air conditioner 21 are set to "low", controller 41 outputs the first control command to each of first ventilator 22 and air conditioner 21 via communicator 43. Furthermore, even if first ventilator 22 and air conditioner 21

are off, controller 41 outputs the first control command or the second control command to each of first ventilator 22 and air conditioner 21 via communicator 43. Controller 41 changes a control command to be output, according to a concentration of a pollutant contained in the air in first indoor space 11a.

[0050]

If a person is present in first indoor space 11a, the air supply and discharge quantities of first ventilator 22 are increased and furthermore, the output of air conditioner 21 is increased.

[0051]

When a person is no longer present in first indoor space 11a (after the person has used the bedroom), or stated differently, when control device 40 does not obtain second information, control device 40 may maintain the quantities and the output at the "high" level if the concentration of a pollutant is higher than or equal to the second concentration. When a person is no longer present in first indoor space 11a, control device 40 may output, to each of first ventilator 22 and air conditioner 21, the second control command if the concentration of a pollutant is higher than or equal to the first concentration and lower than the second concentration. When a person is no longer present in first indoor space 11a, control device 40 may output, to each of first ventilator 22 and air conditioner 21, the stop command if the concentration of a pollutant is lower than the first concentration.

[0052]

If a person is no longer present in first indoor space 11a, the air supply and discharge quantities of first ventilator 22 may be decreased and furthermore, the output of air conditioner 21 may be decreased.

[0053]

Next, air quality control in second indoor space 12a by control device 40 is to be described.

[0054]

Control device 40 controls second ventilator 31 and second air cleaner 32, based on results of detection (third information and fourth information) by second air quality sensor 33a and second occupancy sensor 33b that are indoor sensors.

5 [0055]

Specifically, controller 41 obtains third information indicating a result of detection by second air quality sensor 33a, via communicator 43. Controller 41 determines whether the temperature indicated by the third information detected by second air quality sensor 33a is higher than or equal to a first temperature and the humidity indicated thereby is higher than or equal to first humidity. When the temperature of air in second indoor space 12a is higher than or equal to the first temperature and the humidity is higher than or equal to the first humidity, controller 41 transmits a control command for increasing the air discharge quantity of second ventilator 31 and also increasing the output of second air cleaner 32 to each of second ventilator 31 and second air cleaner 32 via communicator 43. Accordingly, when the temperature of air in second indoor space 12a is higher than or equal to the first temperature and furthermore, the humidity is higher than or equal to the first humidity, control device 40 increases the air discharge quantity of second ventilator 31 and furthermore, increases the output of second air cleaner 32.

25 [0056]

For example, controller 41 determines the air discharge quantity of second ventilator 31 and the output of second air cleaner 32, according to the temperature and the humidity of air in second indoor space 12a. When the temperature of air in second indoor space 12a is higher than or equal to a second temperature that is higher than the first temperature and furthermore, the humidity is higher than or equal to a second humidity that is higher than the first humidity, controller 41 may output, to each of second ventilator 31 and second air cleaner 32 via communicator 43, a control command for changing the air

discharge quantity of second ventilator 31 and the output of second air cleaner 32 to "high" (hereinafter, referred to as a third control command). When the temperature of air in second indoor space 12a is higher than or equal to the first temperature and lower than the second temperature and furthermore, the humidity is higher than or equal to the first humidity and lower than the second humidity, controller 41 may output, to each of second ventilator 31 and second air cleaner 32 via communicator 43, a control command for changing the air discharge quantity of second ventilator 31 and the output of second air cleaner 32 to "low" (hereinafter, referred to as a fourth control command). Note that the above has described changing the air discharge quantity of second ventilator 31 and the output of second air cleaner 32 to two levels of "high" and "low", yet they may be set to three or more levels or may be set to one level. Accordingly, thresholds for temperature and humidity may be further provided.

[0057]

Control device 40 controls second ventilator 31 to cause humidity in second indoor space 12a to be in a range from 0% to 60%, both inclusive. If humidity in second indoor space 12a is maintained in a range from 0% to 60%, both inclusive, mold, for instance, is likely to be prevented from growing.

[0058]

Further, if humidity is low, it is effective in preventing mold, for instance, from growing, but nevertheless, if humidity is excessively low, comfortability for a user may be impaired. In view of this, control device 40 may control second ventilator 31 and second air cleaner 32, according to whether a user is present or absent in second indoor space 12a. Specifically, when a user is present in second indoor space 12a, control device 40 may control humidity in second indoor space 12a to cause the humidity to be in a range from 40% to 60%, both inclusive (a first mode), whereas when no user is present in second indoor space 12a, control device 40 may control humidity

in second indoor space 12a to cause the humidity to be in a range from 0% to 60%, both inclusive (a second mode). Thus, control device 40 can control the air discharge quantity of second ventilator 31 and the output of second air cleaner 32, by
5 switching the control between the first mode and the second mode. Accordingly, this adjusts the environment of (the air quality in) second indoor space 12a.

[0059]

Note that controller 41 may output a stop command to
10 each of second ventilator 31 and second air cleaner 32 via communicator 43, if the temperature of air in second indoor space 12a is lower than or equal to the first temperature.

[0060]

Control device 40 decreases at least the output of second
15 air cleaner 32 when control device 40 obtains, from second occupancy sensor 33b, a detection result indicating that a person is present in second indoor space 12a. Note that the present embodiment describes the case where control device 40 decreases the air discharge quantity of second ventilator 31 and
20 the output of second air cleaner 32 when control device 40 obtains, from second occupancy sensor 33b, a detection result indicating that a person is present in second indoor space 12a.

[0061]

Specifically, when controller 41 obtains fourth information
25 from second occupancy sensor 33b via communicator 43, even if the air discharge quantity of second ventilator 31 and the output of second air cleaner 32 are set to "high", controller 41 outputs the third control command to each of second ventilator 31 and second air cleaner 32 via communicator 43. Furthermore, even
30 if the air discharge quantity of second ventilator 31 and the output of second air cleaner 32 are set to "low", controller 41 outputs the stop command to each of second ventilator 31 and second air cleaner 32 via communicator 43. Control device 40 may change a control command to be output, according to
35 temperature and humidity of air in second indoor space 12a.

[0062]

If a person is present in second indoor space 12a, the air discharge quantity of second ventilator 31 is decreased, and furthermore the output of second air cleaner 32 is decreased.

5 [0063]

When a person is no longer present in second indoor space 12a, or stated differently, when control device 40 does not obtain fourth information, control device 40 may maintain the quantity and the output at the "low" level if the temperature of
10 air in second indoor space 12a is higher than or equal to the first temperature and lower than the second temperature and furthermore, the humidity of the air is higher than or equal to the first humidity and lower than the second humidity. When a person is no longer present in second indoor space 12a, control
15 device 40 may output the third control command to each of second ventilator 31 and second air cleaner 32, if the temperature of air in second indoor space 12a is higher than or equal to the second temperature and furthermore, the humidity of the air is higher than or equal to the second humidity. When
20 a person is no longer present in second indoor space 12a, control device 40 may output the stop command to each of second ventilator 31 and second air cleaner 32, if the temperature of air in second indoor space 12a is lower than the first temperature and furthermore, the humidity of the air in second indoor space
25 12a is lower than the first humidity.

[0064]

When a person is no longer present in second indoor space 12a, the air discharge quantity of second ventilator 31 may be increased and furthermore, the output of second air cleaner 32
30 may be increased.

[0065]

Further, control device 40 controls first ventilator 22 and air conditioner 21, in conjunction with the activation of second ventilator 31.

35 [0066]

For example, control device 40 increases the air supply and discharge quantities of first ventilator 22 and furthermore, increases the output of air conditioner 21, when control device 40 increases the air discharge quantity of second ventilator 31.

5 For example, control device 40 changes the air supply and discharge quantities of first ventilator 22 and the output of air conditioner 21 to "high" or "low", when control device 40 changes the air discharge quantity of second ventilator 31 to "high" or "low". Further, control device 40 turns off first
10 ventilator 22 and air conditioner 21 when control device 40 turns off second ventilator 31.

[0067]

Storage 42 is a storage device that stores a plurality of control commands for adjusting the environment of first indoor
15 space 11a and the environment of second indoor space 12a. In addition, storage 42 stores, for instance, a PM concentration in the past, a CO₂ concentration in the past, and history information of temperature and humidity, for instance (information indicating the environment of first indoor space
20 11a in the past and the environment of second indoor space 12a in the past). Storage 42 is achieved by a semiconductor memory, for instance.

[0068]

Communicator 43 is a communication module that can
25 communicate with air conditioner 21, first ventilator 22, second ventilator 31, and second air cleaner 32 in a wireless or wired manner. Communicator 43 transmits, to operation terminal 50, information indicating the environment of first indoor space 11a and the environment of second indoor space 12a, and receives
30 a control command and transmits the control command.

[0069]

<Operation terminal 50>

Operation terminal 50 is an information terminal that a user owns, and is a mobile terminal such as a smartphone or a
35 tablet terminal, for example. Note that operation terminal 50

may be an information terminal disposed on the wall, for instance, or may be a gateway-integrated type information terminal. Note that single operation terminal 50 may be provided for one building 10 or for each indoor space, and thus
5 the number of operation terminals 50 is not limited. If operation terminal 50 is a type of a terminal that is disposed on the wall, operation terminal 50 may be provided in a single unit that includes first air quality sensor 24a and first occupancy sensor 24b or in a single unit that includes second air quality
10 sensor 33a and second occupancy sensor 33b.

[0070]

Operation terminal 50 selects a control command according to a user by identifying the user, and transmits the selected control command to control device 40. A user is
15 identified by authenticating a user by the user inputting a password, for example. Note that a user may be identified based on, for instance, information of an IC tag that a user has, or information indicating a captured image. In this case, operation terminal 50 may transmit a control command
20 according to the identified user to control device 40 automatically.

[0071]

Operation terminal 50 includes display 51, storage 52, processor 53, operation receiver 54, and communicator 55.

25 [0072]

FIG. 3 illustrates information indicating an environment of first indoor space 11a, which is displayed on operation terminal 50 of air quality control system 1 according to the embodiment. As illustrated in FIG. 3, display 51 displays information
30 indicating environments of first indoor space 11a and second indoor space 12a. In the present embodiment, display 51 displays, for instance, a PM concentration, a CO₂ concentration, temperature, and humidity in first indoor space 11a and outside the building, and temperature and humidity in second indoor
35 space 12a. Display 51 is, for example, a liquid crystal panel or

an organic electroluminescent (EL) panel.

[0073]

As illustrated in FIG. 1, storage 52 is a storage device that stores a plurality of control commands for adjusting the environment of first indoor space 11a and the environment of second indoor space 12a. In addition, storage 52 stores a computer program for generating a control command by receiving an input from a user via operation receiver 54, a PM concentration in the past, a CO₂ concentration in the past, and a history information of temperature and humidity, for instance. Storage 52 is achieved by a semiconductor memory, for instance.

[0074]

When processor 53 obtains information indicating environments of first indoor space 11a and second indoor space 12a, for instance, from control device 40, processor 53 causes display 51 to display the obtained information indicating environments of first indoor space 11a and second indoor space 12a, for instance.

[0075]

When processor 53 receives operation of a user via operation receiver 54, processor 53 reads, from storage 52, a control command for adjusting temperature and humidity of air in first indoor space 11a and second indoor space 12a, for instance, which the user has set in advance, and transmits the control command to control device 40 via communicator 55. Processor 53 may generate a desired control command, in order to adjust environments of first indoor space 11a and second indoor space 12a, for instance, according to an operation received via operation receiver 54.

[0076]

Operation receiver 54 is a touch panel or a hardware key, for instance, and is an input interface that receives operation by a user.

[0077]

Communicator 55 is a communication module that can communicate with control device 40 in a wireless or wired manner. Communicator 55 receives information indicating an environment of first indoor space 11a, and transmits a control
5 command.

[0078]

<Outdoor sensor 60>

Outdoor sensor 60 detects an environment outside building 10, and outputs outdoor environment information
10 indicating the environment outside building 10, as a detection result. Outdoor sensor 60 can communicate with control device 40, and transmits outdoor environment information to control device 40 and operation terminal 50. Outdoor sensor 60 includes at least one of, for instance, a semiconductor gas sensor
15 that can sense a gas concentration, a temperature sensor, and a humidity sensor, which are mentioned above. Note that the outdoor environment information may be obtained from an external server device that manages weather forecast information, for instance, through a wide-area communication
20 network. Note that the outdoor environment information may indicate an air quality index (AQI).

[0079]

[Operation]

Next, operation (processing) of air quality control system
25 1, the air quality control method, and a program in which the air quality control method is used according to the present embodiment is to be described with reference to FIG. 4.

[0080]

FIG. 4 is a flowchart illustrating operation of first
30 ventilator 22 and air conditioner 21 according to a concentration of a pollutant contained in the air in first indoor space 11a. Operation of air quality control system 1 in first indoor space 11a inside first room 11 is to be described with reference to FIG. 4. In FIG. 4, the case is assumed in which the air supply and
35 discharge quantities of first ventilator 22 and the output of air

conditioner 21 can be set to two levels of "high" and "low", as described above. In addition, the state in which first ventilator 22 and air conditioner 21 are off is assumed. Further, pollutants are PM and CO₂.

5 [0081]

First, first air quality sensor 24a measures air quality in first indoor space 11a, as illustrated in FIG. 4. Thus, first air quality sensor 24a detects a concentration of a pollutant in the air in first indoor space 11a (S11), and outputs, to control device
10 40, first information indicating the obtained detection result.
[0082]

Next, when control device 40 obtains first information, controller 41 of control device 40 determines whether the concentration of the pollutant contained in the air in first indoor
15 space 11a, which is indicated by the first information, is higher than or equal to the second concentration (S12). If the concentration of the pollutant is higher than or equal to the second concentration, the concentration of the pollutant in the air in first indoor space 11a is high, which thus indicates that the
20 air is dirty. Accordingly, control device 40 increases the air supply and discharge quantities of first ventilator 22 and furthermore, increases output of air conditioner 21 (S14), when controller 41 determines that the concentration of the pollutant contained in the air in first indoor space 11a is higher than or
25 equal to the second concentration (Yes in S12). Thus, controller 41 outputs the first control command to each of first ventilator 22 and air conditioner 21 via communicator 43.
[0083]

Accordingly, if first ventilator 22 and air conditioner 21
30 that are in the off state obtain the first control command, the air supply and discharge quantities of first ventilator 22 and the output of air conditioner 21 are set to "high". Thereafter, control device 40 ends processing.
[0084]

35 If controller 41 determines that the concentration of the

pollutant in the air in first indoor space 11a is lower than the second concentration (No in S12), controller 41 determines whether the concentration of the pollutant indicated by the first information is higher than or equal to the first concentration
5 (S13). If the concentration of the pollutant in the air in first indoor space 11a is higher than or equal to the first concentration and lower than the second concentration, the concentration of the pollutant in the air in first indoor space 11a is about middle, which thus indicates that the air is slightly dirty.
10 Accordingly, control device 40 increases the air supply and discharge quantities of first ventilator 22 and furthermore, increases the output of air conditioner 21 (S15), when controller 41 determines that the concentration of the pollutant contained in the air in first indoor space 11a is higher than or equal to the
15 first concentration and lower than the second concentration (Yes in S13). Thus, controller 41 outputs the second control command to each of first ventilator 22 and air conditioner 21 via communicator 43.

[0085]

20 If first ventilator 22 and air conditioner 21 that are in the off state obtain the second control command, the air supply and discharge quantities of first ventilator 22 and the output of air conditioner 21 are set to "low". Thereafter, control device 40 ends processing.

25 [0086]

If controller 41 determines that the concentration of the pollutant in the air in first indoor space 11a is lower than the first concentration (No in S13), controller 41 outputs the stop command to each of first ventilator 22 and air conditioner 21 via
30 communicator 43 (S16). This indicates that the concentration of the pollutant in the air in first indoor space 11a is low, which thus indicates that the air is clean. Accordingly, controller 41 turns off first ventilator 22 and air conditioner 21.

[0087]

35 Hence, if first ventilator 22 and air conditioner 21 that are

in the off state obtain the stop command, first ventilator 22 and air conditioner 21 maintain the off state. Note that, as a matter of course, if first ventilator 22 and air conditioner 21 are operating, first ventilator 22 and air conditioner 21 are turned
5 off, upon obtaining the stop command. Thereafter, control device 40 ends processing.

[0088]

Next, operation of air quality control system 1 based on the presence and absence of a user in first indoor space 11a is
10 to be described with reference to FIG. 5.

[0089]

FIG. 5 is a flowchart illustrating operation of first ventilator 22 and air conditioner 21 according to whether a user is present or absent in first indoor space 11a.

15 [0090]

First, as illustrated in FIG. 5, control device 40 determines whether a user is present in first indoor space 11a (S21). Specifically, if first occupancy sensor 24b detects a user present in first indoor space 11a, first occupancy sensor 24b outputs
20 second information indicating the obtained detection result to control device 40. If controller 41 of control device 40 obtains second information, controller 41 determines that a person is present in first indoor space 11a (Yes in S21).

[0091]

25 For example, if first ventilator 22 and air conditioner 21 are in the off state, if the result of the processing is Yes in step S21, control device 40 increases the air supply and discharge quantities of first ventilator 22 and furthermore, increases the output of air conditioner 21 (S22). This is because if a user is
30 present in first indoor space 11a, the CO₂ concentration in first indoor space 11a increases as time elapses due to the user breathing and furthermore, PM is raised due to motion of the user, so that the PM concentration in first indoor space 11a increases. Accordingly, controller 41 needs to discharge air in
35 first indoor space 11a and also obtain air supply from the

outdoor space. Thus, if outdoor air is dirty, the outdoor air needs to be cleaned and supplied. In view of this, first air cleaner 23 is disposed upstream of first ventilator 22, so that the outdoor air cleaned by first air cleaner 23 is supplied to first indoor space 11a.

[0092]

Controller 41 outputs the first control command or the second control command to each of first ventilator 22 and air conditioner 21 via communicator 43. When first ventilator 22 and air conditioner 21 obtain the first control command or the second control command, the air supply and discharge quantities of first ventilator 22 and the output of air conditioner 21 are set to "high" or "low". Thereafter, control device 40 ends processing.

[0093]

If first occupancy sensor 24b does not detect a user present in first indoor space 11a, controller 41 does not obtain second information, and thus determines that no person is present in first indoor space 11a (No in S21).

[0094]

For example, when the air supply and discharge quantities of first ventilator 22 and the output of air conditioner 21 are "high", if the result of step S21 is No, control device 40 decreases the air supply and discharge quantities of first ventilator 22 and furthermore, decreases the output of air conditioner 21 (S23). This is because if no user is present in first indoor space 11a, the CO₂ concentration in first indoor space 11a decreases as time elapses due to the air moving and furthermore, the PM concentration decreases. Accordingly, controller 41 does not greatly need to discharge the air in first indoor space 11a, or does not greatly need to supply air from the outdoor space.

[0095]

For example, controller 41 outputs the second control command or the stop command to each of first ventilator 22 and

air conditioner 21 via communicator 43. If first ventilator 22 and air conditioner 21 obtain the second control command or the stop command, the air supply and discharge quantities of first ventilator 22 and the output of air conditioner 21 are set to "low" or first ventilator 22 and air conditioner 21 are turned off. Thereafter, control device 40 ends processing.

[0096]

Next, operation of air quality control system 1 when processing illustrated in FIG. 4 and processing illustrated in FIG. 5 are combined is to be described with reference to FIG. 6.

[0097]

FIG. 6 is a flowchart illustrating operation of air quality control system 1 according to the embodiment, which is a combination of FIG. 4 and FIG. 5.

[0098]

The processing similar to that in FIG. 4 is given the same numeral, and a description thereof is omitted as appropriate.

[0099]

First, as illustrated in FIG. 6, processing from steps S11 to S13 is performed. If the result of step S13 is Yes, controller 41 of control device 40 determines whether a user is present in first indoor space 11a (S21a). If controller 41 determines that a person is present in first indoor space 11a (Yes in S21a), the processing proceeds to step S14a. Controller 41 outputs the first control command to each of first ventilator 22 and air conditioner 21 via communicator 43. The air supply and discharge quantities of first ventilator 22 and the output of air conditioner 21 are set to "high" (S14a). Thus, the air supply and discharge quantities of first ventilator 22 and the output of air conditioner 21 are to be set to "low", but a user is present in first indoor space 11a, and thus control device 40 increases the air supply and discharge quantities of first ventilator 22 and furthermore, increases the output of air conditioner 21. Thereafter, control device 40 ends processing.

[0100]

If controller 41 determines that no person is present in first indoor space 11a (No in S21a), the processing proceeds to step S15a. Controller 41 outputs the second control command to each of first ventilator 22 and air conditioner 21 via
5 communicator 43. The air supply and discharge quantities of first ventilator 22 and the output of air conditioner 21 are set to "low" (S15a).

[0101]

If the result of step S13 is No, control device 40
10 determines whether a user is present in first indoor space 11a (S21b). If controller 41 determines that a person is present in first indoor space 11a (Yes in S21b), the processing proceeds to step S15a. Thus, first ventilator 22 and air conditioner 21 are to be turned off, but a user is present in first indoor space 11a,
15 and thus control device 40 increases the air supply and discharge quantities of first ventilator 22 and furthermore, increases the output of air conditioner 21.

[0102]

If controller 41 determines that no person is present in
20 first indoor space 11a (No in S21b), the processing proceeds to step S16. Thereafter, control device 40 ends processing.

[0103]

As shown in the processing in FIG. 6, the air supply and discharge quantities of first ventilator 22 and the output of air
25 conditioner 21 are changed not based on whether a user is present in first indoor space 11a, but based on the level of a concentration of a pollutant in the air in first indoor space 11a. Thus, the processing in FIG. 4 may be given priority over the processing in FIG. 5 in first indoor space 11a.

30 [0104]

Next, operation of air quality control system 1 in second indoor space 12a of second room 12 is to be described.

[0105]

FIG. 7 is a flowchart illustrating operation of second
35 ventilator 31 and second air cleaner 32 according to

temperature and humidity of air in second indoor space 12a. In FIG. 7, the case is assumed in which the air discharge quantity of second ventilator 31 and the output of second air cleaner 32 can be set to two levels of "high" and "low", as described above.

5 In addition, the state in which second ventilator 31 and second air cleaner 32 are off is assumed.

[0106]

First, as illustrated in FIG. 7, second air quality sensor 33a measures air quality in second indoor space 12a. Thus, second
10 air quality sensor 33a detects temperature and humidity of air in second indoor space 12a (S41), and outputs third information indicating the obtained detection result to control device 40.

[0107]

Next, when control device 40 obtains third information,
15 controller 41 of control device 40 determines whether the temperature of the air in second indoor space 12a, which is indicated by the third information, is higher than or equal to the second temperature and the humidity of the air is higher than or equal to the second humidity (S42). If the temperature is
20 higher than or equal to the second temperature and furthermore, the humidity is higher than or equal to the second humidity, it indicates that the humidity and temperature of the air in second indoor space 12a are high so that the environment allows mold, bacteria, and virus, for instance, to be readily generated.
25 Accordingly, when controller 41 determines that the temperature of the air in second indoor space 12a is higher than or equal to the second temperature and the humidity is higher than or equal to the second humidity (Yes in S42), control device 40 increases the air discharge quantity of second ventilator 31
30 and furthermore, increases the output of second air cleaner 32 (S44). Thus, controller 41 outputs the third control command to each of second ventilator 31 and second air cleaner 32 via communicator 43.

[0108]

35 Accordingly, when second ventilator 31 and second air

cleaner 32 that are in the off state obtain the third control command, the air discharge quantity of second ventilator 31 and the output of second air cleaner 32 are set to "high".

[0109]

5 Control device 40 performs processing in step S44, and increases at least the air supply quantity of first ventilator 22 and furthermore, increases the output of air conditioner 21 (S45). Thus, controller 41 outputs the first control command to each of first ventilator 22 and air conditioner 21 via
10 communicator 43. The air supply quantity of first ventilator 22 and the output of air conditioner 21 are set to "high".

[0110]

 This is because if the air in second indoor space 12a is discharged, air needs to be taken in from the outside of second
15 indoor space 12a, and thus air is supplied by increasing the air supply quantity of first ventilator 22 in first indoor space 11a (by activating first ventilator 22 in the present embodiment). At this time, the temperature of air in first indoor space 11a increases, and thus the output of air conditioner 21 is increased
20 (air conditioner 21 is activated in the present embodiment). Thus, the temperature of the air in first indoor space 11a is maintained. Thereafter, control device 40 ends processing.

[0111]

 If controller 41 determines that the temperature of air in
25 second indoor space 12a is lower than the second temperature and the humidity of the air is lower than the second humidity (No in S42), controller 41 determines whether the temperature indicated by the third information is higher than or equal to the first temperature and furthermore, the humidity indicated
30 thereby is higher than or equal to the first humidity (S43). If the temperature of air in second indoor space 12a is higher than or equal to the first temperature and lower than the second temperature, and furthermore the humidity of the air is higher than or equal to the first humidity and lower than the second
35 humidity, the temperature and the humidity of the air in second

indoor space 12a are about middle, and thus it indicates that second indoor space 12a has an environment in which mold, bacteria, and virus, for instance, slightly tend to be generated. Accordingly, when controller 41 determines that the
5 temperature of air in second indoor space 12a is higher than or equal to the first temperature and lower than the second temperature and furthermore, the humidity is higher than or equal to the first humidity and lower than the second humidity (Yes in S43), control device 40 increases the air discharge
10 quantity of second ventilator 31 and furthermore, increases the output of second air cleaner 32 (S46). Thus, controller 41 outputs the fourth control command to each of second ventilator 31 and second air cleaner 32 via communicator 43.

[0112]

15 Accordingly, when second ventilator 31 and second air cleaner 32 that are in the off state obtain the fourth control command, the air discharge quantity of second ventilator 31 and the output of second air cleaner 32 are set to "low".

[0113]

20 Control device 40 performs processing in step S46, and increases at least the air supply quantity of first ventilator 22 and furthermore, increases the output of air conditioner 21 (S47). Thus, controller 41 outputs the second control command to each of first ventilator 22 and air conditioner 21 via
25 communicator 43. The air supply quantity of first ventilator 22 and the output of air conditioner 21 are set to "low".

[0114]

In this case also, air is supplied by increasing the air supply quantity of first ventilator 22 in first indoor space 11a (by
30 activating first ventilator 22 in the present embodiment). At this time, the temperature of air in first indoor space 11a increases, and thus the output of air conditioner 21 is increased (air conditioner 21 is activated in the present embodiment). Thus, the temperature of air in first indoor space 11a is
35 maintained. Thereafter, control device 40 ends processing.

[0115]

If controller 41 determines that the temperature of air in second indoor space 12a is lower than the first temperature and the humidity of the air is lower than the first humidity (No in 5 S43), controller 41 outputs the stop command to each of second ventilator 31 and second air cleaner 32 via communicator 43 (S48). This indicates that second indoor space 12a has an environment in which mold, bacteria, and virus, for instance, are not readily generated, due to the temperature and the 10 humidity of the air in second indoor space 12a being excessively high or low, and thus second ventilator 31 and second air cleaner 32 are turned off.

[0116]

When second ventilator 31 and second air cleaner 32 that 15 are in the off state obtain the stop command, second ventilator 31 and second air cleaner 32 maintain the off state. Note that, as a matter of course, if second ventilator 31 and second air cleaner 32 are operating, second ventilator 31 and second air cleaner 32 are turned off. Thereafter, control device 40 ends 20 processing.

[0117]

Next, operation of air quality control system 1 based on the presence and absence of a user in second indoor space 12a is to be described with reference to FIG. 8.

25 [0118]

FIG. 8 is a flowchart illustrating operation of second ventilator 31 and second air cleaner 32 according to whether a user is present or absent in second indoor space 12a.

[0119]

30 First, as illustrated in FIG. 8, control device 40 determines whether a user is present in second indoor space 12a (S51). Specifically, if second occupancy sensor 33b detects a user present in second indoor space 12a, second occupancy sensor 33b outputs fourth information indicating the obtained detection 35 result to control device 40. If controller 41 of control device 40

obtains the fourth information, controller 41 determines that a person is present in second indoor space 12a (Yes in S51).

[0120]

For example, when the air discharge quantity of second ventilator 31 and the output of second air cleaner 32 are "high",
5 if the result of the processing is Yes in step S51, control device 40 decreases the air discharge quantity of second ventilator 31 and furthermore, decreases the output of second air cleaner 32 (S52). This is because a user may breathe in electrolyzed
10 water having deodorizing, sterilizing, and/or disinfecting effects if the user is present in second indoor space 12a, and thus processing in step S52 is performed.

[0121]

Controller 41 outputs the fourth control command or the
15 stop command to each of second ventilator 31 and second air cleaner 32 via communicator 43. If second ventilator 31 and second air cleaner 32 obtain the fourth control command or the stop command, the air discharge quantity of second ventilator 31 and the output of second air cleaner 32 are set to "low" or
20 second ventilator 31 and second air cleaner 32 are turned off. Thereafter, control device 40 ends processing.

[0122]

If second occupancy sensor 33b does not detect a user present in second indoor space 12a, controller 41 does not
25 obtain fourth information, and thus determines that no person is present in second indoor space 12a (No in S51).

[0123]

For example, when second ventilator 31 and second air cleaner 32 are off, if the result of the processing is No in step
30 S51, control device 40 increases the air discharge quantity of second ventilator 31 and furthermore, increases the output of second air cleaner 32 (S53). This is because any user will not breathe in electrolyzed water having deodorizing, sterilizing, and/or disinfecting effects if no user is present in second indoor
35 space 12a, and thus processing in step S53 is performed.

[0124]

For example, controller 41 outputs the fourth control command or the third control command to each of second ventilator 31 and second air cleaner 32 via communicator 43.

5 When first ventilator 22 and air conditioner 21 obtain the second control command or the first control command, the air supply and discharge quantities of first ventilator 22 and the output of air conditioner 21 are set to "low" or "high". Thereafter, control device 40 ends processing.

10 [0125]

Next, operation of air quality control system 1 when processing illustrated in FIG. 7 and processing illustrated in FIG. 8 are combined is to be described.

[0126]

15 FIG. 9 is a flowchart illustrating operation of air quality control system 1 according to the embodiment, which is a combination of FIG. 7 and FIG. 8.

[0127]

The processing similar to that in FIG. 7 is given the same numeral, and a description thereof is omitted as appropriate.

[0128]

First, as illustrated in FIG. 9, processing from steps S41 to S42 is performed. If the result of step S42 is Yes, control device 40 determines whether a user is present in second indoor space 12a (S51a). If controller 41 of control device 40 determines that no person is present in second indoor space 12a (No in S51a), the processing proceeds to step S44a.

[0129]

Controller 41 outputs the third control command to each of second ventilator 31 and second air cleaner 32 via communicator 43 (S44a). Then, the air discharge quantity of second ventilator 31 and the output of second air cleaner 32 are set to "high".

[0130]

35 Thus, controller 41 outputs the first control command to

each of first ventilator 22 and air conditioner 21 via communicator 43 (S45a). Then, the air supply quantity of first ventilator 22 and the output of air conditioner 21 are set to "high". Thereafter, control device 40 ends processing.

5 [0131]

If controller 41 determines that a person is present in second indoor space 12a (Yes in S51a), the processing proceeds to step S46a.

[0132]

10 Controller 41 outputs the fourth control command to each of second ventilator 31 and second air cleaner 32 via communicator 43 (S46a). Then, the air discharge quantity of second ventilator 31 and the output of second air cleaner 32 are set to "low". Thus, the air discharge quantity of second
15 ventilator 31 and the output of second air cleaner 32 are to be set to "high", but a user is present in second indoor space 12a, and thus control device 40 decreases the air discharge quantity of second ventilator 31 and furthermore, decreases the output of second air cleaner 32.

20 [0133]

Thus, controller 41 outputs the second control command to each of first ventilator 22 and air conditioner 21 via communicator 43 (S47a). Then, the air supply quantity of first ventilator 22 and the output of air conditioner 21 are set to "low".
25 Thereafter, control device 40 ends processing.

[0134]

If the result of step S42 is No and the result of step S43 is Yes, control device 40 determines whether a user is present in second indoor space 12a (S51b). If controller 41 determines
30 that no person is present in second indoor space 12a (No in S51b), the processing proceeds to step S46a.

[0135]

If controller 41 determines that a person is present in second indoor space 12a (Yes in S51b), the processing proceeds
35 to step S48. Thus, the air discharge quantity of second

ventilator 31 and the output of second air cleaner 32 are to be set to "low", but a user is present in second indoor space 12a, and thus control device 40 decreases the air discharge quantity of second ventilator 31 and furthermore, decreases the output of second air cleaner 32. Accordingly, second ventilator 31 and second air cleaner 32 are turned off. Thereafter, control device 40 ends processing.

[0136]

As shown in the processing in FIG. 9, the air discharge quantity of second ventilator 31 and the output of second air cleaner 32 are changed not based on the highness of temperature and humidity of air in second indoor space 12a, but based on whether a user is present in second indoor space 12a. Thus, the processing in FIG. 8 may be given priority over the processing in FIG. 7 in second indoor space 12a.

[0137]

[Operations and effects]

Next, operations and effects yielded by air quality control system 1, the air quality control method, and the program according to the present embodiment are to be described.

[0138]

As described above, air quality control system 1 according to the present embodiment includes: air conditioner 21 that adjusts temperature and humidity of air in first indoor space 11a in building 10; first ventilator 22 that supplies outdoor air to first indoor space 11a and discharges the air in first indoor space 11a to outside of first indoor space 11a; first air cleaner 23 that cleans the outdoor air by removing a pollutant contained in the outdoor air when first ventilator 22 supplies the outdoor air to first indoor space 11a; indoor sensor 24 that detects an environment of first indoor space 11a; and control device 40 that controls air conditioner 21 and first ventilator 22, based on a result of detection by indoor sensor 24.

[0139]

According to this, control device 40 activates first

ventilator 22 to remove a pollutant contained in air in first indoor space 11a, so that air in first indoor space 11a is discharged to the outside of first indoor space 11a and the outdoor air is supplied to the indoor space. At this time, temperature and humidity of air in first indoor space 11a are to be changed. However, control device 40 activates also air conditioner 21 so as not to change (so as not to allow a great change in) temperature and humidity of air in first indoor space 11a, based on the result of detection by indoor sensor 24. Accordingly, the temperature and humidity of air in first indoor space 11a can be prevented from changing.

[0140]

For example, if a conventional air quality control system is used in a region where the air outside a building contains a lot of pollutants, when the first ventilator is activated, the outdoor air that contains a lot of pollutants will be supplied to the indoor space.

[0141]

However, according to air quality control system 1 according to the present embodiment, air is cleaned by first air cleaner 23 removing pollutants contained in outdoor air when the outdoor air is supplied to first indoor space 11a. Accordingly, even if first ventilator 22 is activated, cleaned outdoor air can be supplied to first indoor space 11a. Thus, pollutants contained in the air in first indoor space 11a can be efficiently discharged, and also pollutants are less likely to be supplied to first indoor space 11a when the outdoor air is supplied.

[0142]

Thus, air quality control system 1 can provide a more comfortable indoor environment than the environment that a conventional technology provides.

[0143]

An air quality control method according to the present embodiment includes: adjusting, by air conditioner 21,

temperature and humidity of air in first indoor space 11a in building 10; supplying, by first ventilator 22, outdoor air to first indoor space 11a and discharging the air in first indoor space 11a to outside of first indoor space 11a; cleaning the outdoor air by removing a pollutant contained in the outdoor air to be supplied to first indoor space 11a; detecting an environment of first indoor space 11a; and controlling air conditioner 21 and first ventilator 22, based on a result of detecting the environment of first indoor space 11a.

10 [0144]

This method achieves similar operations and effects to those as described above.

[0145]

A program according to the present embodiment causes a computer to execute the air quality control method.

[0146]

This program can achieve similar operations and effects to those as described above.

[0147]

20 In air quality control system 1 according to the present embodiment, indoor sensor 24 includes an air quality sensor that detects a concentration of the pollutant contained in the air in first indoor space 11a. When a result of detection by the air quality sensor indicates that the concentration of the pollutant contained in the air in first indoor space 11a is higher than or equal to a predetermined concentration, control device 40 increases an air supply quantity and an air discharge quantity of first ventilator 22 and increases output of air conditioner 21.

[0148]

30 According to this, if the concentration of a pollutant in air in first indoor space 11a increases, first ventilator 22 supplies cleaned outdoor air to first indoor space 11a, and discharges the pollutant contained in the air in first indoor space 11a. Thus, the concentration of a pollutant in the air in first indoor space 11a can be decreased. In addition, even if air is supplied and

discharged by first ventilator 22, air conditioner 21 is activated, and thus temperature and humidity of air in first indoor space 11a are less likely to change. As a result, the air in first indoor space 11a is cleaned, and thus air quality control system 1 can provide a further comfortable indoor environment.

[0149]

In air quality control system 1 according to the present embodiment, indoor sensor 24 includes first occupancy sensor 24b that detects a user present in first indoor space 11a. When control device 40 obtains, from first occupancy sensor 24b, a result of detection indicating that a user is present in first indoor space 11a, control device 40 increases an air supply quantity and an air discharge quantity of first ventilator 22 and increases output of air conditioner 21.

[0150]

For example, if a user is present in the first indoor space, the CO₂ concentration in the first indoor space increases as time elapses due to the user breathing, and furthermore, PM is raised due to motion of the user, so that the PM concentration in the air in the first indoor space increases.

[0151]

In view of this, in the present embodiment, control device 40 increases the air supply quantity and the air discharge quantity of first ventilator 22 and furthermore, increases the output of air conditioner 21, when a user is present in first indoor space 11a. Accordingly, the air in first indoor space 11a is cleaned and furthermore, temperature and humidity of air in first indoor space 11a are maintained. Thus, air quality control system 1 can provide a further comfortable indoor environment.

[0152]

Air quality control system 1 according to the present embodiment includes: second ventilator 31 that discharges air in second indoor space 12a in building 10 to outside of second indoor space 12a, second indoor space 12a being different from first indoor space 11a; second air cleaner 32 that at least

deodorizes or disinfects the air in second indoor space 12a; and second occupancy sensor 33b that detects a user present in second indoor space 12a. Control device 40 decreases at least output of second air cleaner 32 when control device 40 obtains, 5 from second occupancy sensor 33b, a result of detection indicating that a user is present in second indoor space 12a. [0153]

According to this, if a user is present in second indoor space 12a, the output of second air cleaner 32 is decreased, so 10 that the influence on a user due to deodorization and disinfection of air in second indoor space 12a can be reduced. [0154]

In air quality control system 1 according to the present embodiment, when control device 40 increases an air discharge 15 quantity of second ventilator 31, control device 40 increases an air supply quantity and an air discharge quantity of first ventilator 22 and increases output of air conditioner 21. [0155]

Normally, if building 10 has first indoor space 11a and 20 second indoor space 12a, first indoor space 11a and second indoor space 12a are connected. Thus, if second ventilator 31 discharges air in second indoor space 12a, control device 40 activates, in order to more efficiently discharge air in second indoor space 12a, first ventilator 22 disposed in first indoor 25 space 11a, to supply cleaned outdoor air. Accordingly, the cleaned outdoor air is supplied from first indoor space 11a to second indoor space 12a. [0156]

Since temperature and humidity of air in first indoor space 30 11a are to change along with the activation of first ventilator 22, control device 40 controls output of air conditioner 21 so that temperature and humidity of air in first indoor space 11a are not to change. [0157]

35 Accordingly, air quality control system 1 can provide a

further comfortable indoor environment.

[0158]

In air quality control system 1 according to the present embodiment, control device 40 controls second ventilator 31 to
5 cause humidity in second indoor space 12a to be in a range from 0% to 60%, both inclusive.

[0159]

According to this, mold, for instance, is not readily generated in second indoor space 12a, and thus a further
10 comfortable indoor environment can be provided to a user.

[0160]

In air quality control system 1 according to the present embodiment, the pollutant is at least one of CO₂ and particulate matter (PM).

15 [0161]

According to this, air quality control system 1 can remove such pollutants from first indoor space 11a and second indoor space 12a.

[0162]

20 Air quality control system 1 according to the present embodiment includes: operation terminal 50 wirelessly communicable with control device 40. Operation terminal 50 includes display 51 that displays at least information indicating an environment of first indoor space 11a.

25 [0163]

According to this, display 51 of operation terminal 50 displays at least information indicating an environment of first indoor space 11a, and thus a user can properly recognize at least the environment of first indoor space 11a.

30 [0164]

In air quality control system 1 according to the present embodiment, operation terminal 50: includes storage 52 that stores one or more control commands for causing control device 40 to perform control and adjusting the environment of first
35 indoor space 11a. Operation terminal 50 selects a control

command according to a user from among the one or more control commands by identifying the user; and transmits the control command selected to control device 40.

[0165]

5 According to this, if a control command that suits a preference of a user is stored in storage 52, the environment of first indoor space 11a can be adjusted to a desired environment by selecting such a control command that suits the preference of the user.

10 [0166]

 In air quality control system 1 according to the present embodiment, first ventilator 22 is a heat-exchange ventilator.

[0167]

 According to this, when air in first indoor space 11a is
15 discharged and outdoor air is supplied, heat of air to be discharged can be collected, and the collected heat can be given to air to be supplied. Accordingly, air quality control system 1 achieves high energy efficiency.

[0168]

20 In air quality control system 1 according to the present embodiment, building 10 is located in a region in which temperature and humidity are high.

[0169]

 According to this, even if temperature and humidity of air
25 in first indoor space 11a are to increase due to the operation of first ventilator 22, air conditioner 21 is activated to decrease the temperature and humidity of air in first indoor space 11a, and thus the environments of first indoor space 11a and second indoor space 12a can be made comfortable even in a region in
30 which temperature and humidity are high.

[0170]

[Other Embodiments]

 The above has described the present disclosure based on the embodiments, yet the present disclosure is not limited to the
35 above embodiments.

[0171]

For example, in the air quality control system according to the above embodiments, the air conditioner, the first ventilator, the first air cleaner, the first air quality sensor, the first
5 occupancy sensor, the second ventilator, the second air cleaner, the second air quality sensor, the second occupancy sensor, and the control device may each include a power supply for supplying power. The power supply may be a battery such as an electric cell or a power supply circuit that converts power supplied from a
10 commercial power supply.

[0172]

Further, in the air quality control system according to the above embodiments, the control device may be provided in any of the air conditioner, the first ventilator, the first air cleaner,
15 the first air quality sensor, the first occupancy sensor, the second ventilator, the second air cleaner, the second air quality sensor, the second occupancy sensor, and the operation terminal, or may be another independent device.

[0173]

20 In the air quality control system, the air quality control method, and the program according to the embodiments, a plurality of first air quality sensors may be disposed in the first indoor space. If a plurality of first air quality sensors are disposed in the first indoor space, the first air quality sensors or
25 the control device may have a function of predicting a distribution of air quality in the first indoor space (a distribution of the above-mentioned CO₂ concentration, for instance, indicated by first information). Furthermore, a plurality of second air quality sensors may be disposed in the second indoor
30 space. If a plurality of second air quality sensors are disposed in the second indoor space, the second air quality sensors or the control device may have a function of predicting a distribution of air quality in the second indoor space (a distribution of the above-mentioned humidity, for instance, indicated by the second
35 information).

[0174]

Furthermore, in the air quality control system, the air quality control method, and the program according to the above embodiments, if the first indoor space has a space in which water is used, presence and absence of a user may be estimated based on a change in humidity, for instance, indicated by first information, or whether water is being used may be estimated based thereon. In this manner, the first occupancy sensor can estimate presence of a user, based on the first information that indicates air quality of the first indoor space. Note that the control device may estimate presence of a user, instead of the first occupancy sensor.

[0175]

In the air quality control system, the air quality control method, and the program according to the above embodiments, the first occupancy sensor, the second occupancy sensor, or the control device may learn the life rhythm of a user based on the presence and absence of the user in an indoor space. Further, the control device may have a function of automatically controlling the air quality in an indoor space, according to the life of a user.

[0176]

Further, the air quality control system, the air quality control method, and the program according to the above embodiments are typically achieved as large scale integrated circuits (LSIs). These may be each achieved as a single chip or some or all of these may be achieved as a single chip.

[0177]

Furthermore, the way to achieve integration is not limited to LSIs, and implementation through a dedicated circuit or a general-purpose processor is also possible. A field programmable gate array (FPGA) that can be programmed after manufacturing an LSI or a reconfigurable processor that allows re-configuration of the connection and configuration of circuit cells inside an LSI may be used.

[0178]

Note that in the above embodiments, each of the elements may be configured of dedicated hardware, or may be implemented by executing a software program suitable for the element. Each element may be implemented by a program executor such as a central processing unit (CPU) or a processor reading and executing a software program recorded on a recording medium such as a hard disk or semiconductor memory.

10 [0179]

The numerals used above are all examples in order to specifically describe the present disclosure, and thus the embodiments of the present disclosure are not limited to the exemplified numerals.

15 [0180]

Split of functional blocks in the block diagram is an example, and thus a plurality of functional blocks may be achieved as one functional block, one functional block may be split into a plurality of blocks, or some functions may be transferred to another functional block. Single hardware or software may process similar functions of a plurality of functional blocks, in parallel or by time division.

[0181]

The order in which steps included in a flowchart are performed is an example for specifically describing the present disclosure, and the order may be other than the above. Further, one or more of the steps may be performed simultaneously (in parallel) with other step(s).

[0182]

30 The present disclosure also includes embodiments as a result of adding, to the embodiment, various modifications that may be conceived by those skilled in the art, and embodiments achieved by combining elements and functions in the embodiment in any manner without departing from the scope of
35 the present disclosure.

[Reference Signs List]

[0183]

	1	air quality control system
	10	building
5	11a	first indoor space
	12a	second indoor space
	21	air conditioner
	22	first ventilator
	23	first air cleaner
10	24	indoor sensor
	24a	first air quality sensor (air quality sensor)
	24b	first occupancy sensor
	31	second ventilator
	32	second air cleaner
15	33b	second occupancy sensor
	40	control device
	50	operation terminal
	51	display
	52	storage
20		

CLAIMS

1. An air quality control system comprising:
 - an air conditioner that adjusts temperature and humidity of air in a first indoor space in a building;
 - a first ventilator that supplies outdoor air to the first indoor space and discharges the air in the first indoor space to outside of the first indoor space;
 - a first air cleaner that cleans the outdoor air by removing a pollutant contained in the outdoor air when the first ventilator supplies the outdoor air to the first indoor space;
 - an indoor sensor that detects an environment of the first indoor space;
 - a control device;
 - a second ventilator that discharges air in a second indoor space in the building to outside of the second indoor space, the second indoor space being different from the first indoor space;
 - a second air cleaner that at least deodorizes or disinfects the air in the second indoor space; and
 - a second occupancy sensor that detects a user present in the second indoor space,wherein the first indoor space and the second indoor space are connected, the control device controls the air conditioner and the first ventilator and causes the air conditioner and the first ventilator to cooperate with each other to adjust quality of the air in the first indoor space, based on the environment of the first indoor space that is a result of detection by the indoor sensor,
 - the control device decreases output of the second air cleaner and an air discharge quantity of the second ventilator to adjust quality of the air in the second indoor space by causing the second ventilator and the second air cleaner to cooperate with each other when the control device obtains, from the second occupancy sensor, a result of detection indicating that a user is present in the second indoor space, and

the control device further controls the first ventilator and the first air cleaner when the quality of the air in the second indoor space is to be adjusted.

2. The air quality control system according to claim 1, wherein the indoor sensor includes an air quality sensor that detects a concentration of the pollutant contained in the air in the first indoor space, and

when a result of detection by the air quality sensor indicates that the concentration of the pollutant contained in the air in the first indoor space is higher than or equal to a predetermined concentration, the control device increases an air supply quantity and an air discharge quantity of the first ventilator and increases output of the air conditioner.

3. The air quality control system according to claim 1 or 2, wherein the indoor sensor includes a first occupancy sensor that detects a user present in the first indoor space, and

when the control device obtains, from the first occupancy sensor, a result of detection indicating that a user is present in the first indoor space, the control device increases an air supply quantity and an air discharge quantity of the first ventilator and increases output of the air conditioner.

4. The air quality control system according to any one of the preceding claims,

wherein when the control device increases an air discharge quantity of the second ventilator, the control device increases an air supply quantity and an air discharge quantity of the first ventilator and increases output of the air conditioner.

5. The air quality control system according to any one of the preceding claims,

wherein the control device controls the second ventilator to cause humidity in the second indoor space to be in a range from

0% to 60%, both inclusive.

6. The air quality control system according to any one of the preceding claims,

wherein the pollutant is at least one of CO₂ and particulate matter (PM).

7. The air quality control system according to any one of the preceding claims, comprising:

an operation terminal wirelessly communicable with the control device,

wherein the operation terminal includes a display that displays at least information indicating an environment of the first indoor space.

8. The air quality control system according to claim 7,
wherein the operation terminal:

includes a storage that stores one or more control commands for causing the control device to perform control and adjusting the environment of the first indoor space;

selects a control command according to a user from among the one or more control commands by identifying the user;
and

transmits the control command selected to the control device.

9. The air quality control system according to any one of the preceding claims,

wherein the first ventilator is a heat-exchange ventilator.

10. An air quality control method comprising:

adjusting, by an air conditioner, temperature and humidity of air in a first indoor space in a building;

supplying, by a first ventilator, outdoor air to the first indoor space and discharging the air in the first indoor space to

outside of the first indoor space;

cleaning the outdoor air by removing a pollutant contained in the outdoor air to be supplied to the first indoor space;

detecting an environment of the first indoor space;

providing a control device;

discharging, by a second ventilator, air in a second indoor space in the building to outside of the second indoor space, the second indoor space being different from the first indoor space;

at least deodorizing or disinfecting, by a second air cleaner, the air in the second indoor space; and

detecting, by a second occupancy sensor, a user present in the second indoor space,

wherein the first indoor space and the second indoor space are connected, the controlling device controls the air conditioner and the first ventilator and causes the air conditioner and the first ventilator to cooperate with each other to adjust quality of the air in the first indoor space, based on the environment of the first indoor space that is a result of detection by the indoor sensor,

the control device decreases output of the second air cleaner and an air discharge quantity of the second ventilator to adjust quality of the air in the second indoor space by causing the second ventilator and the second air cleaner to cooperate with each other when the control device obtains, from the second occupancy sensor, a result of detection indicating that a user is present in the second indoor space, and

the control device further controls the first ventilator and the first air cleaner when the quality of the air in the second indoor space is to be adjusted.

11. A program for causing a computer to execute the air quality control method according to claim 10.