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(54) DISINFECTION ROBOT AND CONTROLLING METHOD THEREOF

(71) Applicant: **HDHyundai Robotics Co., Ltd.**, Daegu (KR)

(72) Inventors: **Tae Hyun KIM**, Daegu (KR); **In Hwan JUNG**, Daegu (KR); **Jong Kyu OH**, Daegu (KR)

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(57) **ABSTRACT**

Disclosed herein is a disinfection robot. The disinfection robot includes a body provided with an outlet, a fan provided inside the body, a fan motor configured to rotate the fan, a wheel provided under the body, a wheel motor configured to rotate the wheel, and a processor including geographical map data corresponding to a disinfection space including a plurality of zones and air quality map data indicating air quality of the plurality of zones, and configured to control the fan motor to rotate the fan to discharge air through the outlet and control the wheel motor to rotate the wheel to move the body based on the geographical map data and the air quality map data.

FIG. 1

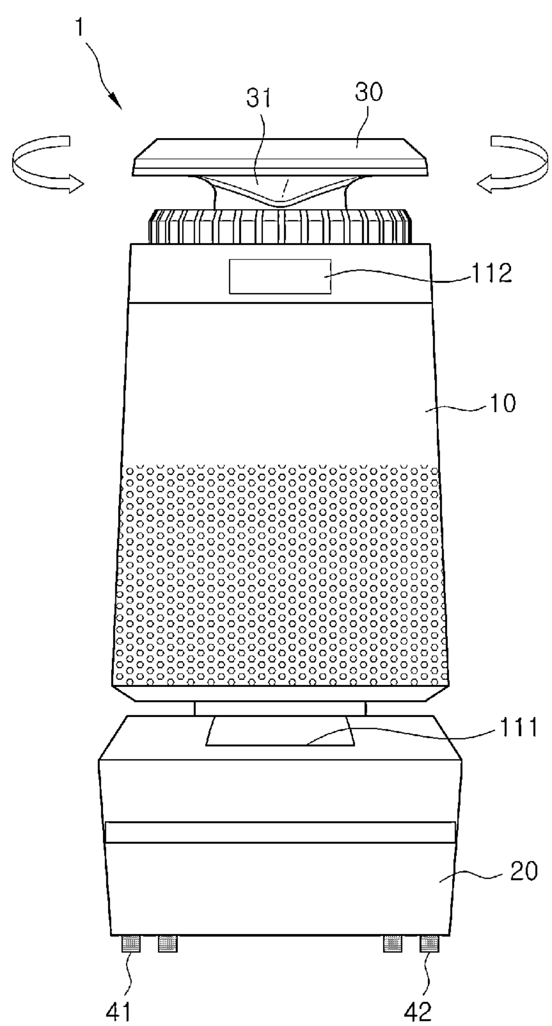


FIG. 1

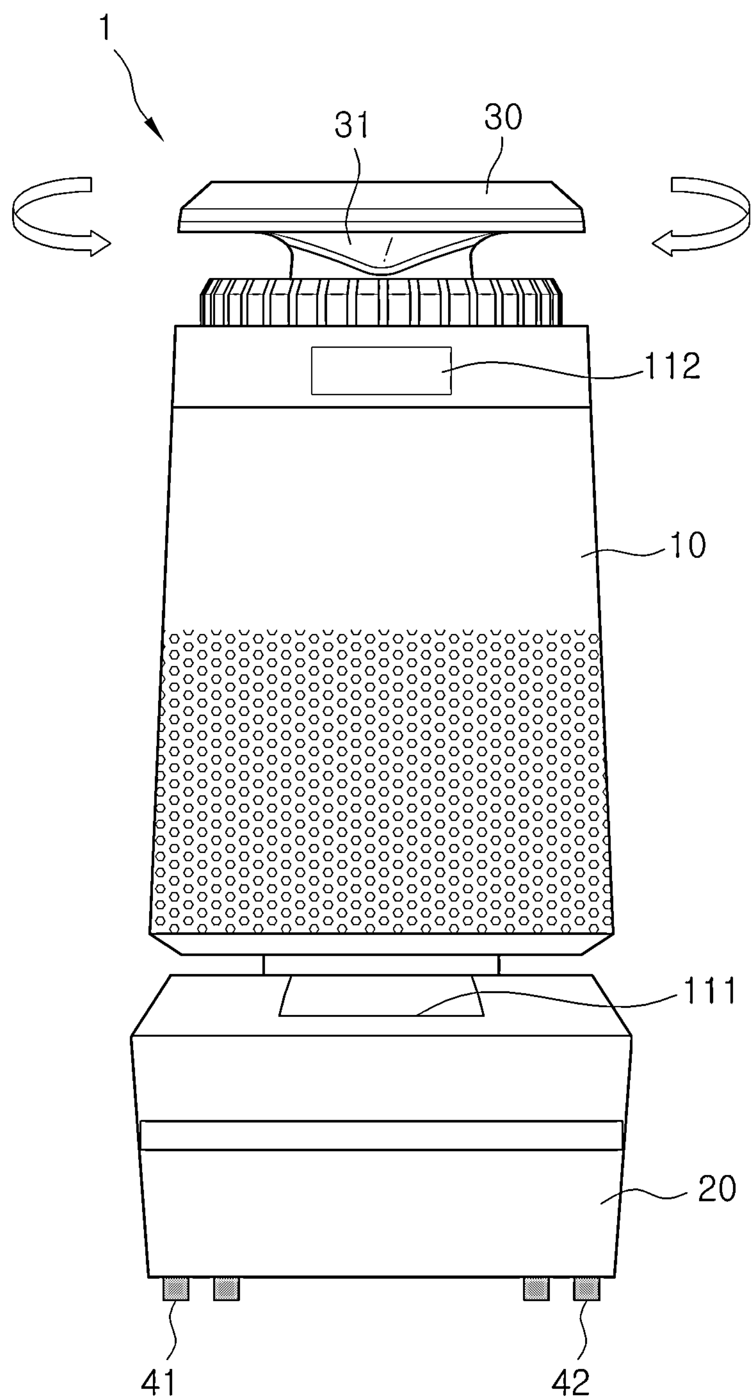


FIG. 2

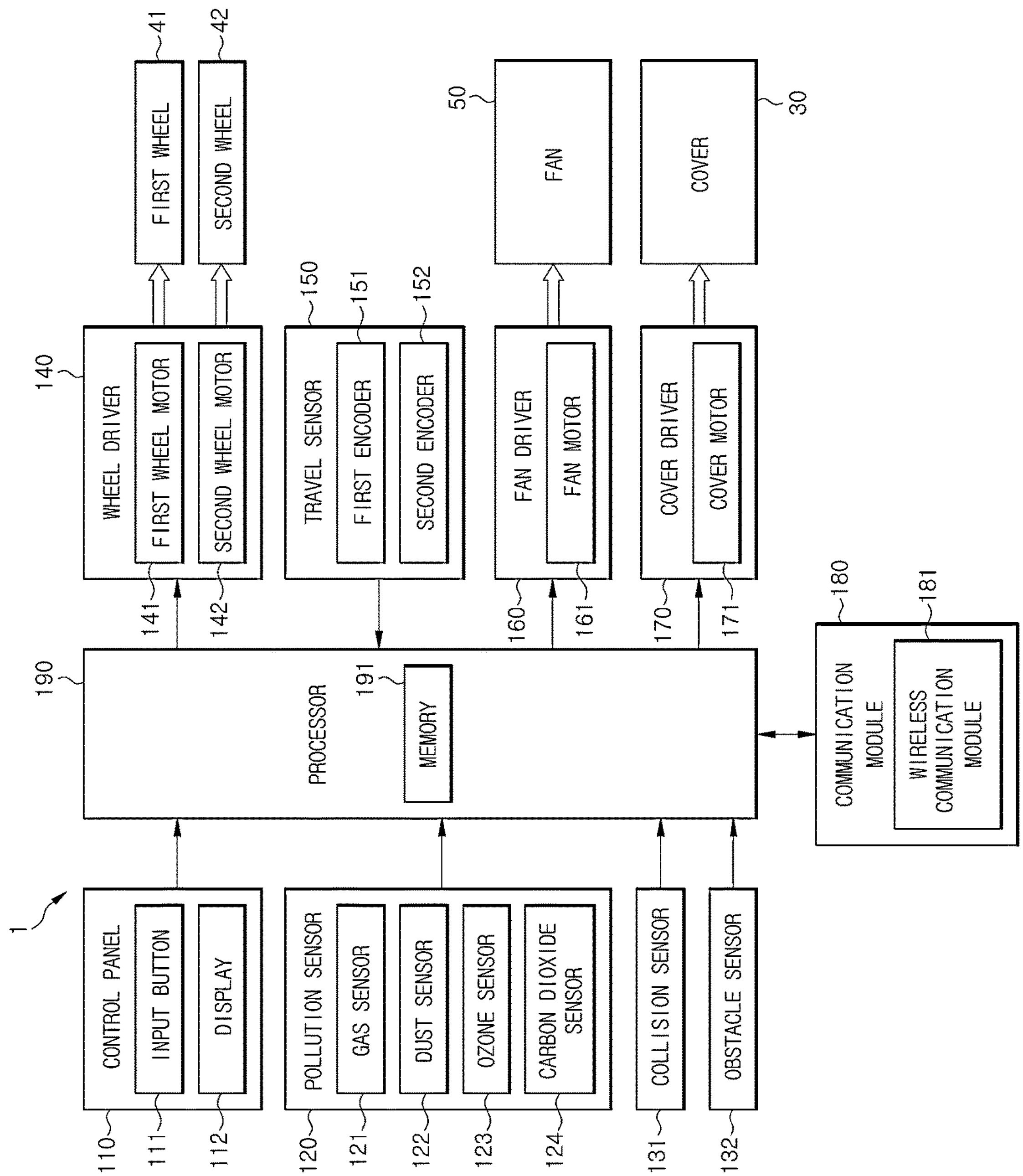

1
CONTROL PANEL
INPUT BUTTON
DISPLAY
POLLUTION SENSOR
GAS SENSOR
DUST SENSOR
OZONE SENSOR
CARBON DIOXIDE SENSOR
COLLISION SENSOR
OBSTACLE SENSOR
110
111
112
120
121
122
123
124
131
132
PROCESSOR
MEMORY
190
191
COMMUNICATION MODULE
WIRELESS COMMUNICATION MODULE
180
181
WHEEL DRIVER
FIRST WHEEL MOTOR
SECOND WHEEL MOTOR
140
141
142
TRAVEL SENSOR
FIRST ENCODER
SECOND ENCODER
150
151
152
FAN DRIVER
FAN MOTOR
160
161
COVER DRIVER
COVER MOTOR
170
171
FIRST WHEEL
SECOND WHEEL
41
42
FAN
50
COVER
30

FIG. 3A

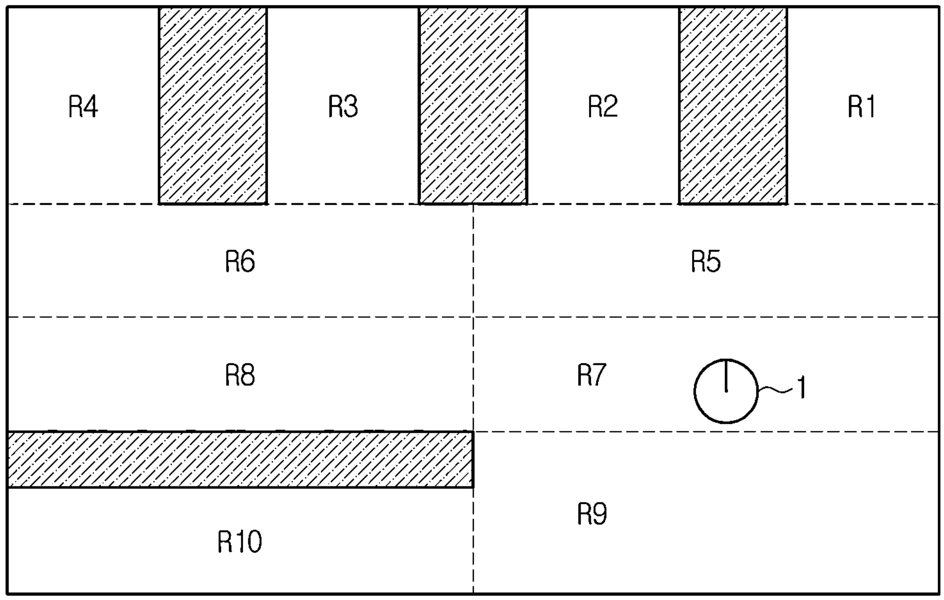


FIG. 3B

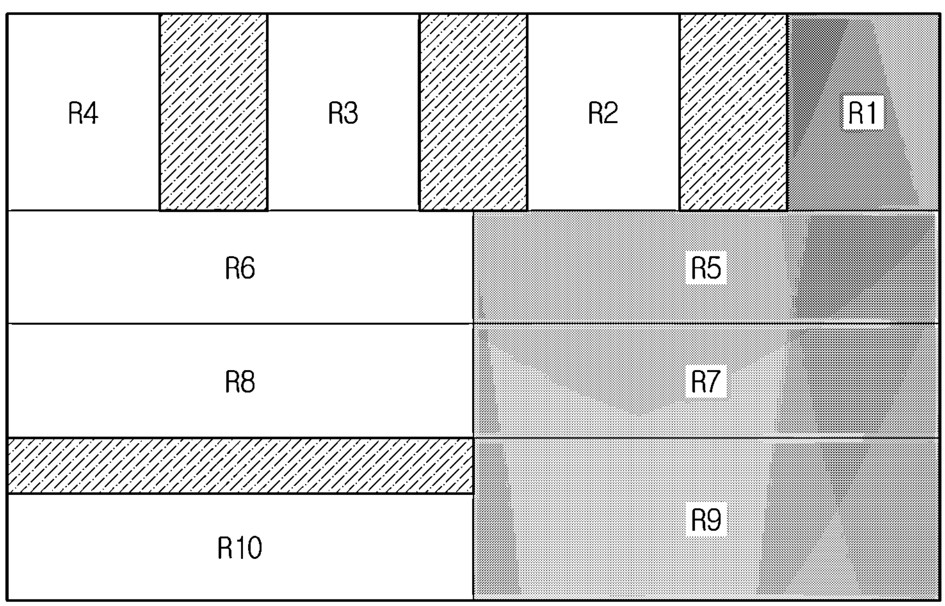


FIG. 4

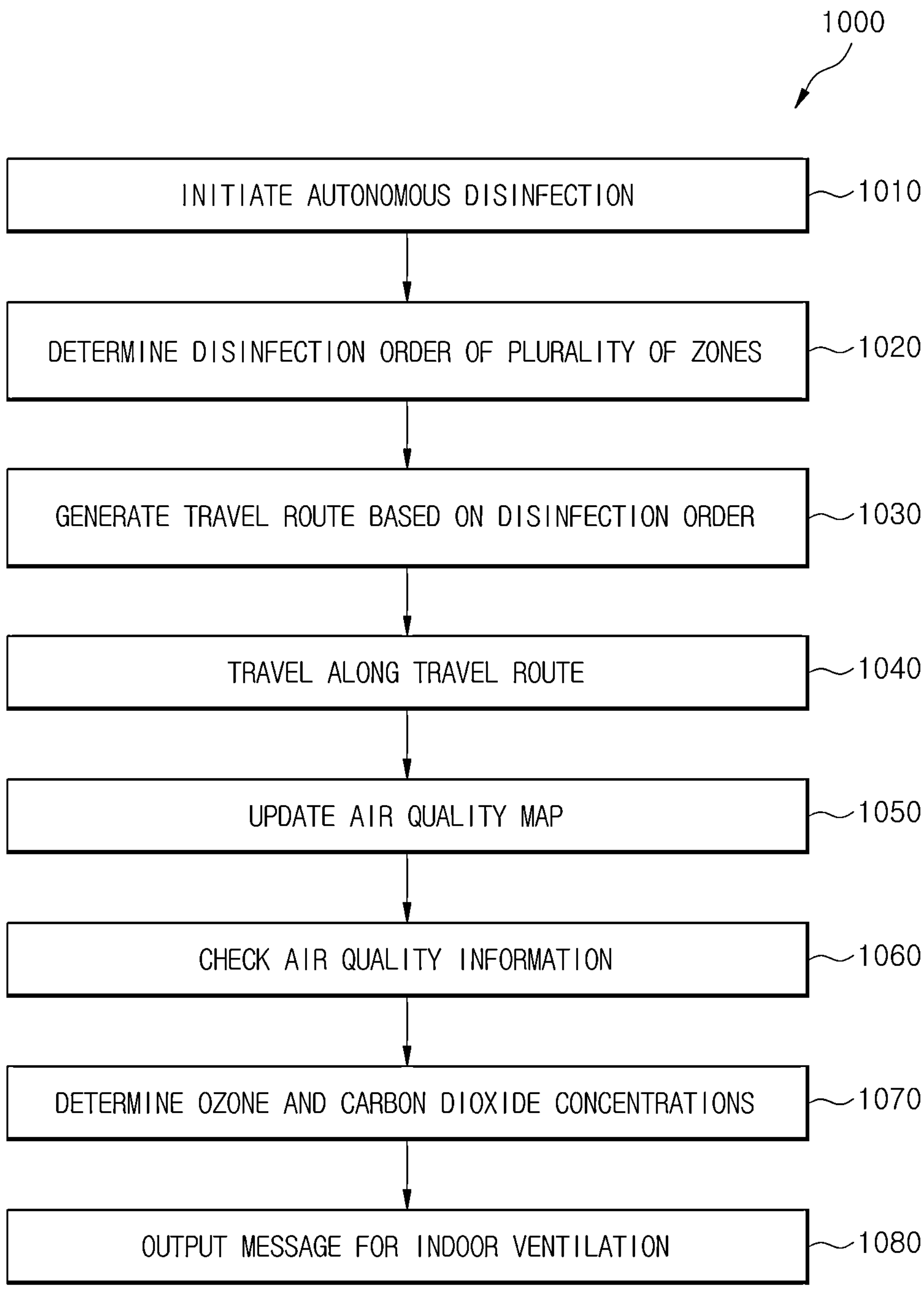

1000
INITIATE AUTONOMOUS DISINFECTION
1010
DETERMINE DISINFECTION ORDER OF PLURALITY OF ZONES
1020
GENERATE TRAVEL ROUTE BASED ON DISINFECTION ORDER
1030
TRAVEL ALONG TRAVEL ROUTE
1040
UPDATE AIR QUALITY MAP
1050
CHECK AIR QUALITY INFORMATION
1060
DETERMINE OZONE AND CARBON DIOXIDE CONCENTRATIONS
1070
OUTPUT MESSAGE FOR INDOOR VENTILATION
1080

FIG. 5

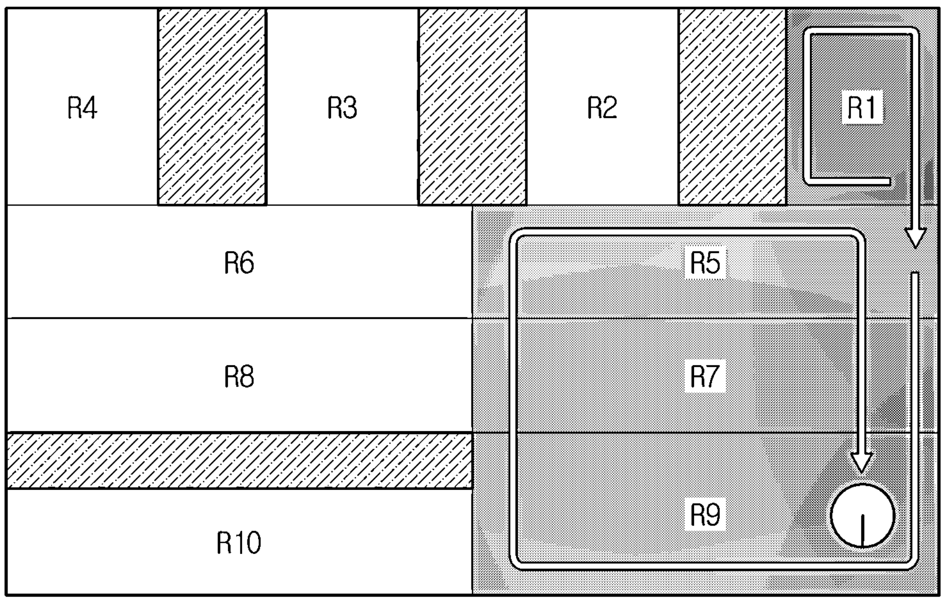

R4
R3
R2
R1
R6
R5
R8
R7
R9
R10

FIG. 6

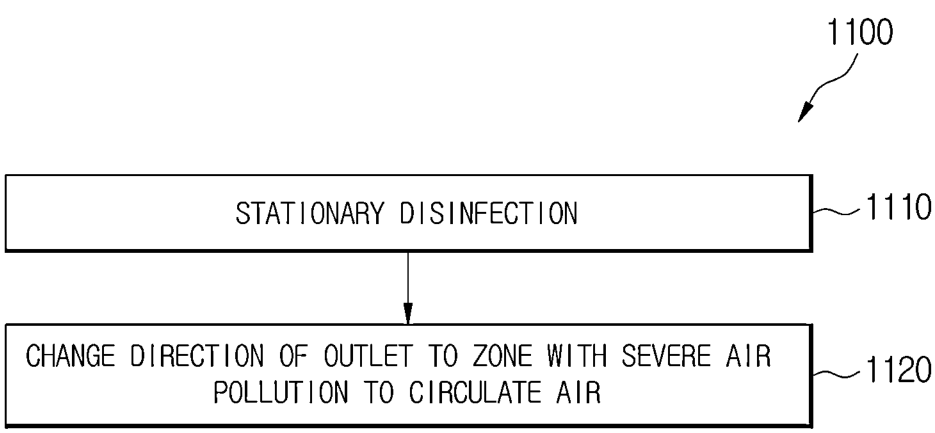

1100
STATIONARY DISINFECTION
1110
CHANGE DIRECTION OF OUTLET TO ZONE WITH SEVERE AIR POLLUTION TO CIRCULATE AIR
1120

FIG. 7

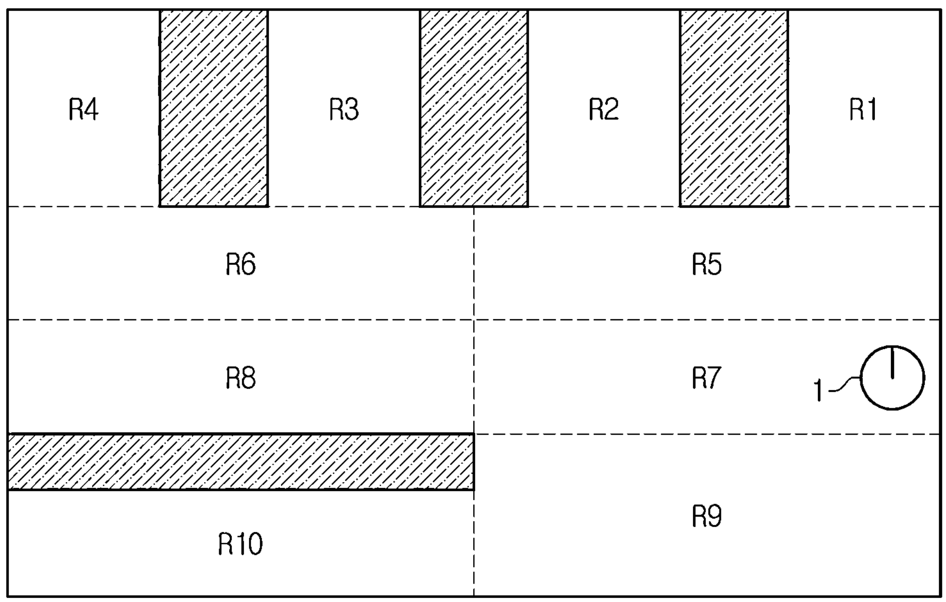

R4
R3
R2
R1
R6
R5
R8
R7
1
R9
R10

FIG. 8

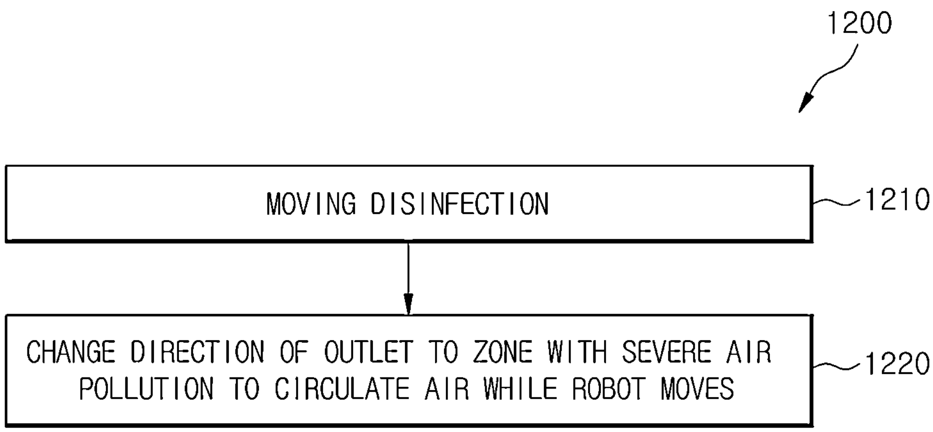
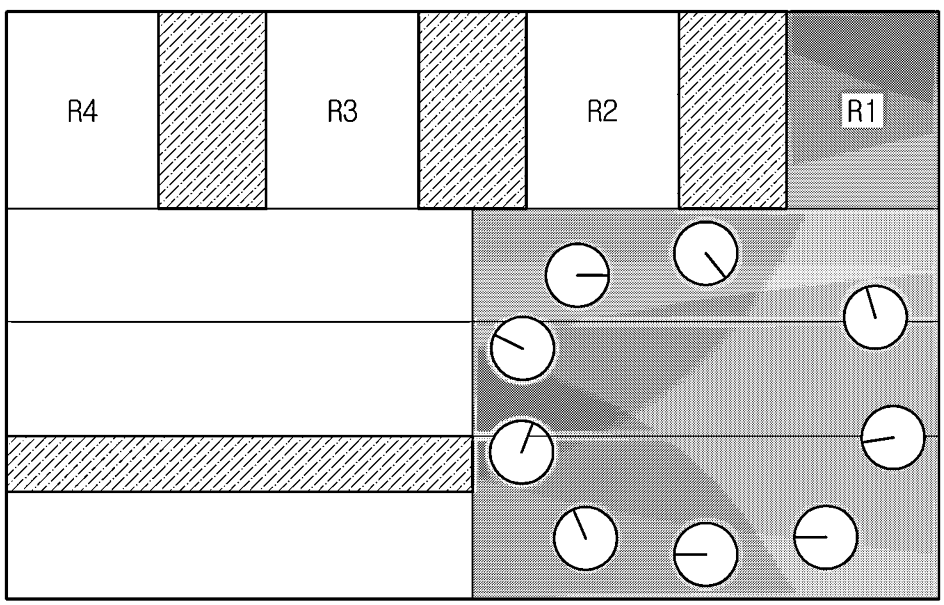

1200
MOVING DISINFECTION
1210
CHANGE DIRECTION OF OUTLET TO ZONE WITH SEVERE AIR POLLUTION TO CIRCULATE AIR WHILE ROBOT MOVES
1220

FIG. 9



DISINFECTION ROBOT AND CONTROLLING METHOD THEREOF

CROSS-REFERENCE TO RELATED APPLICATION

[0001] This application claims the benefit of Korean Patent Application No. 10-2022-0125823, filed on Sep. 30, 2022 in the Korean Intellectual Property Office, the disclosure of which is incorporated herein by reference.

BACKGROUND

1. Field

[0002] Embodiments of the present disclosure relate to a movable disinfection robot and a method of controlling the same.

2. Description of the Related Art

[0003] A disinfection device is a device for suctioning indoor air, disinfecting the suctioned air, and discharging the disinfected air. In this case, disinfection refers to appropriately controlling the cleanliness of indoor air or the like.

[0004] The disinfection device may control the cleanliness of the indoor air by removing pollutants in the air. The disinfection device may remove bacteria, viruses, mold, fine dust, and chemicals that cause bad odors present in the suctioned air.

[0005] The disinfection device may be equipped with a filter for purifying polluted indoor air. The air suctioned into the disinfection device may be purified to be clean air by removing pollutants while passing through the filter, and the purified air may be discharged to the outside of the disinfection device.

[0006] For the purifying operation of the disinfection device, it is necessary to measure a pollution level of a disinfection space. In order to measure the pollution level of the disinfection space, the disinfection device may include a particle sensor for irradiating a laser beam to fine particles contained in the air and then measuring the pollution level through an amount of the beam scattered by the particles.

[0007] The disinfection device may not be moved, and thus may not actively respond to a change according to pollutants in the air.

SUMMARY

[0008] Therefore, it is an aspect of the present disclosure to provide a movable disinfection robot and a method of controlling the same.

[0009] It is another aspect of the present disclosure to provide a disinfection robot, which may actively respond to a change according to pollutants in the air, and a method of controlling the same.

[0010] Additional aspects of the disclosure will be set forth in part in the description which follows and, in part, will be obvious from the description, or may be learned by practice of the disclosure.

[0011] In accordance with one aspect of the present disclosure, a disinfection robot includes a body provided with an outlet, a fan provided inside the body, a fan motor configured to rotate the fan, a wheel provided under the body, a wheel motor configured to rotate the wheel, and a processor including geographical map data corresponding to a disinfection space including a plurality of zones and air quality map data indicating air quality of the plurality of zones, and configured to control the fan motor to rotate the fan to discharge air through the outlet and control the wheel motor to rotate the wheel to move the body based on the geographical map data and the air quality map data.

[0012] The processor may identify a disinfection order of the plurality of zones included in the disinfection space based on the geographical map data and the air quality map data, and generate a travel route along which the body travels based on the disinfection order of the plurality of zones.

[0013] The processor may control the wheel motor so that the body travels along the travel route.

[0014] The disinfection robot may further include a pollution sensor configured to detect pollution of air in the disinfection space. In addition, the processor may update the air quality map data based on an output of the pollution sensor while the body travels along the travel route.

[0015] The processor may identify at least one of an ozone concentration or a carbon dioxide concentration in the disinfection space based on the air quality map data, and output a message for ventilation in the disinfection space based on the at least one of the ozone concentration or the carbon dioxide concentration.

[0016] The disinfection robot may further include a cover in which the outlet is formed and which is provided to be rotatable with respect to the body, and a cover motor configured to rotate the cover. In addition, the processor may control the cover motor to rotate the cover based on the geographical map data and the air quality map data.

[0017] The processor may rotate the cover so that the outlet faces a zone with a highest air pollution level among the plurality of zones while the disinfection robot is stopped.

[0018] The processor may rotate the cover so that the outlet faces a zone with a highest air pollution level among the plurality of zones while the disinfection robot moves.

[0019] The disinfection robot may further include a travel sensor configured to detect the rotation of the wheel. In addition, the processor may control the wheel motor so that the body travels in the disinfection space and generate the geographical map data based on an output of the travel sensor while the body travels in the disinfection space.

[0020] The disinfection robot may further include a pollution sensor configured to detect pollution of air in the disinfection space. The processor may control the wheel motor so that the body travels in the disinfection space and generate the air quality map data based on an output of the pollution sensor while the body travels in the disinfection space.

[0021] In accordance with another aspect of the present disclosure, a method of controlling a disinfection robot including a body provided with an outlet, a fan provided inside the body, and a wheel provided under the body includes controlling the fan to discharge air through the outlet, and moving the body based on geographical map data corresponding to a disinfection space including a plurality of zones and air quality map data indicating air quality of the plurality of zones.

BRIEF DESCRIPTION OF THE DRAWINGS

[0022] These and/or other aspects of the disclosure will become apparent and more readily appreciated from the following description of the embodiments, taken in conjunction with the accompanying drawings of which:

[0023] FIG. **1** is a view illustrating an exterior of a disinfection robot according to one embodiment;

[0024] FIG. **2** is a view illustrating a configuration of the disinfection robot according to one embodiment;

[0025] FIGS. **3**A and **3**B are a view illustrating geographical map data and air quality map data of the disinfection robot according to one embodiment;

[0026] FIG. **4** is a view illustrating a method of the disinfection robot according to one embodiment traveling in a disinfection space;

[0027] FIG. **5** is a view illustrating an example in which the disinfection robot according to one embodiment travels in the disinfection space;

[0028] FIG. **6** is a view illustrating a method of the disinfection robot according to one embodiment disinfecting the disinfection space;

[0029] FIG. **7** is a view illustrating an example in which the disinfection robot according to one embodiment disinfects the disinfection space;

[0030] FIG. **8** is a view illustrating a method of the disinfection robot according to one embodiment disinfecting the disinfection space; and

[0031] FIG. **9** is a view illustrating an example in which the disinfection robot according to one embodiment disinfects the disinfection space.

DETAILED DESCRIPTION

[0032] The same reference numbers may denote the same components throughout the specification.

[0033] The specification does not describe all elements of embodiments, and general contents or overlapping contents between the embodiments in the technical field to which the present disclosure pertains will be omitted.

[0034] Terms "unit," "module," "member," and "block" used in the specification may be implemented as software or hardware, and according to the embodiments, a plurality of "units, modules, members, and blocks" may be implemented as one component, or one "unit, module, member, and block" may include a plurality of components.

[0035] Throughout the specification, when a first component is described as being "connected" to a second component, this includes not only a case in which the first component is directly connected to the second component but also a case in which the first component is indirectly connected to the second component, and the indirect connection includes connection through a wireless communication network.

[0036] Throughout the specification, when the first component is described as "including" the second component, this means further including the third component rather than precluding the third component unless especially stated otherwise.

[0037] Throughout the specification, when a first member is described as being positioned "on" a second member, this includes both a case in which the first member is in contact with the second member and a case in which a third member is present between the two members. In addition, terms used throughout the specification, such as "front," "rear," "left," and "right," are defined based on the drawings, and a shape and a position of each component are not limited by the terms.

[0038] Throughout the specification, terms such as first and second are used to distinguish a first component from a second component, and the components are not limited by the above-described terms.

[0039] Throughout the specification, the singular expression includes the plural expression unless the context clearly dictates otherwise.

[0040] In each operation, identification symbols are used for convenience of description, and the identification symbols do not describe the sequence of each operation, and each operation may be performed in a different sequence from the specified sequence unless a specific sequence is clearly described in context.

[0041] Hereinafter, an operation principle and embodiments of the present disclosure will be described with reference to the accompanying drawings.

[0042] FIG. **1** is a view illustrating an exterior of a disinfection robot according to one embodiment. FIG. **2** is a view illustrating a configuration of the disinfection robot according to one embodiment. FIGS. **3**A and **3**B are a view illustrating geographical map data and air quality map data of the disinfection robot according to one embodiment.

[0043] Referring to FIGS. **1**, **2**, **3**A and **3**B, a disinfection robot **1** may include a disinfection body **10** provided in a substantially cylindrical shape, and a moving body **20** provided under the disinfection body **10**. However, the shapes of the disinfection body **10** and the moving body **20** are not limited to a cylinder and may be provided in various shapes such as a polyhedron. In addition, the disinfection body **10** and the moving body **20** may be provided separately or integrally. Components for purifying air in a disinfection space may be provided in the disinfection body **10** of the disinfection robot **1**. For example, the disinfection body **10** may include a fan **50** for suctioning air in the disinfection space, a filter for purifying the suctioned air, and the like.

[0044] A cover **30** may be formed above the disinfection body **10**.

[0045] The cover **30** may be provided to be rotatable with respect to the disinfection body **10**. As illustrated in FIG. **1**, the cover **30** may rotate clockwise or counterclockwise with respect to the disinfection body **10**.

[0046] An outlet **31** through which the air purified by the filter is discharged may be provided on the cover **30**. The outlet **31** may discharge the air purified by the filter in a specific direction.

[0047] The outlet **31** may be rotated according to the rotation of the cover **30**. For example, when the cover **30** rotates clockwise with respect to the disinfection body **10**, the outlet **31** may also rotate clockwise with respect to the disinfection body **10**, and a discharged direction of the air purified by the filter may also be rotated clockwise. In addition, when the cover **30** rotates counterclockwise with respect to the disinfection body **10**, the outlet **31** may also rotate counterclockwise with respect to the disinfection body **10**, and a discharged direction of the air purified by the filter may also be rotated counterclockwise.

[0048] Components for moving the disinfection robot **1** may be provided in the moving body **20**. For example, the moving body **20** may include a first wheel **41** and a second wheel **42** for moving the disinfection robot **1**.

[0049] The first wheel **41** and the second wheel **42** may be provided on a lower surface of the moving body **20** and may rotate so that the disinfection robot **1** may move. For example, the first wheel **41** may be provided on a left end of the lower surface of the moving body **20**, and the second wheel **42** may be provided on a right end of the lower surface of the moving body **20**. The moving body **20** may be moved in a forward, rearward, leftward, or rightward direction by the rotation of the first wheel **41** and the second wheel **42**.

[0050] The disinfection robot **1** may also include a control panel **110**, a pollution sensor **120**, a collision sensor **131**, an obstacle sensor **132**, a wheel driver **140**, a travel sensor **150**, a fan driver **160**, a cover driver **170**, a communication module **180**, and/or a processor **190**.

[0051] The control panel **110**, the pollution sensor **120**, the collision sensor **131**, the obstacle sensor **132**, the wheel driver **140**, the travel sensor **150**, the fan driver **160**, the cover driver **170**, the communication module **180**, and/or the processor **190** do not correspond to essential components of the disinfection robot **1**, and at least some of the components may be omitted.

[0052] The control panel **110** may provide a user with a user interface for interaction with the user.

[0053] The control panel **110** may include an input button **111** or a display **112**.

[0054] The input button **111** may acquire a user's input related to an operation of the disinfection robot **1**. For example, the input button **111** may acquire a flow amount or rate of air discharged by the disinfection robot **1**.

[0055] The input button **111** may include a tact switch, a push switch, a slide switch, a toggle switch, a micro switch, or a touch switch.

[0056] The display **112** may display operation information of the disinfection robot **1**. In addition, the display **112** may display the user's input acquired in relation to the operation of the disinfection robot **1**. For example, the display **112** may display the flow amount or rate of the air discharged by the disinfection robot **1**.

[0057] The display **112** may include, for example, a liquid crystal display (LCD) panel, a light emitting diode (LED) panel, and the like.

[0058] The pollution sensor **120** may collect information about pollutants contained in the air in the disinfection space. For example, the pollution sensor **120** may collect information about a concentration of an odor-causing particle (hereinafter referred to as "gas") contained in the air and/or information about a concentration of dust.

[0059] The pollution sensor **120** may include a gas sensor **121**, a dust sensor **122**, an ozone sensor **123**, and/or a carbon dioxide sensor **124**. The gas sensor **121**, the dust sensor **122**, the ozone sensor **123**, and/or the carbon dioxide sensor **124** do not correspond to essential components, and at least some of the components may be omitted.

[0060] The gas sensor **121** may measure a concentration of a gas contained in the air and output an electrical signal indicating the concentration of the gas. For example, the gas sensor **121** may detect the gas in the air or measure the concentration of the gas in the air using a change in electrical conductivity of a semiconductor device occurring when the ozone is collected on a surface of the semiconductor.

[0061] The processor **190** may identify the concentration of the ozone contained in the air in the disinfection space based on an output of the gas sensor **121**.

[0062] The dust sensor **122** may measure a concentration of dust contained in the air and output an electrical signal indicating the concentrations of the dust. For example, the dust sensor **122** may detect the dust in the air or measure the concentration of the dust in the air using the scattering of light by the dust contained in the air.

[0063] The processor **190** may identify the concentration of the dust contained in the air in the disinfection space based on an output of the dust sensor **122**.

[0064] The ozone sensor **123** may measure a concentration of ozone contained in the air and output an electrical signal indicating the concentration of the ozone. For example, the ozone sensor **123** may detect the ozone in the air or measure the concentration of the ozone in the air using a change in electrical conductivity of a semiconductor device occurring when the ozone is collected on the surface of the semiconductor.

[0065] The processor **190** may identify the concentration of the ozone contained in the air in the disinfection space based on an output of the ozone sensor **123**.

[0066] The carbon dioxide sensor **124** may measure a concentration of carbon dioxide contained in the air and output an electrical signal indicating the concentration of the carbon dioxide. For example, the carbon dioxide sensor **124** may detect the carbon dioxide in the air or measure the concentration of the carbon dioxide in the air using the absorption of infrared rays by the carbon dioxide contained in the air.

[0067] The processor **190** may identify the concentration of the carbon dioxide contained in the air in the disinfection space based on an output of the carbon dioxide sensor **124**.

[0068] The collision sensor **131** may be positioned inside a bumper of the moving body **20** and may identify a collision with an obstacle.

[0069] The bumper may be provided on a front surface of the moving body **20** and may reduce an impact transmitted to the moving body **20** in the event of the collision with the obstacle. The bumper may transmit the impact caused by the collision in the event of the collision with the obstacle to a collision switch.

[0070] For example, the collision sensor **131** may include the collision switch. The collision switch may detect a collision between the bumper and the obstacle. The opened (turned off) collision switch may be closed (turned on) by the collision between the bumper and the obstacle. When the bumper collides with the obstacle, the collision switch may provide the processor **190** with a collision detection signal (e.g., a voltage signal or a current signal) indicating the collision with the obstacle.

[0071] The obstacle sensor **132** may be positioned inside the moving body **20**. The obstacle sensor **132** may identify the presence or absence of the obstacle and/or a distance to the obstacle without contact or collision with the obstacle.

[0072] The obstacle sensor **132** may transmit infrared rays, ultrasonic waves, or radio waves forward from the moving body **20** and receive infrared rays, ultrasonic waves, or radio waves reflected from the obstacle. The obstacle sensor **132** may identify the presence or absence of the obstacle and/or the distance to the obstacle based on the received infrared rays, ultrasonic waves, or radio waves.

[0073] For example, the obstacle sensor **132** may include a photo diode for emitting infrared rays and a photo sensor. The photo diode may emit the infrared rays forward from the disinfection robot **1**, and the photo sensor may receive the infrared rays reflected from the obstacle positioned in front of the disinfection robot **1**. The obstacle sensor **132** may identify the presence or absence of the obstacle and/or the distance to the obstacle based on an intensity of the infrared ray received by the photo sensor.

[0074] The wheel driver **140** may move the moving body **20** in response to a control signal of the processor **190**.

[0075] The wheel driver **140** may include a first wheel motor **141** and a second wheel motor **142**. The first wheel motor **141** may rotate the first wheel **41**, and the second wheel motor **142** may rotate the second wheel **42**. The first wheel motor **141** and the second wheel motor **142** may independently rotate the first wheel **41** and the second wheel **42** by the control signal of the processor **190**. The first wheel **41** may be rotated by the first wheel motor **141** independently of the rotation of the second wheel **42**, and the second wheel **42** may be rotated by the second wheel motor **142** independently of the rotation of the first wheel **41**.

[0076] The wheel driver **140** may further include a driving circuit for supplying a driving current to each of the first wheel motor **141** and the second wheel motor **142** in response to the control signal of the processor **190**, a power transmission device for transmitting the rotation of the first and second wheel motors **141** and **142** to the first and second wheels **41** and **42**, respectively, and the like.

[0077] The travel sensor **150** may be installed on each of the first wheel **41** and the second wheel **42** and may detect rotation speeds and rotation directions of the first wheel **41** and the second wheel **42**.

[0078] The travel sensor **150** includes a first encoder **151** and a second encoder **152**.

[0079] The first encoder **151** may detect the rotation speed and the rotation direction of the first wheel **41**, and the second encoder **152** may detect the rotation speed and the rotation direction of the second wheel **42**.

[0080] For example, the first encoder **151** and the second encoder **152** may each include a disk in which a plurality of slits are formed, a light emitting diode for emitting light, and a photo diode for detecting light passing through the plurality of slits. The first encoder **151** and the second encoder **152** may respectively identify the rotation speeds and the rotation directions of the first wheel **41** and the second wheel **42** based on a detection cycle and the number of detections for the light detected by the photo diode.

[0081] In addition, the first encoder **151** and the second encoder **152** may each include a disk on which a plurality of permanent magnets are installed and a Hall sensor for detecting magnetic fields generated by the plurality of permanent magnets. The first encoder **151** and the second encoder **152** may identify the rotation speeds and the rotation directions of the first wheel **41** and the second wheel **42**, respectively, based on a detection cycle and the number of detections for the magnetic field detected by the Hall sensor.

[0082] The first encoder **151** and the second encoder **152** may each provide the processor **190** with information about the rotation speed and the rotation direction of the first wheel **41** and information about the rotation speed and the rotation direction of the second wheel **42**.

[0083] The fan driver **160** may drive the fan **50** included in the disinfection body **10** in response to a control signal of the processor **190**.

[0084] The fan driver **160** may include a fan motor **161**. The fan motor **161** may rotate the fan **50**. By the rotation of the fan **50**, air outside the disinfection robot **1** may be suctioned into the disinfection robot **1**. The suctioned air may be forcibly moved to the filter by the rotation of the fan **50**. While the suctioned air passes through the filter, foreign substances or the like contained in the suctioned air may be filtered by the filter.

[0085] The fan driver **160** may further include a driving circuit for supplying a driving current to the fan motor **161** in response to the control signal of the processor **190**, a power transmission device for transmitting the rotation of the fan motor **161** to the fan **50**, and the like.

[0086] The cover driver **170** may rotate the cover **30** in response to a control signal of the processor **190**.

[0087] The cover driver **170** may include a cover motor **171**. The cover motor **171** may be connected to a rotational shaft of the cover **30** and may rotate the cover **30** clockwise or counterclockwise with respect to the disinfection body **10**. By the rotation of the cover **30**, a direction in which the outlet **31** faces may be changed, and a direction in which the air passing through the filter is discharged may also be changed.

[0088] The cover driver **170** may further include a driving circuit for supplying a driving current to the cover motor **171** in response to the control signal of the processor **190**, a power transmission device for transmitting the rotation of the cover motor **171** to the cover **30**, and the like.

[0089] The communication module **180** may include a communication circuit capable of transmitting or receiving data to or from a user device (e.g., a portable device) and/or a communication circuit capable of transmitting or receiving data to or from a service device (e.g., a server device).

[0090] The communication module **180** may include a wireless communication module **181** capable of wirelessly transmitting or receiving data to or from the user device and/or the service device.

[0091] For example, the wireless communication module **181** may wirelessly communicate with a base station or an access point (AP) and may be connected to a wired communication network through the base station or the AP. The wireless communication module **181** may communicate with the user device and/or the service device connected to the wired communication network via the base station or the AP. For example, the wireless communication module **181** may wirelessly communicates with the AP using WiFi™ (IEEE 802.11 technical standard) or communicate with the base station using code division multiple access (CDMA), wideband CDMA (WCDMA), a global system for mobiles (GSM), long term evolution (LTE), wireless broadband Internet (WiBro), or the like. The wireless communication module **181** may also transmit or receive data to or from the user device via the service device through the wired communication network.

[0092] In addition, the wireless communication module **181** may wirelessly communicate with the user device directly. For example, the wireless communication module **181** may wirelessly transmit or receive data to or from the user device using WiFi Direct, Bluetooth™ (IEEE 802.15.1 technical standard), ZigBee™ (IEEE 802.15.4 technical standard), or the like.

[0093] The processor **190** may be electrically connected to the control panel **110**, the pollution sensor **120**, the collision sensor **131**, the obstacle sensor **132**, the wheel driver **140**, the travel sensor **150**, the fan driver **160**, the cover driver **170**, and the communication module **180**.

[0094] The processor **190** may acquire information about the surroundings of the disinfection robot **1** from the sensor and generate the control signal for controlling the operation of the disinfection robot **1** based on the acquired information.

[0095] The processor **190** may process electrical signals or data received from the control panel **110**, the pollution sensor **120**, the collision sensor **131**, the obstacle sensor **132**, and the travel sensor **150** and acquire related information. For example, the processor **190** may acquire information about the user's input from the control panel **110**. The processor **190** may acquire information about a collision with an obstacle from the collision sensor **131**. The processor **190** may acquire information about the presence or absence of the obstacle and a distance to the obstacle from the obstacle sensor **132**. The processor **190** may receive information about the rotation speeds and the rotation directions of the first and second wheels **41** and **42** from the travel sensor **150**.

[0096] The processor **190** may provide the control signal or control data to the wheel driver **140**, the fan driver **160**, and the cover driver **170** based on a result of processing the acquired information. For example, the processor **190** may control the first and second wheel motors **141** and **142** to rotate the first and second wheels **41** and **42** based on the information (collision, presence, or distance) about the obstacle. The processor **190** may control the fan motor **161** to rotate the fan **50** based on the information about the user's input. The processor **190** may control the cover motor **171** to rotate the cover **30** based on the information about the user's input.

[0097] The processor **190** may receive a reception signal from the communication module **180** and also provide a transmission signal to the communication module **180**.

[0098] The processor **190** may include a memory **191** for recording and/or storing a program and data for generating the control signal.

[0099] The memory **191** may temporarily remember electrical signals or data received from the control panel **110**, the pollution sensor **120**, the collision sensor **131**, the obstacle sensor **132**, and the travel sensor **150** and remember temporary data generated while processing the received electrical signals or data. In addition, the memory **191** may temporarily remember the control signal or the control data to be provided to the wheel driver **140**, the fan driver **160**, and the cover driver **170**.

[0100] The memory **191** may include not only volatile memories such as a static random access memory (SRAM) and a dynamic RAM (DRAM) but also non-volatile memories such as a flash memory, a read only memory (ROM), and an erasable programmable ROM (EPROM).

[0101] The memory **191** may be provided integrally with the processor **190** or provided separately from the processor **190**.

[0102] As described above, the processor **190** may control the components included in the disinfection robot **1** so that the disinfection robot **1** may travel in the disinfection space and purify the air in the disinfection space.

[0103] The processor **190** may store geographical map data of the disinfection space in the memory **191** so that the disinfection robot **1** efficiently travels in the disinfection space.

[0104] For example, the geographical map data of the disinfection space may be stored in advance or generated based on a travel record recorded while the disinfection robot **1** travels in the disinfection space.

[0105] For example, the processor **190** may acquire the information (e.g., the information about the rotation speeds and/or the rotation directions) about the rotations of the first and second wheels **41** and **42** from the travel sensor **150** while the disinfection robot **1** travels and determine a moving vector indicating a moving speed and a moving direction of the disinfection robot **1** based on the information about the rotations of the first and second wheels **41** and **42**.

[0106] The processor **190** may determine a current position (relative position from a reference point) of the disinfection robot **1** based on a position of the reference point and the moving vector of the disinfection robot **1**. The processor **190** may store the travel record including current positions of the disinfection robot **1** acquired every predetermined time. In addition, the processor **190** may generate the geographical map data of the disinfection space based on the travel record and control the disinfection robot **1** to efficiently travel in the disinfection space.

[0107] The geographical map data may include information about zones in which the disinfection robot **1** may travel. A disinfection space of the geographical map data may be divided into a plurality of zones according to the arrangement of obstacles and the like that the disinfection robot **1** may not travel. For example, as illustrated in FIG. **3**A, the geographical map data may be partitioned into a first zone R**1**, a second zone R**2**, a third zone R**3**, a fourth zone R**4**, a fifth zone R**5**, a sixth zone R**6**, a seventh zone R**7**, an eighth zone R**8**, a ninth zone R**9**, and a tenth zone R**10** according to the arrangement of the obstacles and the like.

[0108] The processor **190** may store air quality map data of the disinfection space in the memory **191** in order to efficiently purify the air in the disinfection space.

[0109] For example, the air quality map data of the disinfection space may be stored in advance or generated based on air quality records recorded while the disinfection robot **1** travels in the disinfection space.

[0110] The processor **190** may store the travel record including the current positions of the disinfection robot **1** while the disinfection robot **1** travels in the disinfection space. In this case, the processor **190** may acquire an air pollution level corresponding to the current position based on the output of the pollution sensor **120**. The air pollution level may indicate a degree of pollution of the air and may be calculated based on the gas concentration, the dust concentration, the ozone concentration, and/or the carbon dioxide concentration. When the air pollution level is high, this may indicate that the gas concentration, the dust concentration, the ozone concentration, and/or the carbon dioxide concentration in the air are high and the air quality is low, and when the air pollution level is low, this may mean that the gas concentration, the dust concentration, the ozone concentration, and/or the carbon dioxide concentration in the air are low and the air quality is high.

[0111] The processor **190** may generate the air quality map data corresponding to the geographical map data based on the air pollution level corresponding to the current position.

[0112] As described above, the disinfection space of the geographical map data may be divided into the plurality of zones. The air quality map data may include the air pollution level corresponding to each of the plurality of zones. For example, as illustrated in FIG. **3**B, the air quality map data may include an air pollution level of the first zone R**1**, an air pollution level of the second zone R**2**, an air pollution level of the third zone R**3**, an air pollution level of the fourth zone

R**4**, an air pollution level of the fifth zone R**5**, an air pollution level of the sixth zone R**6**, an air pollution level of the seventh zone R**7**, an air pollution level of the eighth zone R**8**, an air pollution level of the ninth zone R**9**, and an air pollution level of the tenth zone R**10**.

[0113] The processor **190** may control the disinfection robot **1** to travel in the disinfection space in order to efficiently purify the air in the disinfection space based on the geographical map data and the air quality map data.

[0114] The disinfection robot **1** may determine the pollution level on the floor of the disinfection space and sterilize the floor of the disinfection space using an ultraviolet light source (UV light emitting diode (LED)). For example, the processor **190** may identify the pollution level on the floor of the disinfection space using an infrared sensor or the like while the disinfection robot **1** travels in the disinfection space and generate pollution level map data of the floor based on the identified pollution level of the floor. The processor **190** may generate a travel route for sterilizing the floor based on the pollution level map data of the floor and control the wheel driver **140** so that the disinfection robot **1** travels along the generated travel route. In addition, the processor **190** may sterilize the floor of the disinfection space while the disinfection robot **1** travels in the disinfection space. Specifically, the processor **190** may control the UV LED to irradiate ultraviolet rays toward the floor of the disinfection space.

[0115] A specific method of the disinfection robot **1** efficiently disinfecting the disinfection space will be described in detail below.

[0116] FIG. **4** is a view illustrating a method of the disinfection robot according to one embodiment traveling in a disinfection space. FIG. **5** is a view illustrating an example in which the disinfection robot according to one embodiment travels in the disinfection space.

[0117] A method **1000** in which the disinfection robot **1** travels in the disinfection space will be described with reference to FIGS. **4** and **5**.

[0118] The disinfection robot **1** may initiate autonomous disinfection (**1010**).

[0119] The autonomous disinfection may indicate that the disinfection robot **1** automatically travels in the disinfection space and purifies the air in the disinfection space while the disinfection robot **1** travels in the disinfection space.

[0120] The user may input the user's input for autonomous disinfection through the input button **111**. The control panel **110** may provide the processor **190** with an electrical signal corresponding to the user's input for autonomous disinfection. The processor **190** may acquire the user's input for autonomous disinfection based on an output signal of the control panel **110**.

[0121] The processor **190** may initiate the autonomous disinfection in response to the user's input for autonomous disinfection.

[0122] The disinfection robot **1** may determine a disinfection order of the plurality of zones (**1020**).

[0123] The processor **190** may identify the disinfection order of the plurality of zones based on the air quality map data. The air quality map data may include the air pollution level of each of the plurality of zones included in the geographical map data. For example, as illustrated in FIG. **5**, the air quality map data may include the air pollution levels of the plurality of zones.

[0124] The processor **190** may identify the disinfection order of the plurality of zones based on the air pollution level of each of the plurality of zones included in the air quality map data. For example, the processor **190** may set priorities for disinfection based on the air pollution level of each of the plurality of zones included in the air quality map data. For example, the processor **190** may determine the disinfection order so that the disinfection robot **1** first disinfects a zone with a high air pollution level and then disinfects a zone with a low air pollution next.

[0125] Based on the air quality map data illustrated in FIG. **5**, the processor **190** may first disinfect the first zone R**1**, which is a zone with the highest air pollution level, disinfects the fifth, seventh, and ninth zones R**5**, R**7**, and R**9**, which are zones with the medium air pollution level next, and lastly disinfects the second, third, fourth, sixth, eight, and tenth zones R**2**, R**3**, R**4**, R**6**, R**8**, and R**10**, which are zones with the lowest air pollution level.

[0126] The disinfection robot **1** may generate the travel route based on the disinfection order (**1030**).

[0127] The processor **190** may generate the travel route of the disinfection robot **1** on the geographical map data based on the disinfection order. For example, the processor **190** may generate the travel route so that the disinfection robot **1** first travels in the zone with the high air pollution level, then travels in the zone with the medium air pollution level, and lastly travels in the zone with the lowest air pollution level.

[0128] For example, as illustrated in FIG. **5**, the processor **190** may generate the travel route so that the disinfection robot **1** travels in the first zone R**1**, then travels in the fifth, seventh, and ninth zones R**5**, R**7**, and R**9**, and then travels in the second, third, fourth, sixth, eighth, and tenth zones R**2**, R**3**, R**4**, R**6**, R**8**, and R**10**.

[0129] The disinfection robot **1** may travel along the travel route (**1040**).

[0130] The processor **190** may control the wheel driver **140** so that the disinfection robot **1** travels along the travel route. As illustrated in FIG. **5**, the disinfection robot **1** may travel along the travel route.

[0131] The disinfection robot **1** may update an air quality map (**1050**).

[0132] The processor **190** may control the fan driver **160** so that the fan **50** rotates while the disinfection robot **1** travels along the travel route. Due to the rotation of the fan **50**, the air in the disinfection space may be suctioned into the disinfection body **10**, and foreign substances contained in the air may be filtered while the suctioned air passes through the filter. Therefore, it is possible to improve the air quality of the disinfection space.

[0133] The processor **190** may acquire the air pollution level based on the output signal of the pollution sensor **120** while the disinfection robot **1** travels along the travel route. The output signal of the pollution sensor **120** may include the gas concentration, the dust concentration, the ozone concentration, and/or the carbon dioxide concentration.

[0134] The processor **190** may update the air quality map data stored in the memory **191** based on the acquired air pollution level.

[0135] The disinfection robot **1** may check air quality information (**1060**).

[0136] The processor **190** may identify the air pollution level of the disinfection space based on the updated air quality map data.

[0137] The disinfection robot **1** may determine the ozone concentration and the carbon dioxide concentration (**1070**).

[0138] The processor **190** may identify the ozone concentration and the carbon dioxide concentration in the disinfection space based on the updated air quality map data.

[0139] The disinfection robot **1** may output a message for indoor ventilation (**1080**).

[0140] When the identified ozone concentration exceeds a reference ozone concentration or the identified carbon dioxide concentration exceeds a reference carbon dioxide concentration, the processor **190** may control the control panel **110** to output the message for the indoor ventilation. In addition, the disinfection robot **1** may further include a speaker, and the processor **190** may control the speaker to output a sound message for the indoor ventilation.

[0141] As described above, the disinfection robot **1** may autonomously travel in the disinfection space. The disinfection robot **1** may generate the travel route based on the air quality map data to first purify the zone with the high air pollution level and travel along the generated travel route.

[0142] FIG. **6** is a view illustrating a method of the disinfection robot according to one embodiment disinfecting the disinfection space. FIG. **7** is a view illustrating an example in which the disinfection robot according to one embodiment disinfects the disinfection space.

[0143] A method **1100** in which the disinfection robot **1** performs stationary disinfection will be described with reference to FIGS. **6** and **7**.

[0144] The disinfection robot **1** may initiate the stationary disinfection (**1110**).

[0145] The stationary disinfection may indicate that the disinfection robot **1** stops in the disinfection space and purifies the air in the disinfection space.

[0146] The user may input the user's input for the stationary disinfection through the input button **111**. The control panel **110** may provide the processor **190** with an electrical signal corresponding to the user's input for the stationary disinfection. The processor **190** may acquire the user's input for the stationary disinfection based on an output signal of the control panel **110**.

[0147] The processor **190** may initiate the stationary disinfection in response to the user's input for the stationary disinfection. For example, the processor **190** may control the wheel driver **140** to prevent the movement of the disinfection robot **1** and control the fan driver **160** to suction air into the filter.

[0148] The disinfection robot **1** may change a direction of the outlet **31** to zones with severe air pollution to circulate air (**1120**).

[0149] The processor **190** may acquire the air pollution levels in the plurality of zones based on the air quality map data. The processor **190** may identify the zone with the highest air pollution level among the plurality of zones based on the air pollution levels in the plurality of zones.

[0150] The processor **190** may identify a position of the stopped disinfection robot **1** and a position of the zone with the highest air pollution level based on the geographical map data. In addition, the processor **190** may identify a relative direction of the zone with the highest air pollution level with respect to the stopped position of the disinfection robot **1**.

[0151] The processor **190** may control the cover driver **170** so that the air filtered by the filter moves toward the zone with the highest air pollution level based on the identified relative direction. For example, as illustrated in FIG. **7**, the processor **190** may control the cover driver **170** so that the outlet **31** of the cover **30** faces the first zone R1.

[0152] As described above, the disinfection robot **1** may purify the air in the disinfection space in a stopped state. The disinfection robot **1** may discharge the purified air toward the zone with high air pollution level in the stopped state.

[0153] FIG. **8** is a view illustrating a method of the disinfection robot according to one embodiment disinfecting the disinfection space. FIG. **9** is a view illustrating an example in which the disinfection robot according to one embodiment disinfects the disinfection space.

[0154] A method **1200** in which the disinfection robot **1** performs moving disinfection will be described with reference to FIGS. **8** and **9**.

[0155] The disinfection robot **1** may initiate the moving disinfection (**1210**).

[0156] The moving disinfection may indicate that the disinfection robot **1** purifies the air in the disinfection space while moving in the disinfection space.

[0157] The user may input the user's input for the moving disinfection through the input button **111**. The control panel **110** may provide the processor **190** with an electrical signal corresponding to the user's input for the moving disinfection. The processor **190** may acquire the user's input for the moving disinfection based on an output signal of the control panel **110**.

[0158] The processor **190** may initiate the moving disinfection in response to the user's input for the moving disinfection. For example, the processor **190** may control the wheel driver **140** so that the disinfection robot **1** travels along a predetermined route and control the fan driver **160** to suction air into the filter.

[0159] The disinfection robot **1** may change the direction of the outlet **31** to zones with severe air pollution to circulate air while the disinfection robot **1** moves (**1220**).

[0160] The processor **190** may acquire the air pollution levels in the plurality of zones based on the air quality map data. The processor **190** may identify the zone with the highest air pollution level among the plurality of zones based on the air pollution levels in the plurality of zones.

[0161] The processor **190** may identify a current position of the disinfection robot **1** in real time while the disinfection robot **1** moves. The processor **190** may identify the current position of the moving disinfection robot **1** and the position of the zone with the highest air pollution level based on the geographical map data. In addition, the processor **190** may identify a relative direction of the zone with the highest air pollution level with respect to the current position of the moving disinfection robot **1**.

[0162] The processor **190** may control the cover driver **170** so that the air filtered by the filter moves toward the zone with the highest air pollution level based on the identified relative direction. For example, as illustrated in FIG. **9**, the processor **190** may control the cover driver **170** so that the outlet **31** of the cover **30** faces the first zone R1 while the disinfection robot **1** moves.

[0163] For example, as illustrated in FIG. **9**, the processor **190** may control the cover driver **170** so that the outlet **31** of the cover **30** faces the first zone R1 when the disinfection robot **1** moves in the vicinity of the first zone R1.

[0164] As described above, the disinfection robot **1** may purify the air in the disinfection space while moving along the predetermined route. The disinfection robot **1** may discharge the purified air toward the zone with high air pollution level while moving.

[0165] Meanwhile, disclosed embodiments may be implemented in the form of a recording medium in which commands executable by a computer are stored. The commands may be stored in the form of program code, and when executed by a processor, program modules are generated to perform operations of the disclosed embodiments. The recording medium may be implemented as a computer-readable recording medium.

[0166] The computer-readable recording medium includes any type of recording media in which commands that may be decoded by a computer are stored. For example, there may be a ROM, a RAM, a magnetic tape, a magnetic disk, a flash memory, an optical data storage device, and the like.

[0167] A device-readable storage medium may be provided in the form of a non-transitory storage medium. Here, "non-transitory" is a tangible device and only means not including a signal (e.g., electromagnetic waves), and this term does not distinguish between cases in which data is stored semi-permanently and temporarily in the storage medium. For example, "non-temporary storage medium" may include a buffer in which data is temporarily stored.

[0168] As is apparent from the above description, it is possible to provide a movable disinfection robot and a method of controlling the same.

[0169] According to one aspect of the present disclosure, it is possible to provide the disinfection robot which may actively respond to a change according to pollutants in the air, and the method of controlling the same.

[0170] As described above, the disclosed embodiments have been described with reference to the accompanying drawings. Those skilled in the art to which the present disclosure pertains will understand that the present disclosure can be carried out in the form different from the disclosed embodiments without changing the technical spirit or essential features of the present disclosure. The disclosed embodiments are illustrative and should not be construed as being limited.

What is claimed is:

1. A disinfection robot comprising:

a body provided with an outlet;

a fan provided inside the body;

a fan motor configured to rotate the fan;

a wheel provided under the body;

a wheel motor configured to rotate the wheel; and

a processor including geographical map data corresponding to a disinfection space including a plurality of zones and air quality map data indicating air quality of the plurality of zones, and configured to control the fan motor to rotate the fan to discharge air through the outlet and control the wheel motor to rotate the wheel to move the body based on the geographical map data and the air quality map data.

2. The disinfection robot of claim **1**, wherein the processor is configured to:

identify a disinfection order of the plurality of zones included in the disinfection space based on the geographical map data and the air quality map data; and

generate a travel route along which the body travels based on the disinfection order of the plurality of zones.

3. The disinfection robot of claim **2**, wherein the processor is configured to control the wheel motor so that the body travels along the travel route.

4. The disinfection robot of claim **3**, further comprising a pollution sensor configured to detect pollution of air in the disinfection space,

wherein the processor is configured to update the air quality map data based on an output of the pollution sensor while the body travels along the travel route.

5. The disinfection robot of claim **4**, wherein the processor is configured to:

identify at least one of an ozone concentration or a carbon dioxide concentration in the disinfection space based on the air quality map data; and

output a message for ventilation in the disinfection space based on the at least one of the ozone concentration or the carbon dioxide concentration.

6. The disinfection robot of claim **1**, further comprising:

a cover in which the outlet is formed and which is provided to be rotatable with respect to the body; and

a cover motor configured to rotate the cover,

wherein the processor is configured to control the cover motor to rotate the cover based on the geographical map data and the air quality map data.

7. The disinfection robot of claim **6**, wherein the processor is configured to rotate the cover so that the outlet faces a zone with a highest air pollution level among the plurality of zones while the disinfection robot is stopped.

8. The disinfection robot of claim **6**, wherein the processor is configured to rotate the cover so that the outlet faces a zone with a highest air pollution level among the plurality of zones while the disinfection robot moves.

9. The disinfection robot of claim **1**, further comprising a travel sensor configured to detect the rotation of the wheel,

wherein the processor is configured to control the wheel motor so that the body travels in the disinfection space and generate the geographical map data based on an output of the travel sensor while the body travels in the disinfection space.

10. The disinfection robot of claim **9**, further comprising a pollution sensor configured to detect pollution of air in the disinfection space,

wherein the processor is configured to control the wheel motor so that the body travels in the disinfection space and generate the air quality map data based on an output of the pollution sensor while the body travels in the disinfection space.

11. A method of controlling a disinfection robot including a body provided with an outlet, a fan provided inside the body, and a wheel provided under the body, the method comprising:

controlling the fan to discharge air through the outlet; and

moving the body based on geographical map data corresponding to a disinfection space including a plurality of zones and air quality map data indicating air quality of the plurality of zones.

12. The method of claim **11**, wherein the moving of the body includes:

identifying a disinfection order of the plurality of zones included in the disinfection space based on the geographical map data and the air quality map data; and

generating a travel route along which the body travels based on the disinfection order of the plurality of zones.

13. The method of claim **12**, wherein the moving of the body further includes moving the body along the travel route.

14. The method of claim **13**, further comprising updating the air quality map data based on an output of a pollution sensor configured to detect pollution of air in the disinfection space while the body travels along the travel route.

15. The method of claim **14**, further comprising:

identifying at least one of an ozone concentration or a carbon dioxide concentration in the disinfection space based on the air quality map data; and

outputting a message for ventilation in the disinfection space based on the at least one of the ozone concentration or the carbon dioxide concentration.

16. The method of claim **11**, further comprising rotating a cover in which the outlet is formed and which is provided to be rotatable with respect to the body based on the geographical map data and the air quality map data.

17. The method of claim **16**, wherein the rotating of the cover includes rotating the cover so that the outlet faces a zone with a highest air pollution level among the plurality of zones while the disinfection robot is stopped.

18. The method of claim **16**, wherein the rotating of the cover includes rotating the cover so that the outlet faces a zone with a highest air pollution level among the plurality of zones while the disinfection robot moves.

19. The method of claim **11**, further comprising:

moving the body in the disinfection space; and

generating the geographical map data based on an output of a travel sensor configured to detect rotation of the wheel.

20. The method of claim **19**, further comprising, after the moving of the body in the disinfection space, generating the air quality map data based on an output of a pollution sensor configured to detect pollution of air in the disinfection space.

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