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(54) **ROBOT CLEANER AND METHOD FOR CONTROLLING THE SAME**

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(57) **ABSTRACT**

A robot cleaner which performs a re-cleaning to allow a mop to re-clean over a contaminated area again after performing a drying operation on the mop, based on determining dry mopping is required for the contaminated area and a humidity of the mop being greater than a reference humidity.

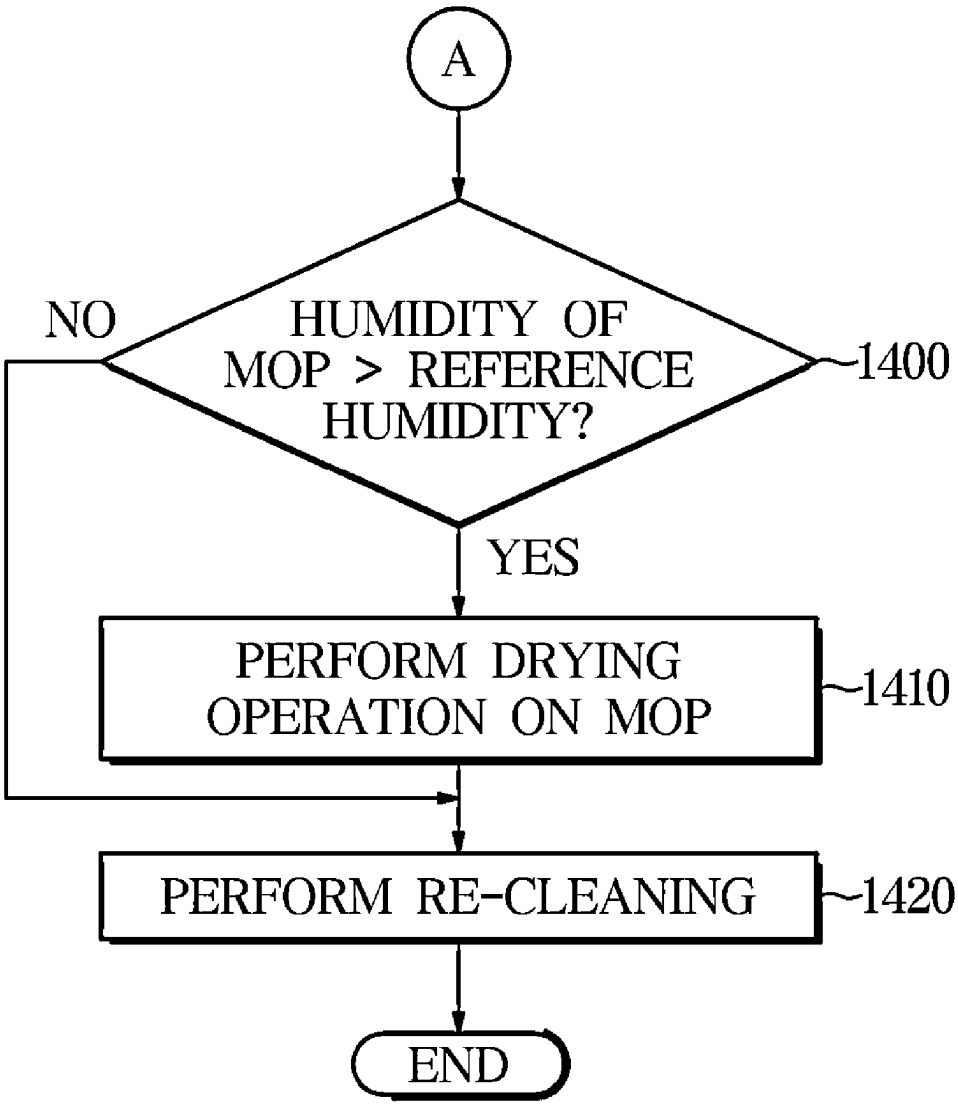


FIG. 1

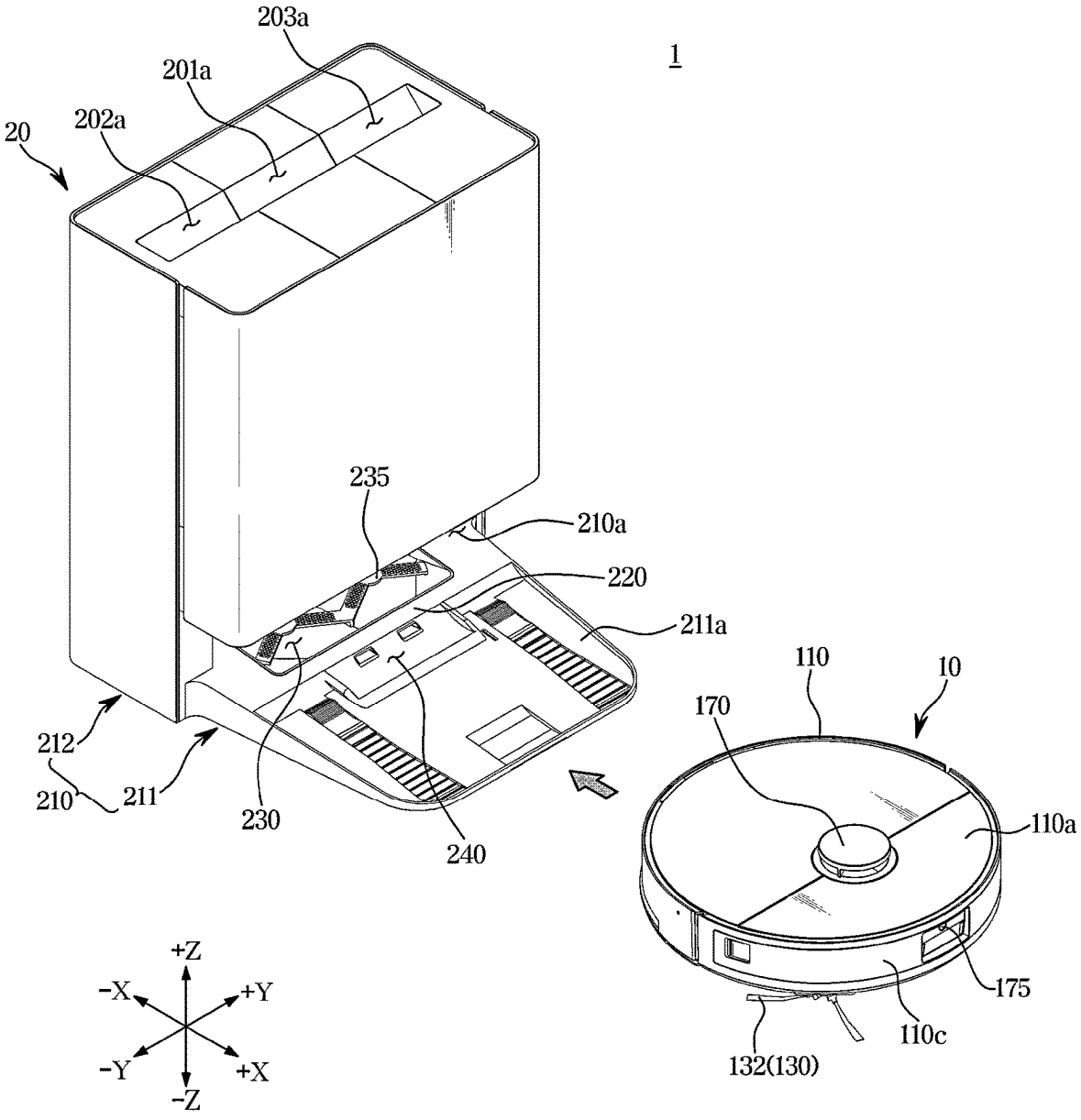

1
20
203a
201a
202a
235
210a
220
211a
212
210
211
230
240
110
10
170
110a
175
110c
132(130)
+Z
-X
+Y
-Y
+X
-Z

FIG. 2

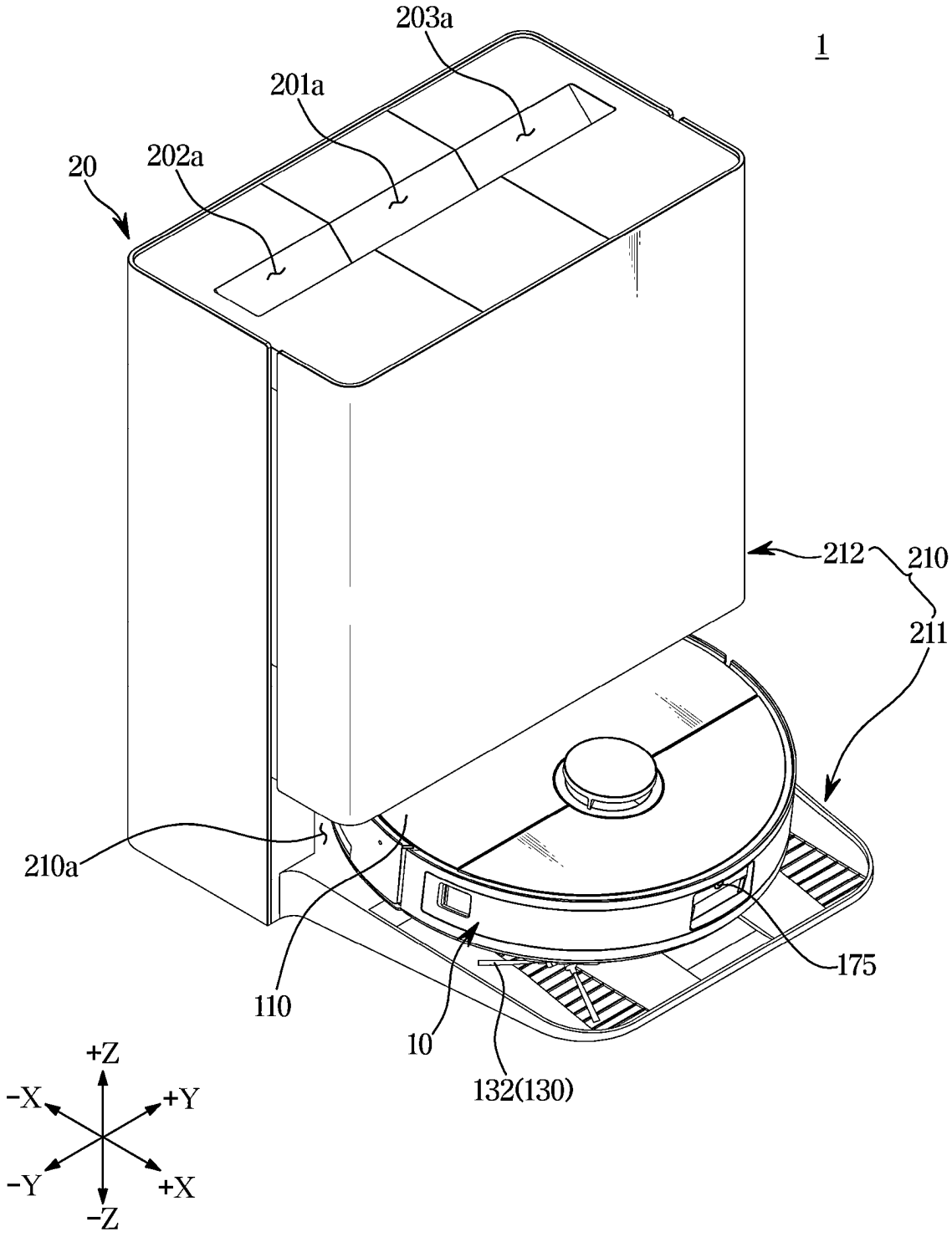


FIG. 3

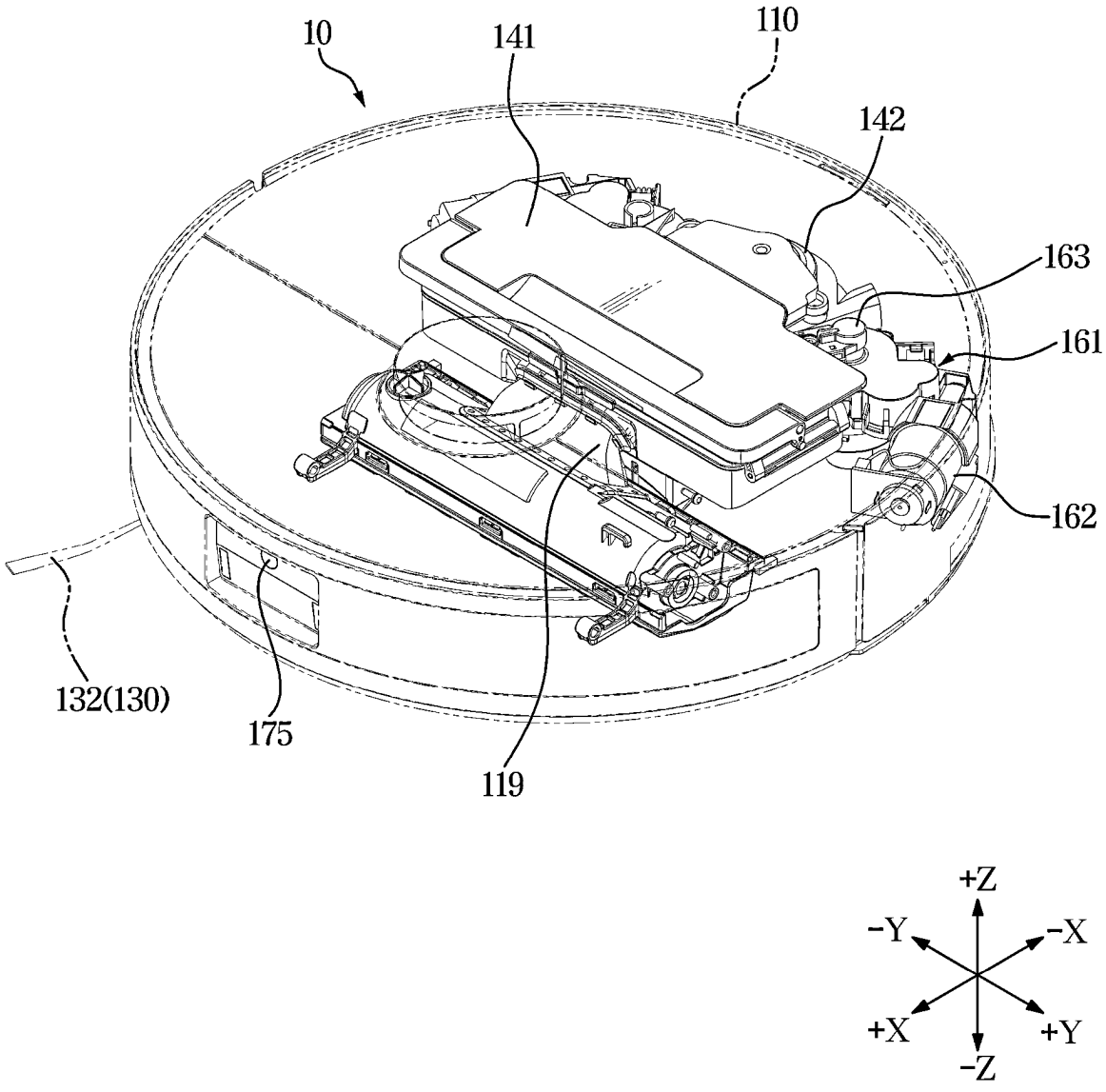


FIG. 4

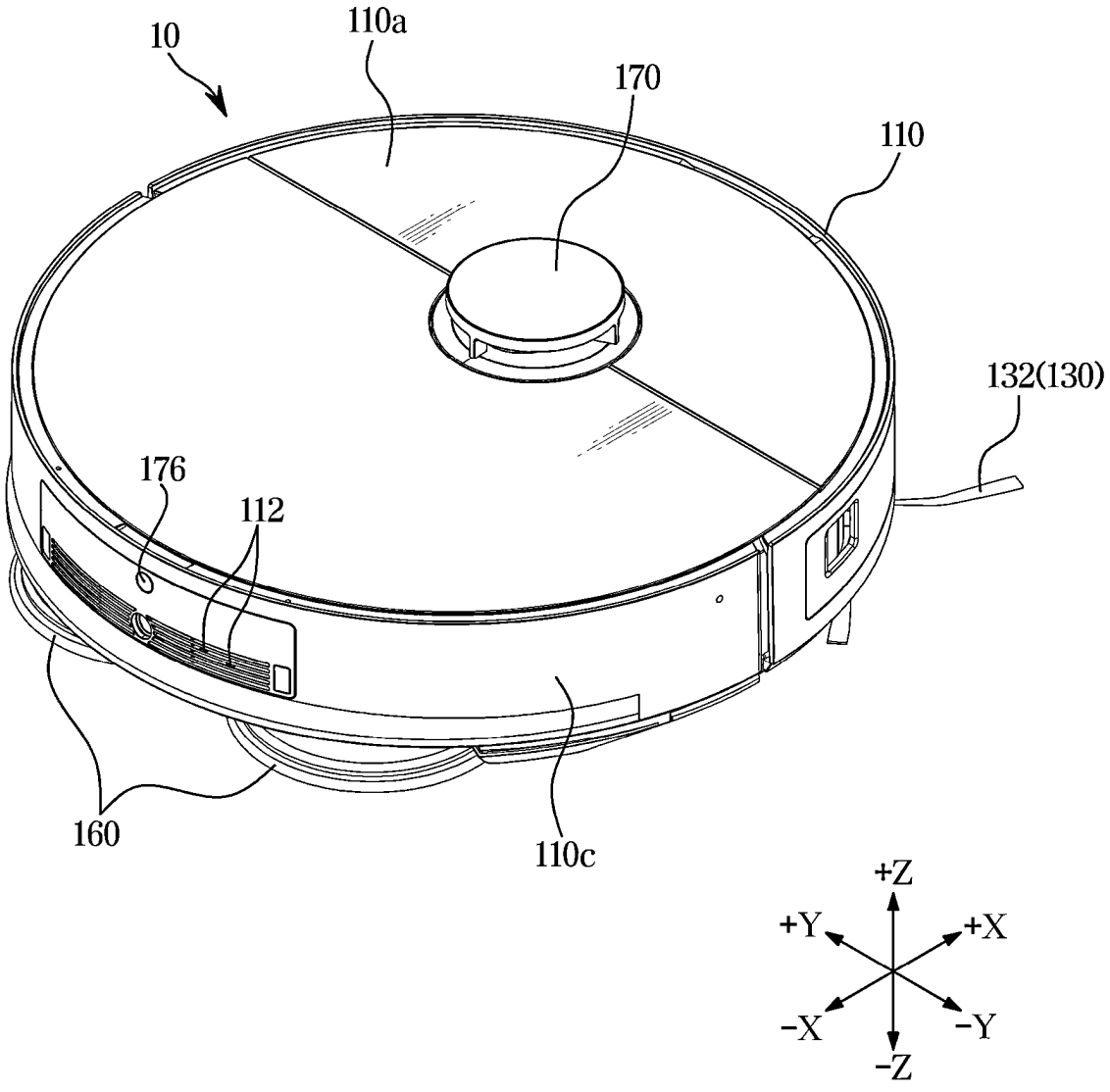


FIG. 5

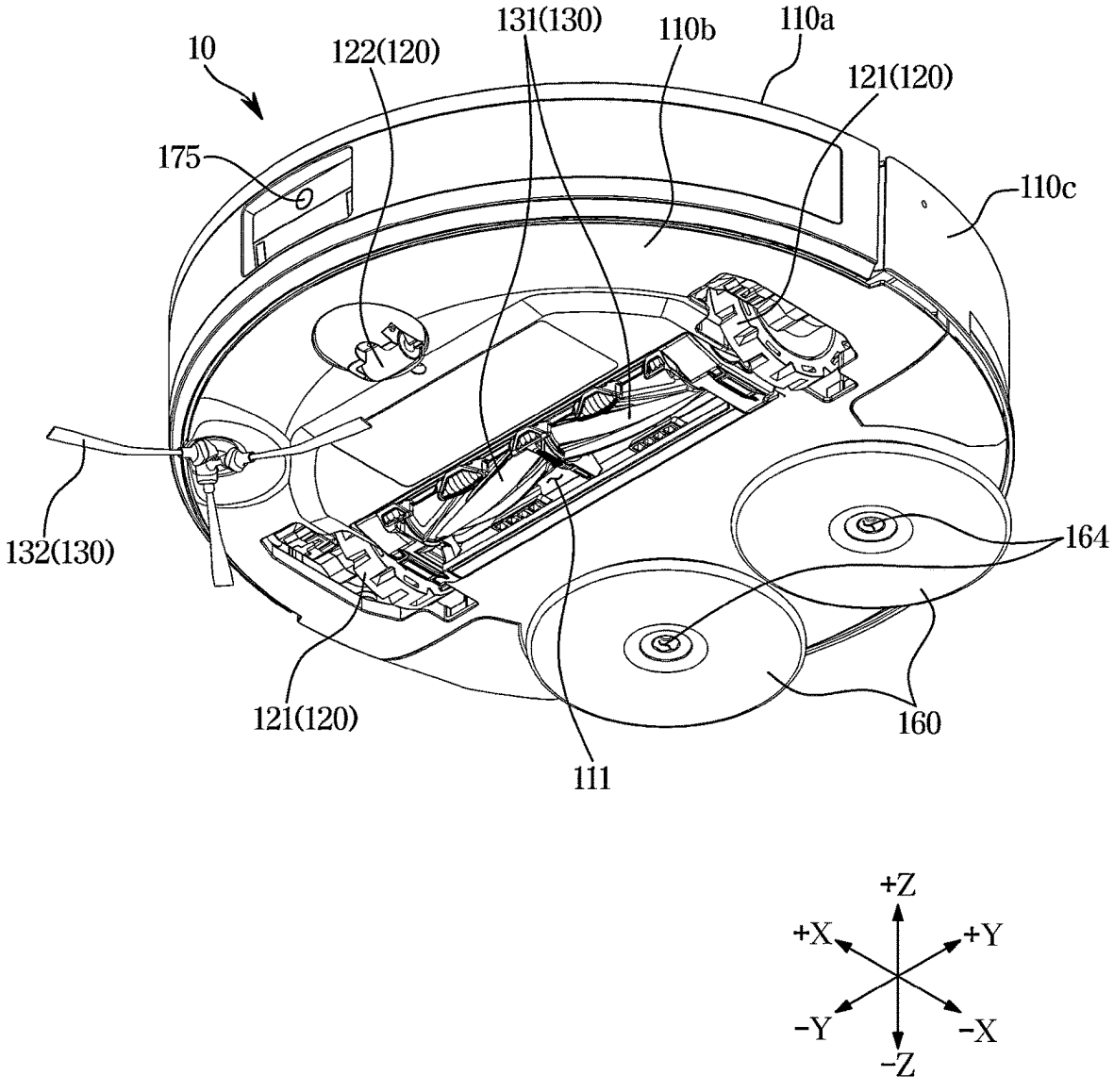

10
122(120)
131(130)
110b
110a
121(120)
175
110c
132(130)
164
121(120)
160
111
+Z
+X
+Y
-Y
-X
-Z

FIG. 6

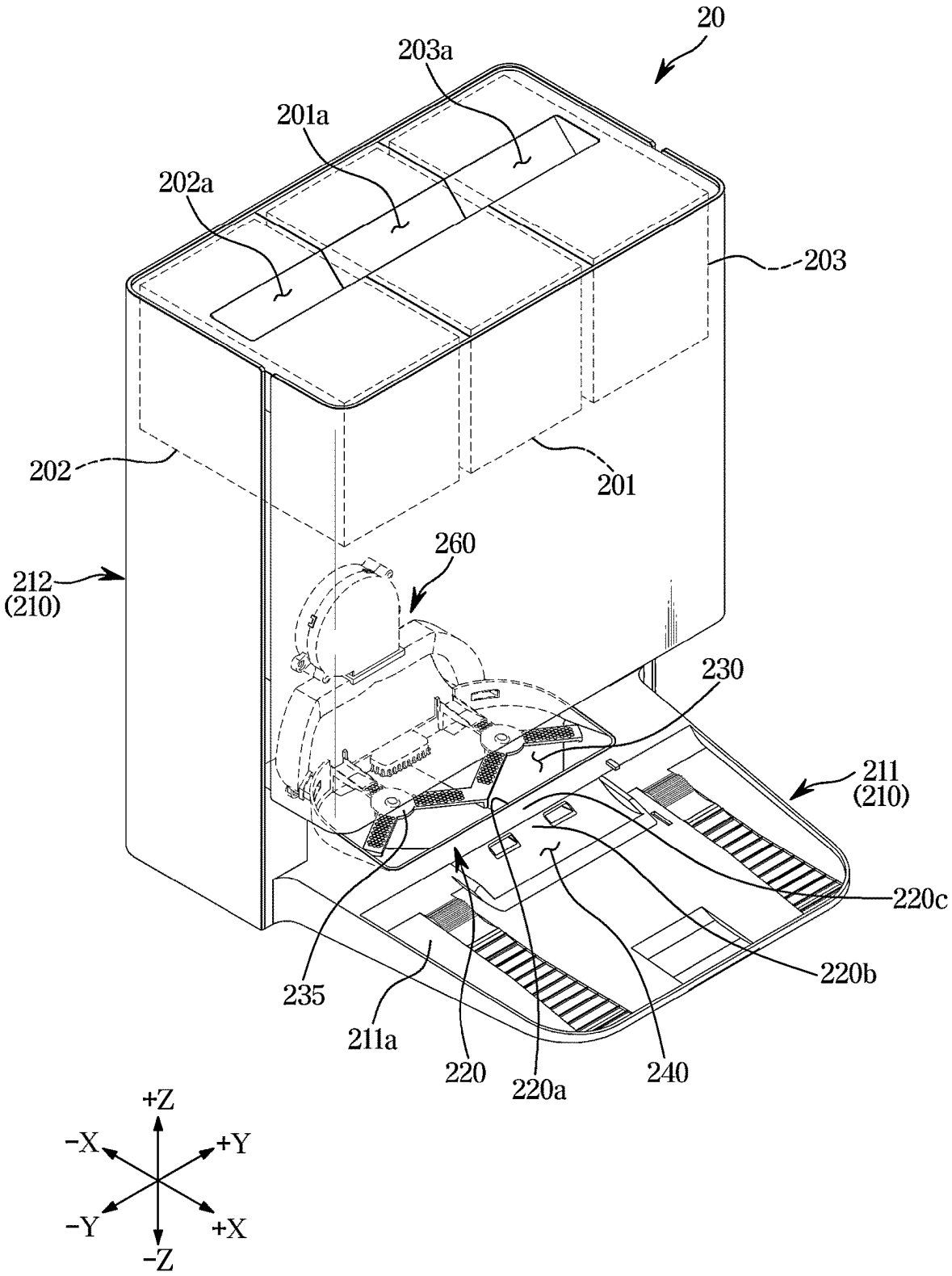
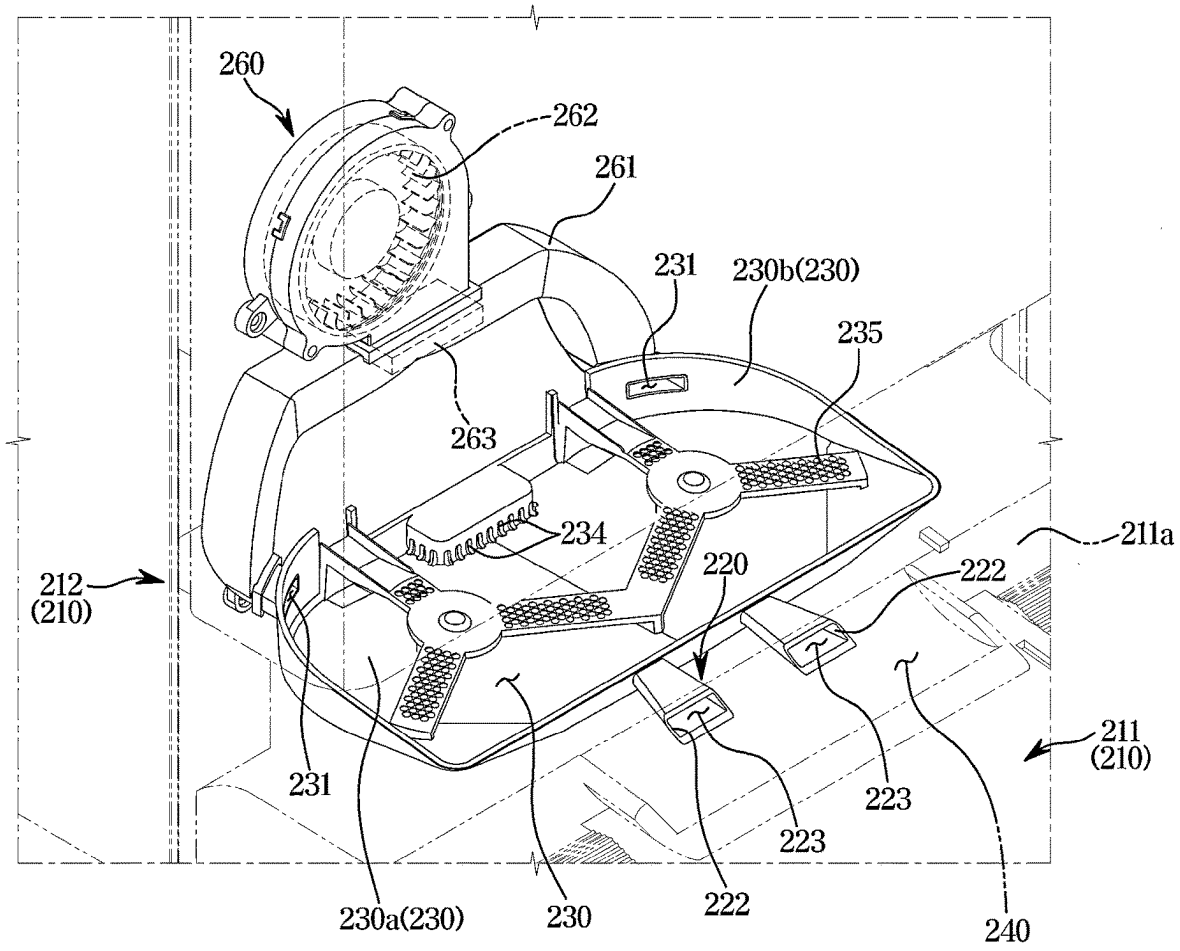

20
203a
201a
202a
203
202
201
260
212
(210)
230
211
(210)
220c
220b
235
211a
220
220a
240
+Z
−X
+Y
−Y
+X
−Z

FIG. 7


260
262
261
231
230b(230)
235
263
234
211a
212
(210)
220
222
231
223
211
(210)
223
230a(230)
230
222
240

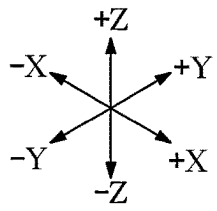

+Z
-X
+Y
-Y
+X
-Z

FIG. 8

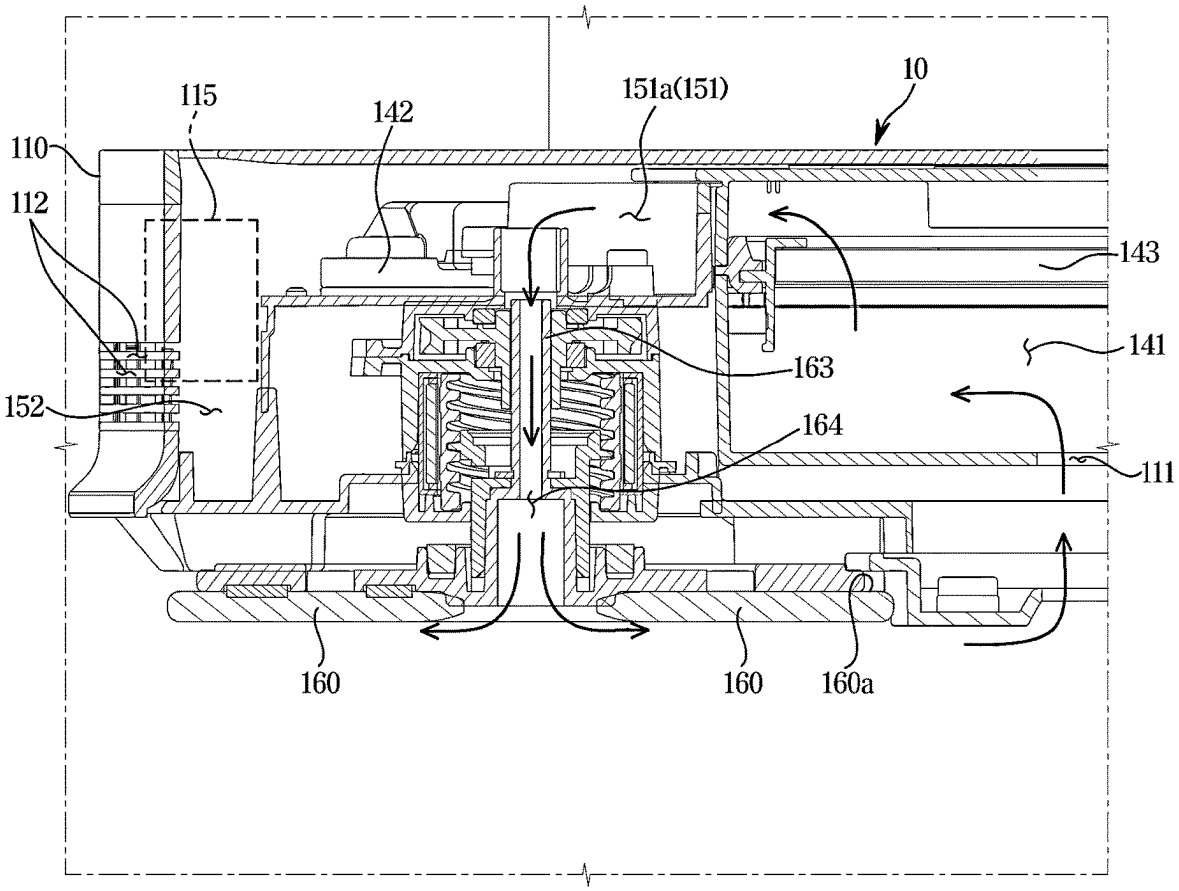


FIG. 9

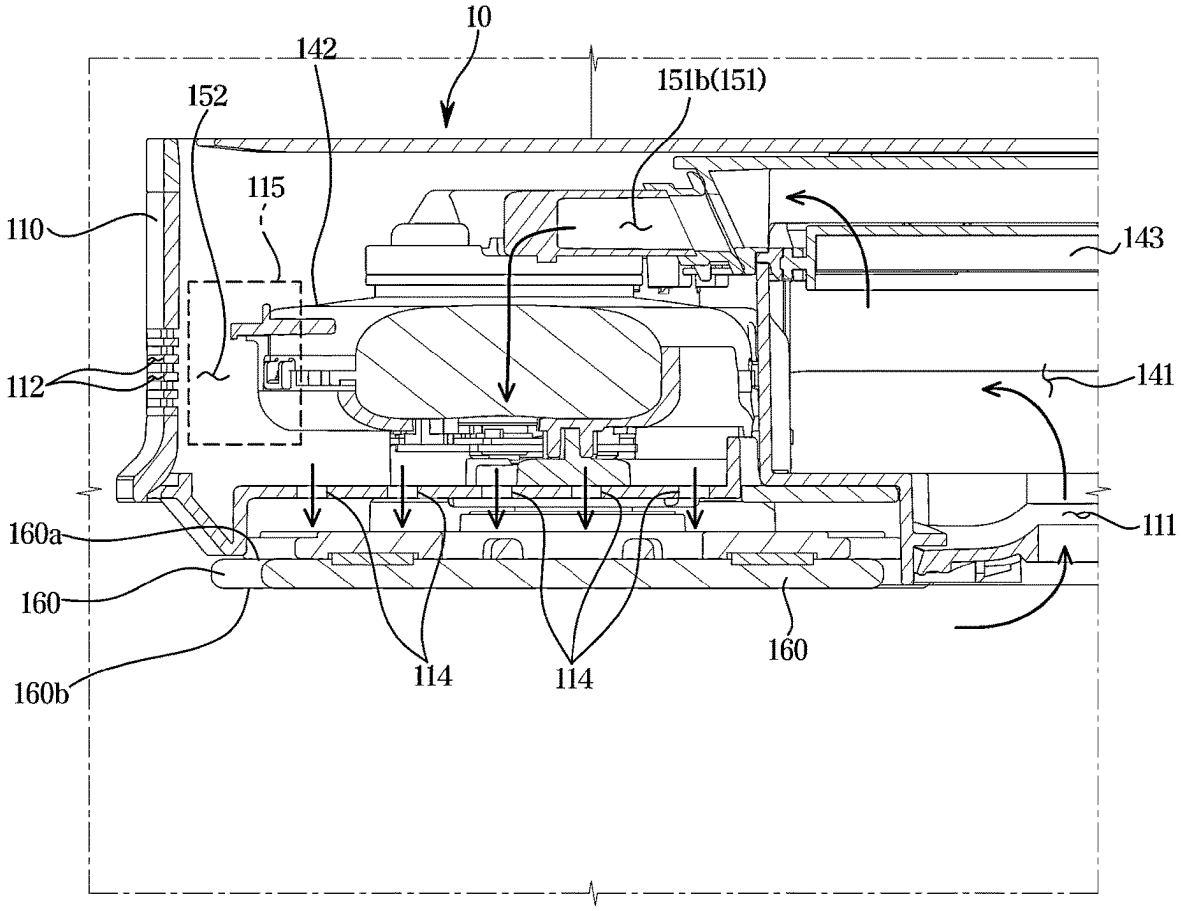

10
142
152
151b(151)
115
110
143
112
141
111
160a
160
160b
114
114
160

FIG. 10

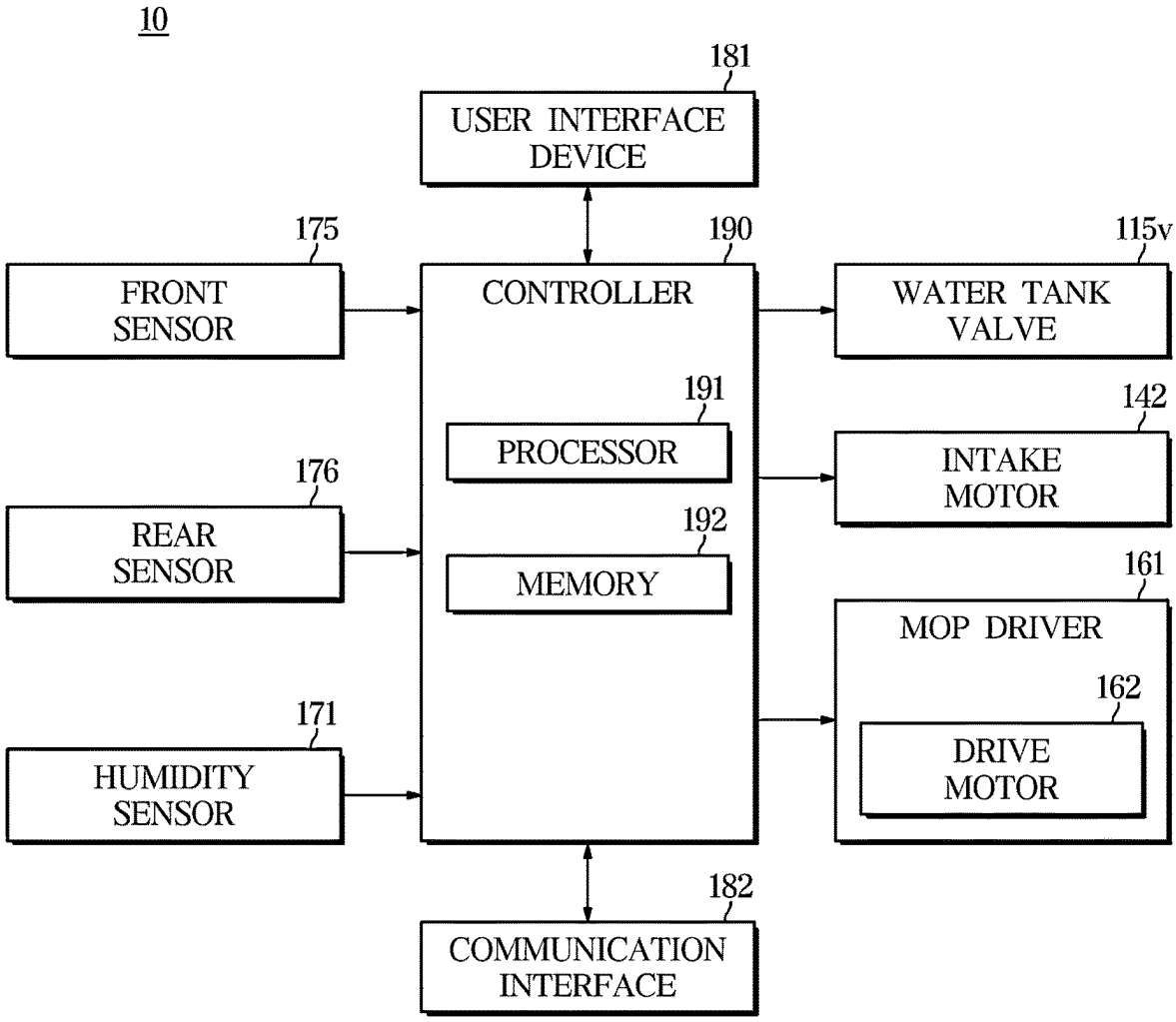

10
181
USER INTERFACE DEVICE
175
FRONT SENSOR
190
CONTROLLER
115v
WATER TANK VALVE
191
PROCESSOR
142
INTAKE MOTOR
176
REAR SENSOR
192
MEMORY
161
MOP DRIVER
162
DRIVE MOTOR
171
HUMIDITY SENSOR
182
COMMUNICATION INTERFACE

FIG. 11

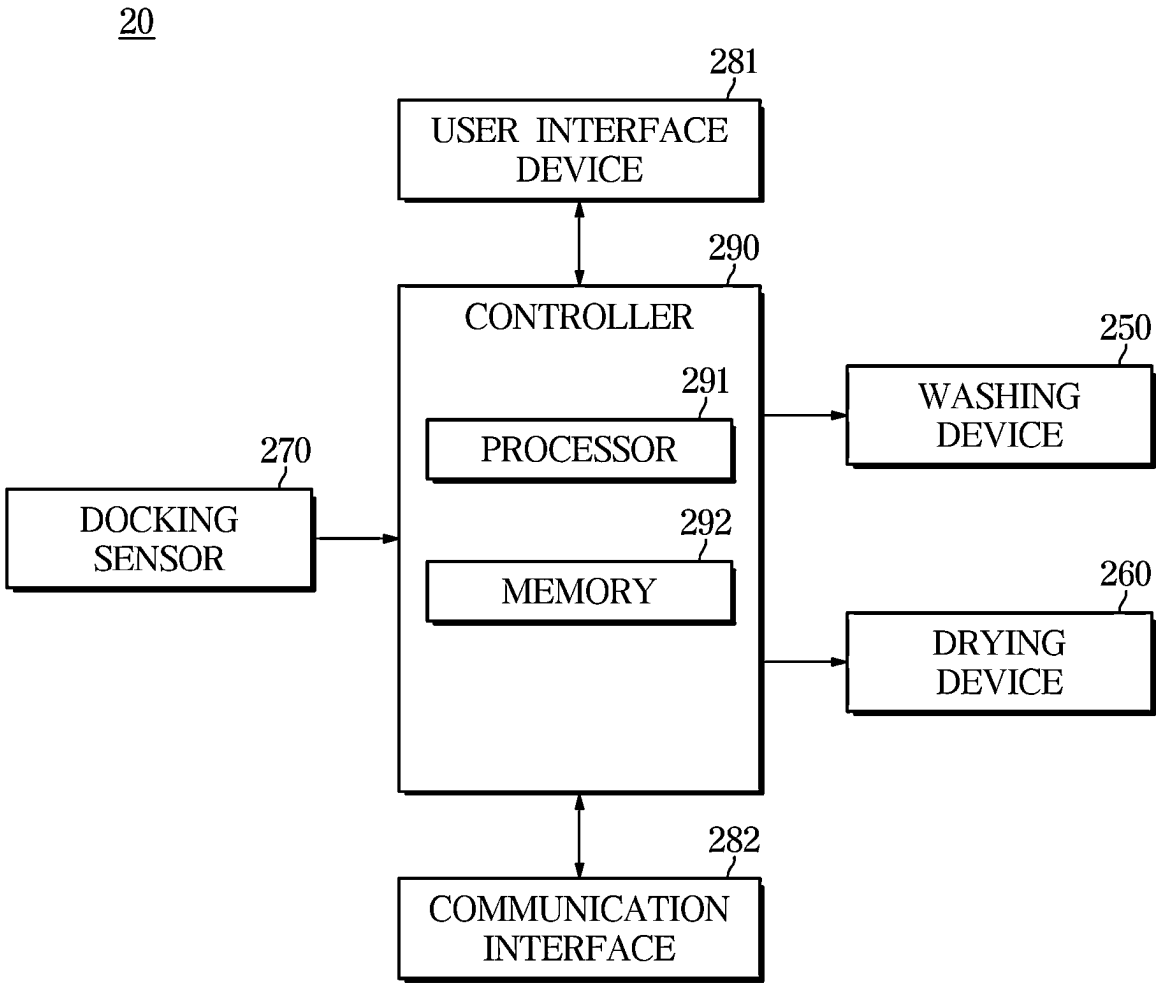

20
281
USER INTERFACE DEVICE
290
CONTROLLER
291
PROCESSOR
292
MEMORY
270
DOCKING SENSOR
250
WASHING DEVICE
260
DRYING DEVICE
282
COMMUNICATION INTERFACE

FIG. 12

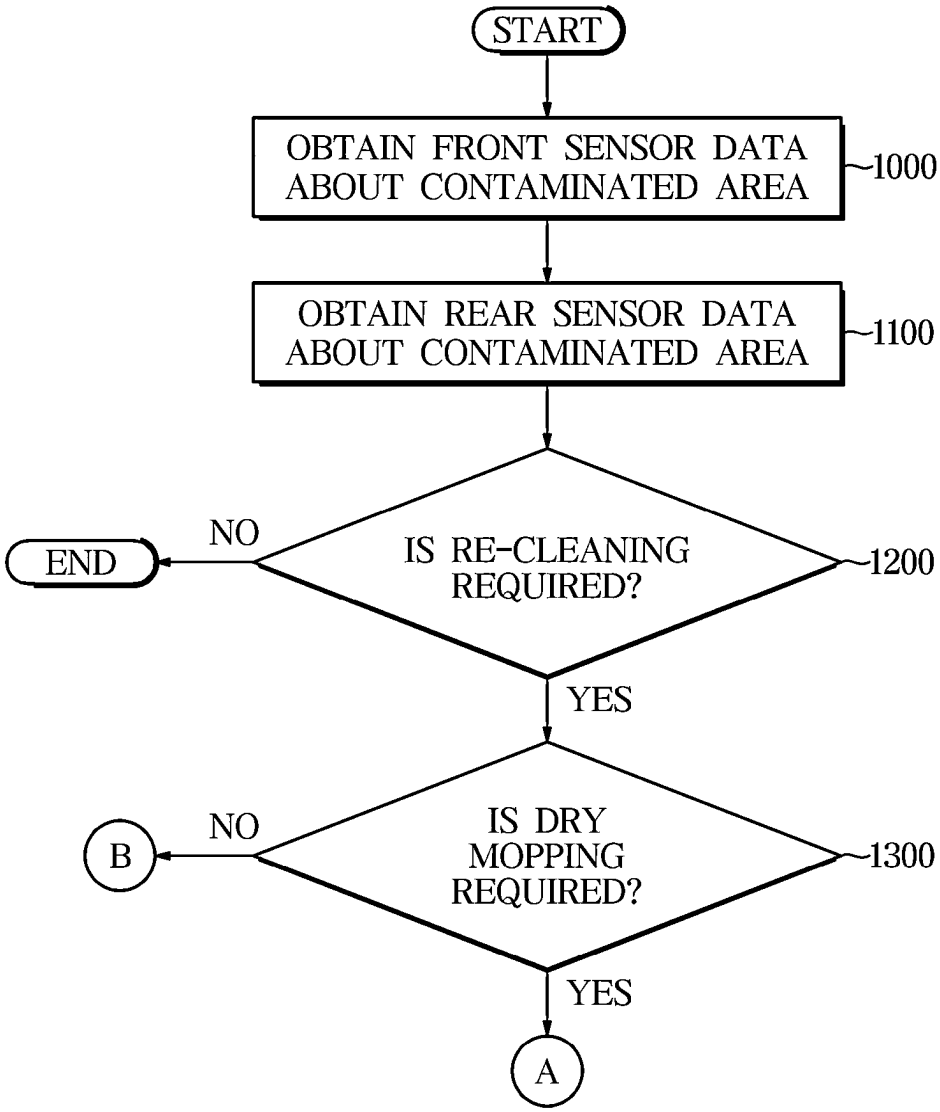

START
OBTAIN FRONT SENSOR DATA ABOUT CONTAMINATED AREA
1000
OBTAIN REAR SENSOR DATA ABOUT CONTAMINATED AREA
1100
IS RE-CLEANING REQUIRED?
1200
NO
END
YES
IS DRY MOPPING REQUIRED?
1300
NO
B
YES
A

FIG. 13

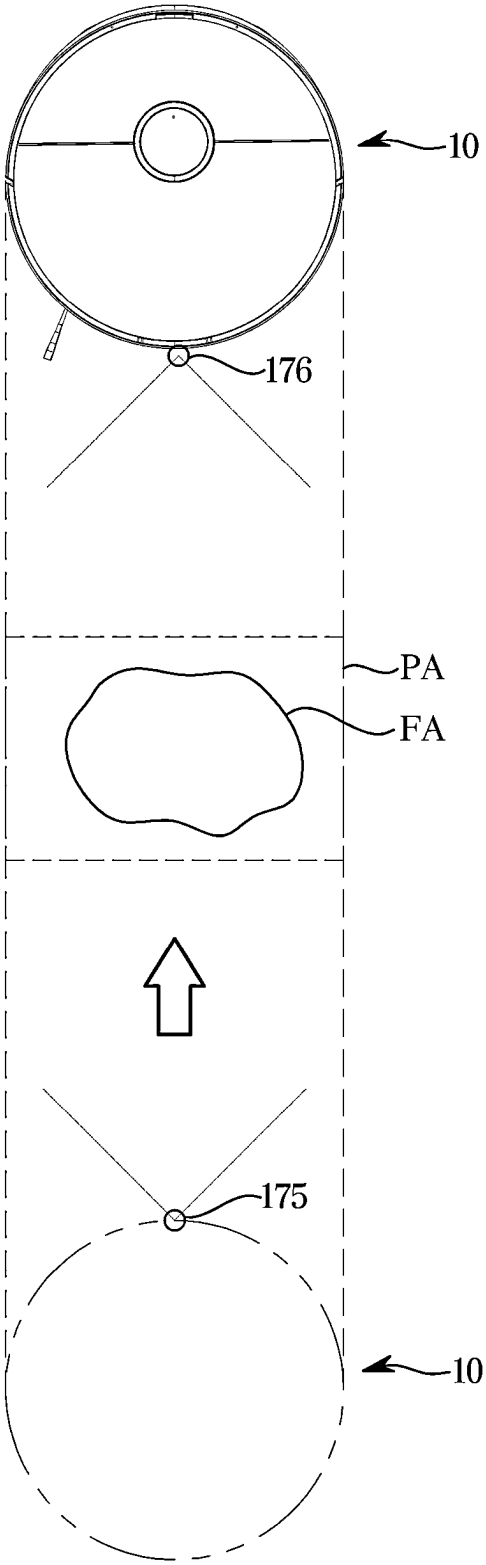


FIG. 14

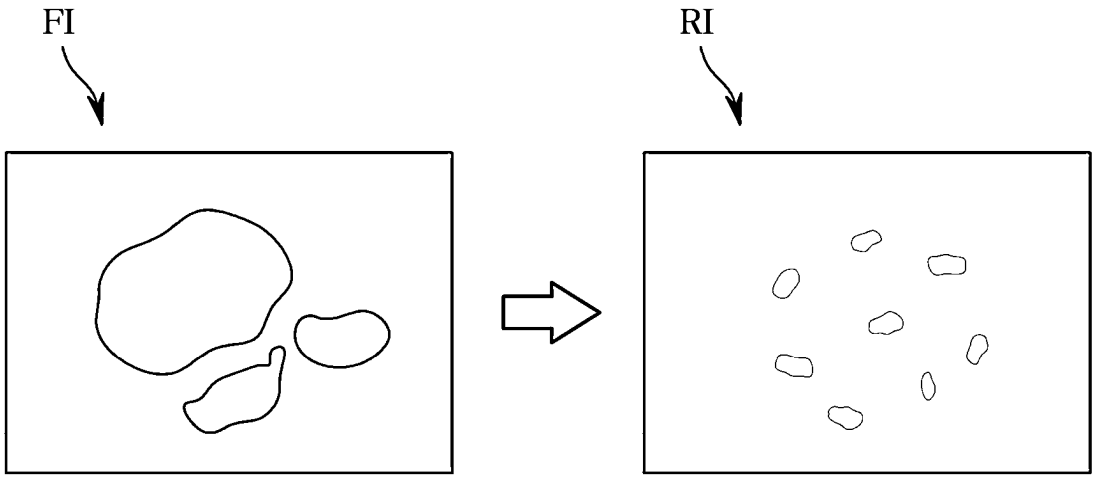


FIG. 15

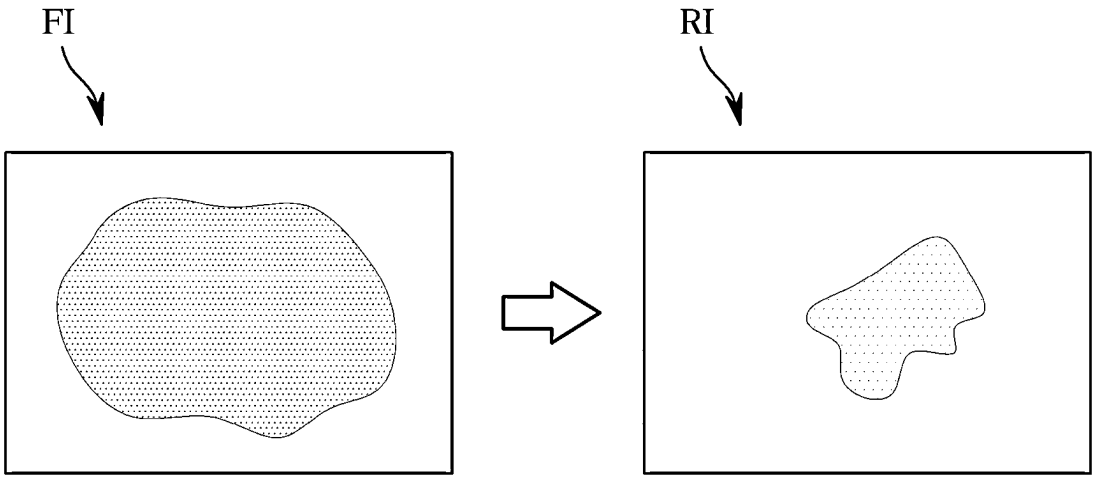


FIG. 16

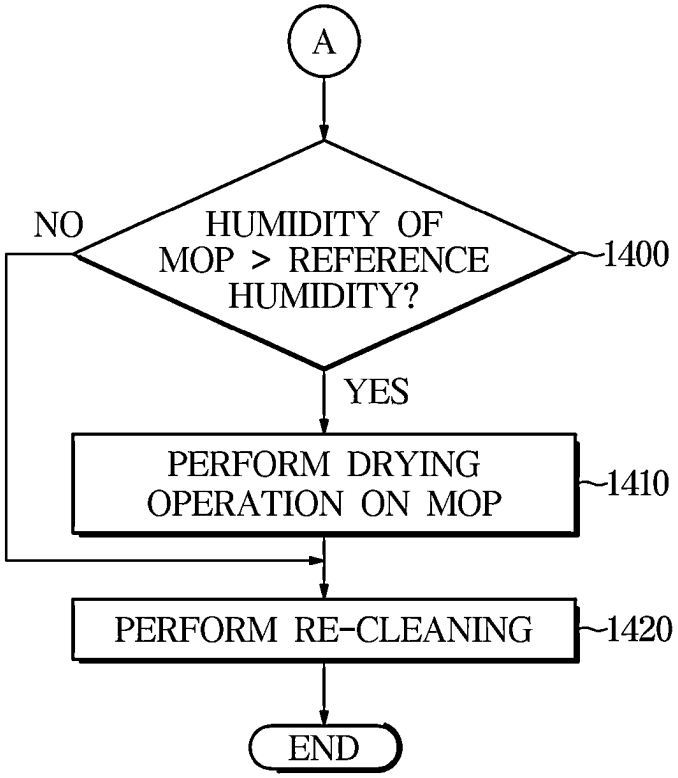

A
HUMIDITY OF MOP > REFERENCE HUMIDITY?
1400
NO
YES
PERFORM DRYING OPERATION ON MOP
1410
PERFORM RE-CLEANING
1420
END

FIG. 17

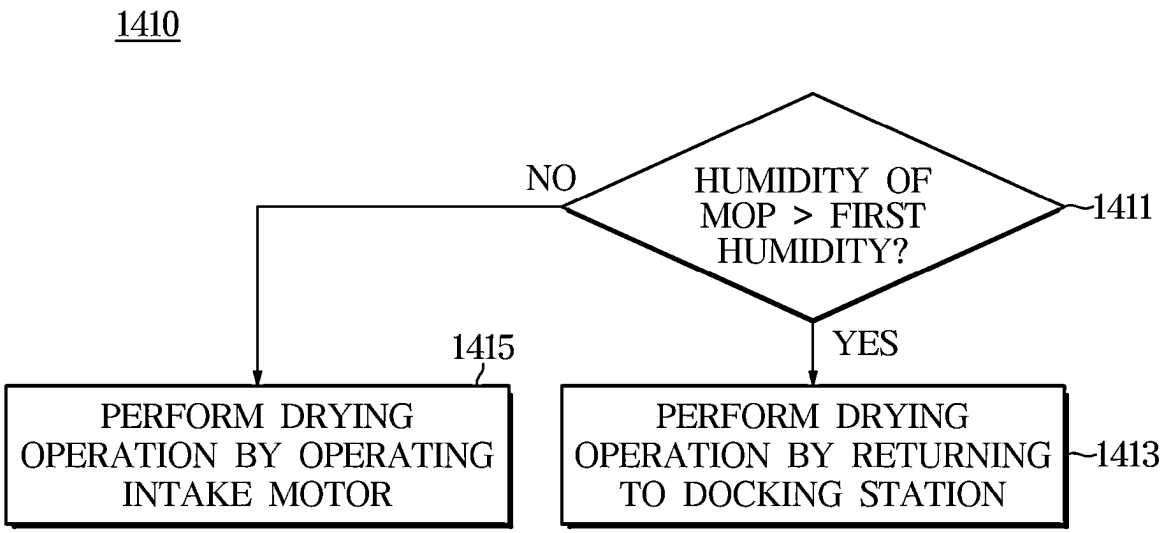

1410
HUMIDITY OF MOP > FIRST HUMIDITY?
1411
NO
YES
1415
PERFORM DRYING OPERATION BY OPERATING INTAKE MOTOR
PERFORM DRYING OPERATION BY RETURNING TO DOCKING STATION
1413

FIG. 18

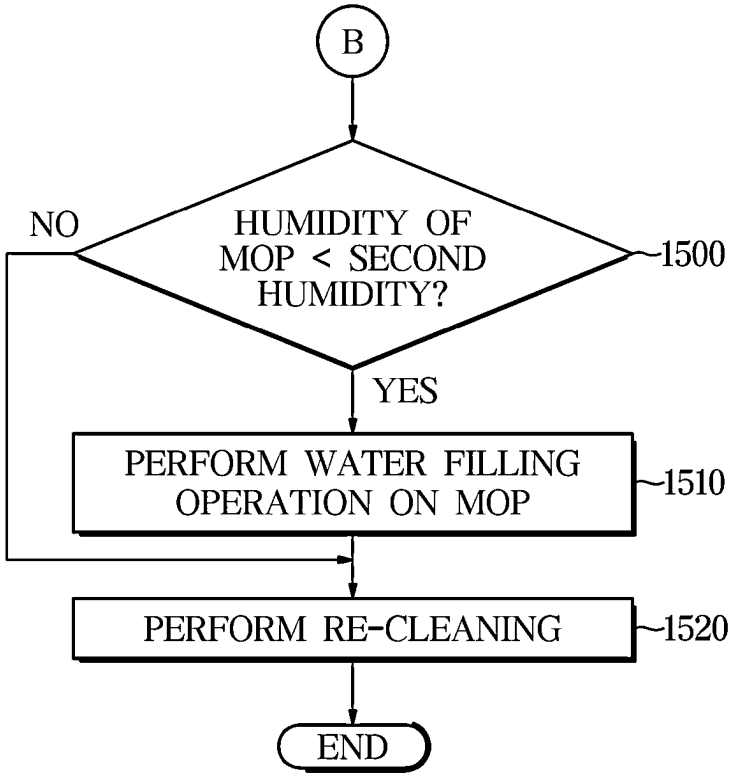
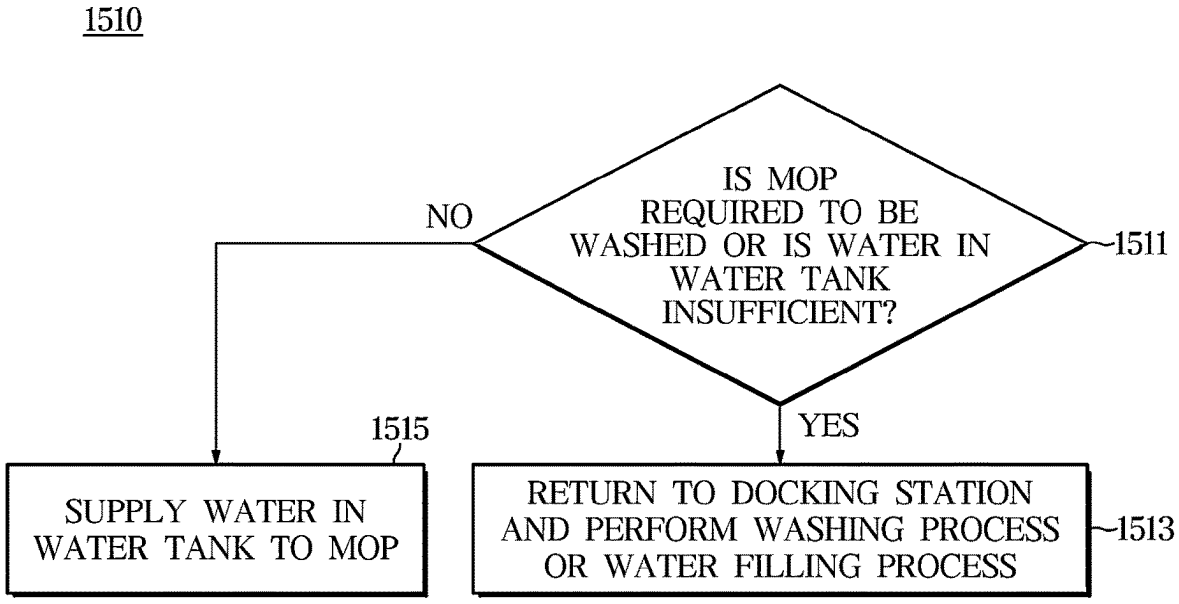

B
HUMIDITY OF MOP < SECOND HUMIDITY?
1500
NO
YES
PERFORM WATER FILLING OPERATION ON MOP
1510
PERFORM RE-CLEANING
1520
END

FIG. 19


1510
IS MOP REQUIRED TO BE WASHED OR IS WATER IN WATER TANK INSUFFICIENT?
1511
NO
YES
1515
SUPPLY WATER IN WATER TANK TO MOP
RETURN TO DOCKING STATION AND PERFORM WASHING PROCESS OR WATER FILLING PROCESS
1513

ROBOT CLEANER AND METHOD FOR CONTROLLING THE SAME

CROSS-REFERENCE TO RELATED APPLICATION

[0001] This application is a continuation application, under 35 U.S.C. § 111 (a), of international application No. PCT/KR2024/021465, filed Dec. 30, 2024, which claims priority under 35 U. S. C. § 119 to Korean Patent Application No. 10-2024-0022024, filed on Feb. 15, 2024, the disclosures of which are incorporated herein by reference in their entireties.

TECHNICAL FIELD

[0002] The disclosure relates to a robot cleaner that performs mop cleaning and a method for controlling the robot cleaner.

BACKGROUND ART

[0003] In general, a robot cleaner is a device that automatically cleans an area by moving across the cleaning area and picking up dirt, such as dust on the floor, without user intervention. The robot cleaner travels across the cleaning area to clean.

[0004] The robot cleaner identifies a distance to an obstacle, such as furniture, office equipment, walls, and the like, installed in the cleaning area using a distance sensor, and selectively drives left and right wheel motors of the robot cleaner, thereby changing its direction and cleaning the cleaning area by itself.

[0005] Recently, robot cleaners have been developed that not only vacuum foreign substances, such as dirt and dust on the floor, but also perform wet cleaning with a mop.

[0006] In addition to dry cleaning that uses an intake motor to pick up dust and other debris from the floor, robot cleaners may also perform wet cleaning with a mop.

DISCLOSURE

Technical Problem

[0007] An aspect of the disclosure provides a robot cleaner that may efficiently clean liquid contaminant, and a method for controlling the same.

[0008] An aspect of the disclosure provides a robot cleaner that may prevent situations where a cleaned area becomes slippery and poses a risk to a user, and a method for controlling the same.

[0009] An aspect of the disclosure provides a robot cleaner that may efficiently dry a mop depending on the amount of liquid contaminant, and a method for controlling the same.

[0010] An aspect of the disclosure provides a robot cleaner that may efficiently clean a stain, and a method for controlling the same.

[0011] Technical objects that may be achieved by the disclosure are not limited to the above-mentioned objects, and other technical objects not mentioned will be clearly understood by one of ordinary skill in the art to which the disclosure belongs from the following description.

Technical Solution

[0012] According to an embodiment, a robot cleaner may include: a main body: a mop configured to be coupleable to and decoupleable from a lower portion of the main body: a front sensor configured to have a front field of view of the main body: a rear sensor configured to have a rear field of view of the main body: a humidity sensor configured to detect a humidity of the mop; and a controller configured to: determine whether dry mopping is required for an area to be cleaned that is detected by the front sensor based on information about the area obtained by the rear sensor after the mop coupled to the lower portion of the main body cleans the area detected by the front sensor, and based on the dry mopping being determined as being required for the area and the humidity of the mop detected by the humidity sensor being greater than a reference humidity, perform a re-cleaning to allow the mop to pass over the area again after performing a drying operation on the mop.

[0013] According to an embodiment, a method for controlling a robot cleaner may include: determining whether dry mopping is required for an area to be cleaned based on information about the area obtained by a rear sensor after a mop cleaned the area detected by a front sensor, and based on the dry mopping being determined as being required for the area and a humidity of the mop detected by the humidity sensor being greater than a reference humidity, performing a re-cleaning to allow the mop to pass over the area again after performing a drying operation on the mop.

DESCRIPTION OF DRAWINGS

[0014] FIG. **1** illustrates a state in which a robot cleaner is away from a station in a cleaning apparatus according to an embodiment.

[0015] FIG. **2** illustrates a state in which a robot cleaner is seated on a station in a cleaning apparatus according to an embodiment.

[0016] FIG. **3** is a view illustrating an interior of a robot cleaner according to an embodiment.

[0017] FIG. **4** is a rear view of the robot cleaner shown in FIG. **3** according to an embodiment.

[0018] FIG. **5** is a view illustrating a lower portion of the robot cleaner shown in FIG. **3** according to an embodiment.

[0019] FIG. **6** is a view illustrating a docking station according to an embodiment.

[0020] FIG. **7** is a view illustrating a portion of a docking station according to an embodiment.

[0021] FIG. **8** illustrates an example of air flow when an intake motor of a robot cleaner operates according to an embodiment.

[0022] FIG. **9** illustrates another example of air flow when an intake motor of a robot cleaner operates according to an embodiment.

[0023] FIG. **10** is a block diagram illustrating an example configuration of a robot cleaner according to an embodiment.

[0024] FIG. **11** is a block diagram illustrating an example configuration of a docking station according to an embodiment.

[0025] FIG. **12** is a flowchart illustrating an example method for controlling a robot cleaner according to an embodiment.

[0026] FIG. **13** illustrates an example of a robot cleaner passing over a contaminated area according to an embodiment.

[0027] FIG. **14** illustrates an example of front sensor data obtained by a front sensor and rear sensor data obtained by a rear sensor of a robot cleaner according to an embodiment.

[0028] FIG. **15** illustrates another example of front sensor data obtained by a front sensor and rear sensor data obtained by a rear sensor of a robot cleaner according to an embodiment.

[0029] FIG. **16** is a flowchart illustrating an example method of re-cleaning in a case where a robot cleaner according to an embodiment determines that dry mopping is required.

[0030] FIG. **17** is a flowchart illustrating an example drying operation of a robot cleaner according to an embodiment.

[0031] FIG. **18** is a flowchart illustrating an example method of re-cleaning in a case where a robot cleaner according to an embodiment determines that wet mopping is required.

[0032] FIG. **19** is a flowchart illustrating an example water filling operation of a robot cleaner according to an embodiment.

MODES OF THE DISCLOSURE

[0033] Various embodiments and the terms used therein are not intended to limit the technology disclosed herein to specific forms, and the disclosure should be understood to include various modifications, equivalents, and/or alternatives to the corresponding embodiments.

[0034] The terms used herein are used only to describe particular embodiments and are not intended to limit the disclosure.

[0035] The expressions "A or B," "at least one of A or/and B," or "one or more of A or/and B," A, B or C," "at least one of A, B or/and C," or "one or more of A, B or/and C," and the like used herein may include any and all combinations of one or more of the associated listed items.

[0036] For example, a singular form of a noun corresponding to an item may include one item or a plurality of the items unless context clearly indicates otherwise.

[0037] It is to be understood that when the terms "includes," "comprises," "including," and/or "comprising," when used in this specification, specify the presence of stated features, figures, steps, operations, components, members, or combinations thereof, but do not preclude the presence or addition of one or more other features, figures, steps, operations, components, members, or combinations thereof.

[0038] An expression that one component is "connected", "coupled", "supported", or "in contact" with another component includes a case in which the components are directly "connected", "coupled", "supported", or "in contact" with each other and a case in which the components are indirectly "connected", "coupled", "supported", or "in contact" with each other through a third component.

[0039] It will also be understood that when one component is referred to as being "on" or "over" another component, it may be directly on the other component or intervening components may also be present.

[0040] It is to be understood that if a certain component (for example, a first component) is referred to, with or without the term "operatively" or "communicatively", as "coupled with," "coupled to," "connected with," or "connected to" another component (for example, a second component), it means that the component may be coupled with the other component directly (for example, wiredly), wirelessly, or via a third component.

[0041] According to the situation, the expression "configured to" used herein may be used as, for example, the expression "suitable for," "having the capacity to," "designed to," "adapted to," "made to," or "capable of". The term "configured to" must not mean only "specifically designed to" in hardware.

[0042] The expression "a device configured to" may mean that the device is "capable of" operating together with another device or other components. For example, a "processor configured to perform A, B, and C" may mean a dedicated processor (e.g., an embedded processor) for performing a corresponding operation or a generic-purpose processor (e.g., a central processing unit (CPU) or an application processor) which may perform corresponding operations by executing one or more software programs which are stored in a memory device.

[0043] The terms, such as "first," "second", and the like used herein may refer to various elements of various embodiments of the disclosure, but do not limit the elements.

[0044] The terms such as "portion", "device", "block", "member", and "module" indicate a unit for processing at least one function or operation. For example, those terms may refer to at least one process processed by at least one hardware such as field programmable gate array (FPGA), application specific integrated circuit (ASIC), at least one software stored in a memory or a processor.

[0045] Meanwhile, the terms "front," "rear," "left," "right," "upper," "lower," etc., used in the following description are defined based on the drawings, and the shape and position of each component are not limited by these terms. For example, as shown in FIG. **1**, a direction in which a robot cleaner **10** enters a docking station **20** may be defined as the rear (−X direction), and an opposite direction may be defined as the front (+X direction).

[0046] As another example, the direction in which the robot cleaner **10** moves forward may be defined as forward (+X direction), and the direction in which the robot cleaner **10** moves backward may be defined as backward (−X direction).

[0047] Although an example in which the robot cleaner **10** moves backward to enter the docking station **20** is illustrated in FIG. **1**, the robot cleaner **10** may move forward to enter the docking station **20** depending on the structure of the robot cleaner **10** (e.g., a position of a mop).

[0048] Hereinafter, embodiments of the disclosure are described in detail with reference to the accompanying drawings. Like reference numerals throughout the disclosure denote like elements.

[0049] FIG. **1** illustrates a state in which a robot cleaner is away from a station in a cleaning apparatus according to an embodiment. FIG. **2** illustrates a state in which a robot cleaner is seated on a station in a cleaning apparatus according to an embodiment.

[0050] Referring to FIG. **1** and FIG. **2**, a cleaning apparatus **1** may include a robot cleaner **10** and a docking station **20**. The cleaning apparatus **1** may be referred to as a cleaning system **1**.

[0051] The robot cleaner **10** may clean a floor while moving across the floor. The floor cleaned by the robot cleaner **10** may be referred to as a surface to be cleaned (surface being cleaned). The robot cleaner **10** may perform dry cleaning and/or wet cleaning. The robot cleaner **10** may draw in (pick up) or wipe away dirt on the surface to be

cleaned. Here, the term "dirt" may refer to foreign substances, such as dust, hair, food particles, and the like.

[0052] Dry cleaning may refer to drawing in dirt from a surface to be cleaned using an intake motor **142** (see FIG. **3**), and wet cleaning may refer to wiping away dirt from a surface to be cleaned using a mop **160** (see FIG. **5**).

[0053] In the disclosure, wet cleaning may be divided into dry mopping and wet mopping. Dry mopping may refer to mopping with the mop **160** in a state where a humidity (or moisture content) of the mop **160** is less than or equal to a defined value, and wet mopping may refer to mopping with the mop **160** in a state where a humidity (or moisture content) of the mop **160** is greater than the defined value.

[0054] Dry mopping may be performed to absorb a liquid contaminant (spilled liquid), and wet mopping may be performed to wipe off a stain, but the roles of dry mopping and wet mopping are not limited thereto. For example, depending on the situation, dry mopping may also be performed to wipe off stains, and wet mopping may also be performed to wipe off liquid contaminants.

[0055] The robot cleaner **10** may perform cleaning without user intervention by using a built-in battery (not shown). The robot cleaner **10** may move autonomously and clean the surface to be cleaned according to a cleaning plan established by a user, a cleaning plan established by the robot cleaner **10**, and/or a preset moving path.

[0056] The robot cleaner **10** may be docked (seated or placed) on the docking station **20**. At least a portion of the robot cleaner **10** may be placed in a receiving space **210***a* of the docking station **20**.

[0057] The robot cleaner **10** may move to the docking station **20** during cleaning and/or after completion of the cleaning.

[0058] For example, the robot cleaner **10** may move to the docking station **20** in a case where recharging is required, in a case where dirt in a dust bin **141** (see FIG. **3**) requires to be emptied, in a case where a water tank **115** (see FIG. **8**) is low on water, in a case where moisture content of the mop **160** is low, in a case where the mop **160** requires to be washed, in a case where the mop **160** requires to be sterilized, and/or in a case where the mop **160** requires to be dried (in case of high humidity of the mop **160**).

[0059] The docking station **20** may allow the robot cleaner **10** to be placed. The docking station **20** may allow the robot cleaner **10** to be seated. The docking station **20** may be configured to store the robot cleaner **10**.

[0060] For example, while the robot cleaner **10** is seated on the docking station **20**, the docking station **20** may charge a battery (not shown) of the robot cleaner **10**. For example, while the robot cleaner **10** is seated on the docking station **20**, the docking station **20** may collect the dirt collected in the dust bin **141** (see FIG. **3**) of the robot cleaner **10**. For example, while the robot cleaner **10** is seated on the docking station **20**, the docking station **20** may supply water to the water tank **115** of the robot cleaner **10**. For example, while the robot cleaner **10** is seated on the docking station **20**, the docking station **20** may wet the mop **160** with water and/or steam. For example, while the robot cleaner **10** is seated on the docking station **20**, the docking station **20** may wash (clean) the mop **160**. For example, while the robot cleaner **10** is seated on the docking station **20**, the docking station **20** may sterilize the mop **160**. For example, while the robot cleaner **10** is seated on the docking station **20**, the docking station **20** may dry the mop **160**.

[0061] FIG. **3** is a view illustrating an interior of a robot cleaner according to an embodiment. FIG. **4** is a rear view of the robot cleaner shown in FIG. **3**. FIG. **5** is a view illustrating a lower portion of the robot cleaner shown in FIG. **3**.

[0062] The robot cleaner **10** may include a main body **110**. The main body **110** may form an overall exterior of the robot cleaner **10**. Components of the robot cleaner **10** may be accommodated in the main body **110**. Electronic components may be disposed in the main body **110**. The main body **110** may be referred to as the cleaner main body **110**.

[0063] The front of the main body **110** may refer to a direction in which the robot cleaner **10** moves forward (+X direction), and the rear of the main body **110** may refer to a direction in which the robot cleaner **10** moves backward (−X direction).

[0064] The main body **110** may be provided with a front sensor **175** having a front view of the main body **110**. The main body **110** may be provided with a rear sensor **176** having a rear view of the main body **110**. The front sensor **175** may obtain sensor data (e.g., image, radar data, light reception data) for the front of the main body **110**. The rear sensor **176** may obtain sensor data (e.g., image, radar data, light reception data) for the rear of the main body **110**.

[0065] The robot cleaner **10** may include an inlet **111**. The inlet **111** may be formed in the main body **110**. The inlet **111** may be formed at a lower part of the main body **110**. The inlet **111** may be formed through a lower side **110***b* of the main body **110**. The inlet **111** may face the surface to be cleaned. The inlet **111** may be open to the surface to be cleaned. Dirt on the surface to be cleaned may be drawn into the main body **110** through the inlet **111** together with air. The inlet **111** may be referred to as the cleaner inlet **111**.

[0066] The robot cleaner **10** may include a brush **130**. The brush **130** may scatter dirt by scrubbing the surface to be cleaned. Dirt scattered by the brush **130** may flow into the inlet **111** together with air. For example, the robot cleaner **10** may include a first brush **131** disposed in the inlet **111**. The first brush **131** may be rotatably mounted with respect to the main body **110**. A rotation axis of the first brush **131** may be an axis extending along a substantially horizontal direction (Y direction). The first brush **131** may be referred to as the main brush **131**.

[0067] For example, the robot cleaner **10** may include a second brush **132** disposed adjacent to a bottom edge of the main body **110**. The second brush **132** may direct, to the inlet **111**, dirt around the main body **110** where the first brush **131** may not sweep. The second brush **132** may be rotatably mounted with respect to the main body **110**. A rotation axis of the second brush **132** may be an axis extending along a substantially vertical direction (Z direction). The second brush **132** may be referred to as the side brush **132**.

[0068] The robot cleaner **10** may include the dust bin **141**. The dust bin **141** may be disposed in the main body **110**. The dust bin **141** may be detachably mounted. The dust bin **141** may store dirt included in the air drawn in through the inlet **111**. Dirt and/or air drawn in through the inlet **111** may move to the dust bin **141**. For example, dirt and/or air drawn in through the inlet **111** may pass through a frame **119** connecting the inlet **111** and the dust bin **141** and flow into the dust bin **141**. Dirt drawn in through the inlet **111** may be collected in the dust bin **141**. The air drawn in through the inlet **111** may be filtered while passing through the dust bin

141. The dirt and air drawn in through the inlet **111** may be separated within the dust bin **141**.

[0069] The robot cleaner **10** may include a filter **143** (see FIG. **8** and FIG. **9**). The filter **143** may be disposed on a flow path through which air flows in the main body **110**. For example, the filter **143** may be disposed in the dust bin **141**, and air drawn in through the inlet **111** may be filtered by the filter **143** while passing through the dust bin **141**.

[0070] The robot cleaner **10** may include an outlet **112**. The outlet **112** may be formed in the main body **110**. The outlet **112** may be formed on a rear side of the main body **110**. The outlet **112** may be formed at a side entering to the docking station **20** of the main body **110**. For example, the outlet **112** may be formed through a circumferential surface **110***c* of the main body **110**. The air drawn in through the inlet **111** may be filtered and discharged to the outside of the robot cleaner **10** through the outlet **112**. The outlet **112** may be formed to discharge the air that has passed through the dust bin **141** to the outside of the main body **110**. For example, a plurality of outlets **112** may be formed, and the plurality of outlets may be formed as a plurality of holes. The outlet **112** may be referred to as the cleaner outlet **112**. As will be described below, the robot cleaner **10** may further include an outlet (**114** see FIG. **9**; **164**, see FIG. **8**) formed in a direction toward the mop **160**.

[0071] The robot cleaner **10** may include an intake motor **142**. The intake motor **142** may be disposed in the main body **110**. The intake motor **142** may generate suction force. Due to the suction force generated by the intake motor **142**, dirt and/or air may be drawn in through the inlet **111**. Due to the suction force generated by the intake motor **142**, the air drawn into and filtered in the robot cleaner **10** may be discharged to the outside through the outlet **112**. The intake motor **142** may be disposed in an air flow path formed between the inlet **111** and the outlet **112**. The intake motor **142** may be referred to as the cleaner intake motor **142**.

[0072] As described above, air drawn into the robot cleaner **10** and filtered may be discharged toward the mop **160** through the outlet (**114**, see FIG. **9**, **164**, see FIG. **8**).

[0073] The robot cleaner **10** may include a driving device **120** for moving the robot cleaner **10**. The driving device **120** is mounted to the main body **110** and may move the main body **110**. At least a portion of the driving device **120** may protrude from the lower side **110***b* of the main body **110**. For example, the driving device **120** may include a pair of main wheels **121**. For example, the driving device **120** may further include at least one auxiliary wheel **122** to enable the robot cleaner **10** to travel stably. The driving device **120** may include a wheel motor for rotating the at least one wheel **121** and **122**. The wheel motor may generate rotational force to rotate the wheels **121** and **122**. A direct current (DC) motor or a brushless DC electric motor (BLDC) may be used as the wheel motor, but an embodiment of the robot cleaner **10** is not limited thereto. In addition to the wheel motor, the types of other motors included in the robot cleaner **10** are not limited.

[0074] Each of the left and right wheel motors may operate independently of each other according to a control signal from the controller **190** (see FIG. **10**), and the main body **110** may move forward, backward, or rotate according to the operation of the left and right wheel motors.

[0075] The controller **190** may control the movement of the robot cleaner **10** by controlling the driving device **120** (e.g., wheel motor).

[0076] The robot cleaner **10** may include the battery (not shown). The battery **150** may provide power required to drive the robot cleaner **10**. While the robot cleaner **10** is seated on the docking station **20**, the battery of the robot cleaner **10** may be rechargeable.

[0077] The robot cleaner **10** may include the mop **160**. The mop **160** is detachably mountable to a lower portion of the main body **110**. The mop **160** may be rotatably mounted with respect to the main body **110**. The mop **160** may clean a surface to be cleaned by contacting the surface to be cleaned. In a state where the mop **160** is wet, the mop **160** may wipe away dirt on the surface to be cleaned. Although the two mops **160** are illustrated in the drawings, the number of mops **160** is not limited thereto. The mop **160** may be referred to as the cleaning pad **160**. The mop **160** may also be referred to as the wet pad **160**.

[0078] The mop **160** may receive moisture from a water tank **115** disposed in the robot cleaner **10**. For example, in a case where a moisture content of the mop **160** decreases while the robot cleaner **10** is cleaning, water stored in the water tank **115** may be provided to the mop **160**.

[0079] The mop **160** may receive moisture from the docking station **20**. For example, in a case where the moisture content of the mop **160** decreases while the robot cleaner **10** is cleaning, the robot cleaner **10** may return to the docking station **20**. While the robot cleaner **10** is seated on the docking station **20**, the docking station **20** may supply water to the water tank **115** of the robot cleaner **10** or spray water and/or steam toward the mop **160**.

[0080] The robot cleaner **10** may include a driver **161** to operate the mop **160**. The driver **161** may rotate or vertically move the mop **160**. As will be described below, the controller **190** (see FIG. **10**) of the robot cleaner **10** may control the driver **161**. The driver **161** may also be referred to as the mop driver **161**.

[0081] For example, while the robot cleaner **10** is cleaning the surface to be cleaned, the driver **161** may rotate the mop **160**, thereby allowing the mop **160** to efficiently wipe the surface to be cleaned. For example, while the mop **160** is being washed, sterilized and/or dried at the docking station **20**, the driver **161** may rotate the mop **160**, thereby reducing a time required for washing, sterilizing and/or drying the mop **160**.

[0082] For example, while the robot cleaner **10** performs wet cleaning, the driver **161** may move the mop **160** downward. As a result, the mop **160** may come into contact with the surface being cleaned. For example, while the robot cleaner **10** returns to the docking station **20**, the driver **161** may move the mop **160** upward. As a result, while the robot cleaner **10** is moving to the docking station **20**, the mop **160** may be prevented from colliding with an obstacle on the surface to be cleaned or from leaving moisture on the surface to be cleaned. For example, while the robot cleaner **10** performs dry cleaning, the driver **161** may move the mop **160** upward. As a result, while the robot cleaner **10** is moving to the docking station **20**, the mop **160** may be prevented from colliding with an obstacle on the surface to be cleaned or from leaving moisture on the surface to be cleaned.

[0083] The robot cleaner **10** may include a drive motor **162**. The drive motor **162** may generate a driving force to rotate or move the mop **160** up and down. The drive motor **162** may be disposed in the main body **110**. The drive motor **162** may be provided as a component of the driver **161**.

[0084] The robot cleaner **10** may include a shaft **163**. The shaft **163** may be provided to transmit the driving force of the drive motor **162** to the mop **160**. For example, the shaft **163** may be provided to connect the drive motor **162** and the mop **160**. For example, the shaft **163** may be arranged to rotate by the driving force of the drive motor **162**, and the mop **160** may be arranged to be coupled to the shaft **163** and rotate together with the shaft **163**. For example, the shaft **163** may be arranged to form a rotation axis of the mop **160**. The shaft **163** may be provided as a component of the driver **161**.

[0085] According to various embodiments, the robot cleaner **10** may include an obstacle sensor **170**. The obstacle sensor **170** may detect a location of an obstacle or a distance to the obstacle. The obstacle sensor **170** may be mounted to the main body **110**. For example, the obstacle sensor **170** may protrude from an upper surface **110***a* of the main body **110**. In an embodiment, the obstacle sensor **170** may be replaced by the front sensor **175** and the rear sensor **176**.

[0086] FIG. **6** is a view illustrating a docking station according to an embodiment. FIG. **7** is a view illustrating a portion of a docking station according to an embodiment.

[0087] Referring to FIG. **6** and FIG. **7**, the docking station **20** may include a main body **210**. The main body **210** may form an overall exterior of the docking station **20**. The main body **210** may form the receiving space **210***a* to receive at least a portion of the robot cleaner **10**. The main body **210** may be referred to as the docking station main body **210**.

[0088] The main body **210** may include a base **211** and a housing **212** that may be detachably coupled to the base **211**.

[0089] The base **211** may include a seating surface **211***a* on which the robot cleaner **10** is seated (placed). The seating surface **211***a* may be inclined from a surface to be cleaned to allow the robot cleaner **10** to enter. For example, the seating surface **211***a* may be inclined upward along a direction in which the robot cleaner **10** enters the docking station **20**.

[0090] The housing **212** may cover at least a portion of the base **211**. The housing **212** may accommodate components of the docking station **20**. Electronic components may be disposed in the housing **212**.

[0091] The docking station **20** may include a water storage container **201**. The water storage container **201** may store water. Relatively clean water may be stored in the water storage container **201**. The water stored in the water storage container **201** may be provided to the water tank **115** of the robot cleaner **10** or to a washing chamber **230** of the docking station **20**, which will be described later. That is, the water stored in the water storage container **201** may be used to wet the mop **160** or to wash the mop **160**. The water storage container **201** is detachably mountable to the main body **210**. For example, a user may separate the water storage container **201** from the main body **210** or couple the water storage container **201** to the main body **210** by holding a handle **201***a* of the water storage container **201**.

[0092] The docking station **20** may include a wastewater container **202**. The wastewater container **202** may store water. Relatively dirty water may be stored in the wastewater container **202**. The dirty water (wastewater) generated by washing the mop **160** may be stored in the wastewater container **202**. The wastewater container **202** is detachably mountable to the main body **210**. For example, a user may separate the wastewater container **202** from the main body **210** or couple the wastewater container **202** to the main body **210** by holding a handle **202***a* of the wastewater container **202**.

[0093] The docking station **20** may include a dirt container **203**. The dirt container **203** may store dirt collected from the dust bin **141** of the robot cleaner **10**. The dirt container **203** is detachably mountable to the main body **210**. For example, a user may separate the dirt container **203** from the main body **210** or couple the dirt container **203** to the main body **210** by holding a handle **203***a* of the dirt container **203**.

[0094] Although the wastewater container **202**, the water storage container **201**, and the dirt container **203** are shown as being arranged side by side along the approximately horizontal direction (Y direction), a position of each of the wastewater container **202**, the water storage container **201**, and the dirt container **203** is not limited thereto.

[0095] The docking station **20** may include the washing chamber **230**. While the robot cleaner **10** is seated on the docking station **20**, the washing chamber **230** may be arranged to correspond to the mop **160**.

[0096] The washing chamber **230** may receive water from the water storage container **201**. The washing chamber **230** may have a shape to accommodate water. While the robot cleaner **10** is seated on the docking station **20**, the mop **160** may be washed with the water accommodated in the washing chamber **230**. The washing chamber **230** may be defined as a space where the mop **160** is washed.

[0097] The washing chamber **230** may accommodate air discharged from a drying device **260** to be described below. While the robot cleaner **10** is seated on the docking station **20**, the mop **160** may be dried by dry air discharged to the washing chamber **230**.

[0098] The washing chamber **230** may be formed in the base **211** of the main body **210**. The washing chamber **230** may be recessed in the base **211**. The washing chamber **230** may be recessed from the seating surface **211***a*. The washing chamber **230** may be defined by a chamber bottom **230***a* and a chamber side wall **230***b* extending upward from the chamber bottom **230***a*. The chamber side wall **230***b* may have a defined height.

[0099] The chamber bottom **230***a* may be inclined downward along a direction in which the robot cleaner **10** enters the docking station **20**. For example, the chamber bottom **230***a* may be inclined downwardly toward the rear. Accordingly, after washing of the mop **160** is completed, the water (wastewater) in the washing chamber **230** may easily flow to a drain hole **234** located at the rear of the washing chamber **230** along the inclined surface of the chamber bottom **230***a*. However, the disclosure is not limited thereto, and an inclination direction of the chamber bottom **230***a* may vary depending on a location of the drain hole **234**. The wastewater discharged through the drain hole **234** may be stored in the dirt container **203**.

[0100] The docking station **20** may include a washing frame **235**. The washing frame **235** may correspond to the washing chamber **230**. The washing frame **235** is detachably mountable to the washing chamber **230**. While the robot cleaner **10** is placed on the docking station **20**, the washing frame **235** may contact the mop **160**. While the robot cleaner **10** is placed on the docking station **20**, the washing frame **235** may be rubbed (scrubbed) against the mop **160**. The mop **160** may be washed by rubbing against the washing frame **235**. In this instance, the mop **160** is rotatable.

[0101] The docking station **20** may include a brush seating portion **240**. The brush seating portion **240** may be formed on the base **211** of the main body **210**. The brush seating portion **240** may be spaced apart from the washing chamber **230**. For example, the brush seating portion **240** may be positioned in front of the washing chamber **230**.

[0102] While the robot cleaner **10** is placed on the docking station **20**, the brush seating portion **240** may correspond to the first brush **131** of the robot cleaner **10**. While the robot cleaner **10** is placed on the docking station **20**, the first brush **131** may be seated on the brush seating portion **240**. While the robot cleaner **10** is placed on the docking station **20**, the inlet **111** of the robot cleaner **10** may face the brush seating portion **240** of the docking station **20**. For example, the brush seating portion **240** may include a curved shape to correspond to the shape of the first brush **131**.

[0103] The docking station **20** may include a step wall **220**. The step wall **220** may be formed on the base **211** of the main body **210**. The step wall **220** may be arranged between the washing chamber **230** and the brush seating portion **240**.

[0104] For example, the step wall **220** may include a first wall portion **220***a* facing the washing chamber **230**, a second wall portion **220***b* facing the brush seating portion **240**, and a connection portion **220***c* connecting the first wall portion **220***a* and the second wall portion **220***b*. For example, the first wall portion **220***a* may be provided as a part of the chamber side wall **230***b*. For example, the second wall portion **220***b* may be provided as a part of the brush seating portion **240**. For example, the second wall portion **220***b* may be connected to the brush seating portion **240** without a step. For example, the connection portion **220***c* may be provided as a part of the seating surface **211***a* of the base **211**.

[0105] The docking station **20** may include a step wall flow path **223**. The step wall flow path **223** may be formed on the step wall **220**. The step wall flow path **223** may guide dry air generated in the drying device **260**. The step wall flow path **223** may allow dry air generated in the drying device **260** to flow. The step wall flow path **223** may guide dry air in the washing chamber **230** to the brush seating portion **240**. The step wall flow path **223** may communicate with the washing chamber **230**. The step wall flow path **223** may communicate with the brush seating portion **240**. The step wall flow path **223** may extend from the washing chamber **230** toward the brush seating portion **240**. For example, the step wall flow path **223** may have a shape extending approximately along the forward-backward direction (X direction). Although two step wall flow paths **223** are illustrated in the drawing, the disclosure is not limited thereto. The number of step wall flow paths **223** is not limited.

[0106] The docking station **20** may include a step wall inlet **221**. The step wall inlet **221** may be in communication with the washing chamber **230**. The step wall inlet **221** may be open toward the washing chamber **230**. The step wall inlet **221** may form one end of the step wall flow path **223**. The step wall inlet **221** may be formed in the first wall portion **220***a* of the step wall **220**.

[0107] The docking station **20** may include a step wall outlet **222**. The step wall outlet **222** may be in communication with the brush seating portion **240**. The step wall outlet **222** may be open toward the brush seating portion **240**. The step wall outlet **222** may form the other end of the step wall flow path **223**. The step wall outlet **222** may be formed in the second wall portion **220***b* of the step wall **220**.

[0108] For example, the step wall inlet **221** may be smaller than the step wall outlet **222**. For example, a width of the step wall inlet **221** may be smaller than that of the step wall outlet **222**. Dry air may be widely sprayed to the brush seating portion **240** by being pressurized while passing through the step wall flow path **223** due to a difference in size between the step wall inlet **221** and the step wall outlet **222**.

[0109] The docking station **20** may include a door **224**. The door **224** may be placed in the step wall inlet **221**. The door **224** may open or cover the step wall inlet **221**. The door **224** may prevent foreign substances, water, etc., other than dry air from flowing into the step wall flow path **223**. For example, the door **224** may open the step wall inlet **221** by the pressure of the dry air sprayed into the washing chamber **230**. For example, the door **224** may be driven by a door driver (not shown) to open or cover the step wall inlet **221**. For example, the door **224** may be made of a flexible material that is bendable (see FIG. **12**). For example, the door **224** may include a rubber material.

[0110] The docking station **20** may include a steam generation device (not shown). The steam generation device may generate steam. The steam generation device may generate steam using water stored in the water storage container **201**. The steam generation device may generate steam by receiving water stored in the water storage container **201**. While the robot cleaner **10** is seated on the docking station **20**, steam generated in the steam generation device (not shown) may be sprayed toward the mop **160**.

[0111] The docking station **20** may include the drying device **260**. The drying device **260** may generate air for drying the mop **160** (hereinafter referred to as "dry air"). The drying device **260** may provide dry air to the washing chamber **230** to be described later. While the robot cleaner **10** is seated on the docking station **20**, dry air discharged from the drying device **260** may be directed to the mop **160**. While the robot cleaner **10** is seated on the docking station **20**, the docking station **20** may spray dry air to the mop **160**. The dry air may have relatively low humidity or high temperature. The dry air may also be referred to as hot air or dry wind.

[0112] For example, after washing and/or sterilizing the mop **160**, the docking station **20** may provide dry air to the mop **160**. For example, in a case where a moisture content of the mop **160** increases as the mop **160** wipes water from the surface to be cleaned during cleaning, the robot cleaner **10** may return to the docking station **20** and the docking station **20** may discharge dry air toward the mop **160**.

[0113] The operation of discharging dry air to the washing chamber **230** by the drying device **260** may be referred to as a drying operation on the mop **160**. That is, the drying operation on the mop **160** may include blowing dry air toward the mop **160** of the robot cleaner **10** placed on the docking station **20** by the drying device **260** of the docking station **20**.

[0114] The drying device **260** may include a fan **262** generating blowing force. The drying device **260** may include a drying duct **261** to guide air blown by the fan **262**. The drying duct **261** may guide the air blown by the fan **262** to the washing chamber **230**. The drying duct **261** may connect the fan **262** and the washing chamber **230** to be described later. The drying device **260** may include a heater **263** to heat the air blown by the fan **262**. The heater **263** may heat the air guided by the drying duct **261**. At least a portion

of the heater **263** may be disposed in the drying duct **261**. For example, in a case where the drying device **260** includes the heater **263**, the drying device **260** may generate high temperature dry air (hot air). However, the disclosure is not limited thereto, and the drying device **260** may not include the heater **263**.

[0115] The docking station **20** may include a discharge opening **231**. The discharge opening **231** may be formed in the washing chamber **230**. For example, the discharge opening **231** may be formed in the chamber side wall **230***b* of the washing chamber **230**. The discharge opening **231** may supply dry air generated in the drying device **260** to the washing chamber **230**. The discharge opening **231** may spray dry air guided by the drying duct **261** to the washing chamber **230**. In a state where the robot cleaner **10** is placed on the docking station **20**, the discharge opening **231** may be arranged to be open toward the mop **160**. Although two openings **231** are illustrated in the drawing, the number of openings **231** is not limited. For example, the number of openings **231** may correspond to the number of mops **160**.

[0116] FIG. **8** illustrates an example of air flow when an intake motor of a robot cleaner operates according to an embodiment.

[0117] Referring to FIG. **8**, the robot cleaner **10** may include the shaft **163**. The shaft **163** may transmit a driving force of the drive motor **162** (see FIG. **3**) to the mop **160**. The shaft **163** may be coupled to the mop **160**. For example, a portion of the shaft **163** may be disposed in the main body **110**, and the remainder of the shaft **163** may protrude from the main body **110** and be coupled to the mop **160**. For example, the shaft **163** may be coupled to an approximately central portion of the mop **160**.

[0118] The shaft **163** may include a shaft hole **164**. The shaft hole **164** may be formed in the shaft **163**. The shaft hole **164** may be formed by penetrating the shaft **163**. The shaft hole **164** may be opened toward a lower side of the mop **160**. While the robot cleaner **10** is seated on the docking station **20**, the shaft hole **164** may be formed to face the washing chamber **230**. A first end of the shaft hole **164** may be formed to receive dry air guided by a first guide flow path **151***a*. The first end of the shaft hole **164** may communicate with the first guide flow path **151***a*. A second end of the shaft hole **164** may be opened toward a lower side of the mop **160**. The second end of the shaft hole **164** may be opened toward the washing chamber **230**. For example, the shaft hole **164** may extend along a longitudinal direction of the shaft **163**. For example, the shaft hole **164** may extend along a height direction of the main body **110**. The shaft hole **164** may be referred to as the shaft flow path **164**. The shaft hole **164** may be referred to as the hollow portion **164**. The shaft hole **164** may be referred to as the hollow flow path **164**. The shaft hole **164** may be referred to as the opening **164**. The shaft hole **164** may be referred to as the outlet **164**.

[0119] The shaft hole **164** may allow dry air to flow. The shaft hole **164** may allow dry air to pass through. The shaft hole **164** may guide the dry air. The shaft hole **164** may receive the dry air guided by the first guide flow path **151***a*. The shaft hole **164** may spray the dry air guided by the first guide flow path **151***a* to the lower side of the mop **160**. The shaft hole **164** may discharge the dry air guided by the first guide flow path **151***a* toward the mop **160**.

[0120] The first guide flow path **151***a* may guide the dry air drawn into the robot cleaner **10** to the shaft hole **164**. Accordingly, the dry air drawn into the robot cleaner **10** may flow toward the mop **160** through the shaft hole **164**.

[0121] For example, when the intake motor **142** of the robot cleaner **10** operates, the air drawn in through the inlet **111** may flow toward the mop **160** through the shaft hole **164**. However, the disclosure is not limited to the above example, and any structure in which the air drawn in through the inlet **111** may flow toward the mop **160** when the intake motor **142** operates may be employed without limitation as an example of the disclosure.

[0122] FIG. **9** illustrates another example of air flow when an intake motor of a robot cleaner operates according to an embodiment.

[0123] Referring to FIG. **9**, the robot cleaner **10** may include a discharge hole **114**. The discharge hole **114** may be formed on the main body **110**. The discharge hole **114** may be formed in the lower part of the main body **110**. For example, the discharge hole **114** may be formed by penetrating the lower side **110***b* of the main body **110**. The discharge hole **114** may be formed to open toward the mop **160**. The discharge hole **114** may be formed to open toward an upper part of the mop **160**. The discharge hole **114** may be formed to face an upper side **160***a* of the mop **160**. For example, the robot cleaner **10** may include a plurality of discharge holes **114**. However, the disclosure is not limited to the above example and may include a single discharge hole **114**. The number of discharge holes **114** is not limited. The discharge hole **114** may be referred to as the opening **114**. The discharge hole **114** may be referred to as the outlet **114**.

[0124] The discharge hole **114** may allow dry air to flow. The discharge hole **114** may allow dry air to pass through. The discharge hole **114** may allow dry air to be discharged toward the mop **160**. The discharge hole **114** may allow dry air guided by the second guide flow path **151***b* to be sprayed toward the mop **160**. The discharge hole **114** may allow dry air guided by the second guide flow path **151***b* to be discharged toward the upper part of the mop **160**. The discharge hole **114** may allow dry air guided by the second guide flow path **151***b* to be sprayed onto the upper side **160***a* of the mop **160**.

[0125] The second guide flow path **151***b* may guide dry air drawn into the robot cleaner **10** to the discharge hole **114**. As a result, the dry air drawn into the robot cleaner **10** may flow toward the mop **160** through the discharge hole **114**.

[0126] For example, when the intake motor **142** of the robot cleaner **10** operates, air drawn in through the inlet **111** may flow toward the mop **160** through the discharge hole **114**. However, the disclosure is not limited to the above example, and any structure in which air drawn in through the inlet **111** may flow toward the mop **160** when the intake motor **142** operates may be employed without limitation as an example of the disclosure.

[0127] The air drawn into the main body **110** when the intake motor **142** operates may be evenly distributed toward the mop **160** through the outlets **164** and **114**, and thus the mop **160** may be effectively dried in a short period of time.

[0128] FIG. **10** is a block diagram illustrating an example configuration of a robot cleaner according to an embodiment.

[0129] Referring to FIG. **10**, the robot cleaner **10** according to an embodiment may include the front sensor **175**, the rear sensor **176**, the humidity sensor **171**, a user interface

device **181**, a water tank valve **115***v*, the intake motor **142**, the mop driver **161**, a communication interface **182**, and/or the controller **190**.

[0130] Electrical components of the robot cleaner **10** may be powered by a battery (not shown), and as described above, the battery may be charged while placed on the docking station **20**.

[0131] The robot cleaner **10** may include various components in addition to those shown in FIG. **10**. For example, the robot cleaner **10** may further include the driving device **120** described above, and may further include a brush motor for rotating the brush **130**.

[0132] As another example, the robot cleaner **10** may further include the obstacle sensor **170** distinguished from the front sensor **175** and the rear sensor **176**. The obstacle sensor **170** may detect obstacles that impede movement of the robot cleaner **10**. An obstacle may refer to any object that interferes with the movement of the robot cleaner **10** on or around a floor of a cleaning area. For example, in addition to the presence or absence of a table, sofa, and the like, located in the cleaning area, walls that divide a space may be obstacles, and objects that the robot cleaner **10** may climb or descend, such as a threshold or a round bar, may also be obstacles.

[0133] The obstacle sensor **170** may detect obstacles in a non-contact manner using electromagnetic waves such as infrared rays, visible ray, or ultrasonic waves. For example, the obstacle sensor **170** may emit infrared rays and then detect the infrared rays reflected from an obstacle, and may output, to the controller **190**, an intensity of the detected infrared rays or a time of flight (TOF) from the emission of the infrared rays to the detection of the reflected infrared rays.

[0134] The controller **190** may calculate the presence or absence of an obstacle, or a distance between the obstacle and the robot cleaner **10** based on an output value of the obstacle sensor **170**.

[0135] According to various embodiments, the obstacle sensor **170** may be replaced by the front sensor **175** and the rear sensor **176**.

[0136] The front sensor **175** may have a front view of the main body **110**. The front sensor **175** may obtain information about a floor area in front of the main body **110** (hereinafter, "front sensor data").

[0137] The rear sensor **176** may have a rear view of the main body **110**. The rear sensor **176** may obtain information about a floor area in the rear of the main body **110** (hereinafter, "rear sensor data").

[0138] In an embodiment, the front sensor **175** and the rear sensor **176** may each include a camera. In this case, the sensor data collected by the front sensor **175** and the rear sensor **176** may be image data. For example, the front sensor data collected by the front sensor **175** may be front image data, and the rear sensor data collected by the rear sensor **176** may be rear image data.

[0139] In an embodiment, the front sensor **175** and the rear sensor **176** may each include a light emitter that emits light and a camera. The front sensor **175** and the rear sensor **176** may each collect the front image data and the rear image data such that the light emitter emits light and the camera obtains an image.

[0140] The front sensor **175** may transmit the front image data to the controller **190**.

[0141] The rear sensor **176** may transmit the rear image data to the controller **190**.

[0142] In an embodiment, the front sensor **175** and the rear sensor **176** may include an emitter that emits a defined signal (e.g., electromagnetic waves, light, infrared rays, etc.) and a receiver that receives a defined signal reflected from the obstacle. In this case, the sensor data collected by the front sensor **175** and the rear sensor **176** may be light reception data. For example, the front sensor data collected by the front sensor **175** may be front light reception data, and the rear sensor data collected by the rear sensor **176** may be rear light reception data.

[0143] The emitter of the front sensor **175** may be arranged at the front of the main body **110** and may transmit a defined signal toward the front of the main body **110**. In addition, according to embodiments, the emitter may include a signal generator (e.g., light emitting diode (LED)) that generates a defined signal and a wide-angle lens that refracts the generated signal to disperse the signal in all directions.

[0144] The emitter of the rear sensor **176** may be arranged at the rear of the main body **110** and may transmit a defined signal toward the rear of the main body **110**. In addition, according to embodiments, the emitter may include a signal generator (e.g., LED) that generates a defined signal and a wide-angle lens that refracts the generated signal to disperse the signal in all directions.

[0145] The front sensor **175** may emit a defined signal toward the front of the main body **110** and then detect a signal reflected from an obstacle, and output an intensity of the detected signal, or a time of flight (TOF) from the emission of the defined signal to the detection of the reflected signal, to the controller **190**.

[0146] The rear sensor **176** may emit a defined signal toward the rear of the main body **110** and then detect a signal reflected from an obstacle, and output an intensity of the detected signal, or a time of flight (TOF) from the emission of the defined signal to the detection of the reflected signal, to the controller **190**.

[0147] According to the disclosure, information about a contaminated area may be obtained based on front sensor data obtained by the front sensor **175** before the main body **110** of the robot cleaner **10** passes over the contaminated area, and rear sensor data obtained by the rear sensor **176** after the main body **110** of the robot cleaner **10** has passed over the contaminated area.

[0148] The humidity sensor **171** may include at least one sensor for measuring a humidity (or moisture content) of the mop **160**.

[0149] In an embodiment, the humidity sensor **171** may measure a change in moisture in the air. The humidity sensor **171** may be located around the mop **160** to measure the humidity (or moisture content) of the mop **160**. In this case, an output humidity of the humidity sensor **171** may be proportional to the moisture content of the mop **160**.

[0150] The controller **190** may determine the humidity (or moisture content) of the mop **160** based on the humidity measured by the humidity sensor **171**.

[0151] In an embodiment, the humidity sensor **171** may emit light such as infrared rays and visible rays, or electromagnetic waves such as ultrasonic waves to the mop **160**, and then may measure an intensity of the electromagnetic waves reflected from the mop **160** and/or a time of flight (TOF) from the emission of the electromagnetic waves to the detection of the reflected electromagnetic waves.

[0152] For example, the humidity sensor **171** may include a light emitter that emits light to the mop **160** and a light receiver that receives light reflected from the mop **160**.

[0153] The controller **190** may determine the humidity (or moisture content) of the mop **160** based on an output value of the humidity sensor **171**.

[0154] In an embodiment, the controller **190** may determine a contamination level of the mop **160** based on the output value of the humidity sensor **171**. As another example, the robot cleaner may be equipped with a separate contamination sensor for measuring the contamination level of the mop **160**.

[0155] The controller **190** may perform various operations depending on the humidity (or moisture content) of the mop **160**. For example, the controller **190** may control the driving device **120** to allow the robot cleaner **10** to return to the docking station **20** based on the humidity of the mop **160** being measured to be greater than or equal to a defined first humidity. As another example, the controller **190** may control the driving device **120** to allow the robot cleaner **10** to return to the docking station **20** based on the humidity of the mop **160** being measured to be less than a defined minimum humidity.

[0156] The user interface device **181** may include an output interface and an input interface.

[0157] At least one output interface may generate sensory information and transmit various information related to operations of the robot cleaner **10** to a user.

[0158] For example, the at least one output interface may transmit information related to the settings and an operation time of the robot cleaner **10** to the user. Information about the operation of the robot cleaner **10** may be output through a display, indicator, and/or may be output as voice. The at least one output interface may include, for example, a liquid crystal display (LCD) panel, an indicator, a light emitting diode (LED) panel, a speaker, and the like.

[0159] In a case where the display includes a touch screen display, the touch screen display may correspond to an example of the output interface and the input interface.

[0160] In an embodiment, the at least one output interface may output sensory information (e.g., visual information, auditory information, etc.) related to control of the robot cleaner **10**.

[0161] At least one input interface may convert the sensory information received from the user into an electrical signal.

[0162] The at least one input interface may include a power button for turning on the robot cleaner **10**.

[0163] Each button may include a visual indicator (e.g. text, icon, etc.) that may indicate its function.

[0164] The at least one input interface may include, for example, a tact switch, a push switch, a slide switch, a toggle switch, a micro switch, a touch switch, a touch pad, a touch screen, a jog dial, and/or a microphone, and the like.

[0165] In the disclosure, a "button" may be replaced by a user interface element (UI element), a tact switch, a push switch, a slide switch, a toggle switch, a micro switch, a touch switch, a touch pad, a touch screen, a jog dial, and/or a microphone, and the like.

[0166] The robot cleaner **10** may process a user input received via the user interface device **181** and may output information related to the robot cleaner **10** via the user interface device **181**.

[0167] The water tank valve **115***v* may open and close a flow path connecting the water tank **115** and the mop **160** to allow the water stored in the water tank **115** to be supplied to the mop **160**.

[0168] During wet cleaning, in a case where the humidity of the mop **160** measured by the humidity sensor **171** falls below a defined humidity, the controller **190** may control the water tank valve **115***v* to supply the water stored in the water tank **115** to the mop **160**. In an embodiment, the water tank valve **115***v* may be replaced by various configurations (e.g., a pump) that may selectively supply the water stored in the water tank **115** to the mop **160**. In the disclosure, controlling the water tank valve **115***v* to supply water from the water tank **115** to the mop **160** may be replaced by various operations (e.g., operating the pump) to supply water from the water tank **115** to the mop **160**. In the disclosure, controlling the water tank valve **115***v* to supply water from the water tank **115** to the mop **160** may be defined as a water filling operation.

[0169] During dry cleaning, the controller **190** may control the brush motor (not shown) to rotate the brush **130**, thereby blowing away foreign substances on the floor with the brush **130**.

[0170] The intake motor **142** may draw the foreign substances scattered by the brush **130** into the dust bin **141**, and may rotate an intake fan generating a suction force to draw the foreign substances into the dust bin **141**.

[0171] The controller **190** may control the intake motor **142** to rotate the intake fan during dry cleaning, allowing the foreign substances scattered by the brush **130** to be collected into the dust bin **141** through the inlet **111**.

[0172] During dry cleaning, i.e., during the operation of the intake motor **142**, the air drawn into the main body **110** may be evenly distributed toward the mop **160** through the outlets **164** and **114**.

[0173] That is, the intake motor **142** may be configured to draw external air into the main body **110** and discharge the air drawn into the main body **110** in a direction toward the mop **160**.

[0174] The mop driver **161** may include a rotation driver that rotates the mop **160** and/or a lifting driver that lifts or lowers the mop **160**. The rotation driver and the lifting driver may include the drive motor **162**.

[0175] The controller **190** may control the rotation driver to rotate the mop **160**. The rotation driver may include a motor for rotating the mop **160** and drive circuitry for driving the motor.

[0176] The controller **190** may control the drive motor **162** to lift or lower the mop **160**. That is, the controller **190** may control the drive motor **162** to move the mop **160**. The drive motor **162** may include an actuator capable of moving the mop **160**.

[0177] The communication interface **182** may communicate with an external device (e.g., a server, a user device, the docking station **20**) wired and/or wirelessly.

[0178] The communication interface **182** may transmit data to an external device (e.g., a server, a user device, and/or the docking station **20**) or receive data from the external device. For the communication, the communication interface **182** may establish a direct (e.g., wired) communication channel or a wireless communication channel between external devices, and support the performance of the communication through the established communication channel. According to an embodiment, the communication

interface **182** may include a wireless communication module (e.g., a cellular communication module, a short-range wireless communication module, or a global navigation satellite system (GNSS) communication module) or a wired communication module (e.g., a local area network (LAN) communication module, or a power line communication module). Among these communication modules, the corresponding communication module may communicate with an external device through a first network (e.g., a short-range wireless communication network such as Bluetooth, wireless fidelity (Wi-Fi) direct, or infrared data association (IrDA)) or a second network (e.g., a long-range wireless communication network such as a legacy cellular network, a 5G network, a next-generation communication network, the Internet, or a computer network (e.g., LAN or wide area network (WAN)). These various types of communication modules may be integrated as one component (e.g., a single chip) or implemented as a plurality of separate components (e.g., multiple chips).

[0179] The short-range wireless communication module may include a Bluetooth communication module, a Bluetooth Low Energy (BLE) communication module, a near field communication module, a WLAN (Wi-Fi) communication module, and a Zigbee communication module, an infrared data association (IrDA) communication module, a Wi-Fi Direct (WFD) communication module, an ultrawideband (UWB) communication module, an Ant+ communication module, a microwave (uWave) communication module, etc., but is not limited thereto.

[0180] The long-range wireless communication module may include a communication module that performs various types of long-range wireless communication, and may include a mobile communication interface. The mobile communication interface transmits and receives radio signals with at least one of a base station, an external terminal, or a server on a mobile communication network.

[0181] In an embodiment, the communication interface **182** may communicate with an external device through an access point (AP). The AP may connect a local area network (LAN), to which the robot cleaner **10** is connected, to a wide area network (WAN) to which a server is connected. The robot cleaner **10** may be connected to the server through the wide area network (WAN).

[0182] In an embodiment, the communication interface **182** may communicate wirelessly with the docking station **20**.

[0183] The controller **190** may control an overall operation of the robot cleaner **10**.

[0184] The controller **190** may include at least one processor **191** controlling an operation of the robot cleaner **10** and at least one memory **192** storing programs and data for controlling the operation of the robot cleaner **10**.

[0185] The at least one processor **191** may control overall operations of the robot cleaner **10**. Specifically, the at least one processor **191** may be connected to each component of the robot cleaner **10** and may control overall operations of the robot cleaner **10**. For example, the at least one processor **191** may be electrically connected to the memory **192** to control the overall operations of the robot cleaner **10**. A single processor **191** or a plurality of processors **191** may be provided.

[0186] The at least one processor **191** may execute at least one instruction stored in the memory **192**, thereby allowing the robot cleaner **10** to perform operations according to various embodiments.

[0187] The at least one memory **192** may store data required for various embodiments. The memory **192** may be implemented as a memory embedded in the robot cleaner **10** or as a memory detachable from the robot cleaner **10** depending on a data storage use. For example, data for driving the robot cleaner **10** may be stored in the memory embedded in the robot cleaner **10**, and data for an extended function of the robot cleaner **10** may be stored in the memory detachable from the robot cleaner **10**. Meanwhile, the memory embedded in the robot cleaner **10** may be implemented as at least one of a volatile memory (e.g., dynamic random access memory (DRAM), static RAM (SRAM), or synchronous dynamic RAM (SDRAM), etc.), or a non-volatile memory (e.g., one time programmable read only memory (OTPROM), programmable ROM (PROM), erasable programmable ROM (EPROM), electrically erasable programmable ROM (EEPROM), mask ROM, flash ROM, flash memory (e.g. NAND flash or NOR flash, etc.), a hard drive, or a solid state drive (SSD)). In addition, the memory detachable from the robot cleaner **10** may be implemented as a memory card (e.g., compact flash (CF), secure digital (SD), micro secure digital (Micro-SD), mini secure digital (Mini-SD), extreme digital (xD), multi-media card (MMC), etc.), an external memory (e.g., universal serial bus (USB) memory) connectable to a USB port, and the like.

[0188] The at least one processor **191** may include at least one of a central processing unit (CPU), graphics processing unit (GPU), accelerated processing unit (APU), many integrated core (MIC), digital signal processor (DSP), neural processing unit (NPU), hardware accelerator, or machine learning accelerator. The at least one processor **191** may control one or any combination of other components of the robot cleaner **10**, and may perform communication-related operations or data processing. The at least one processor **191** may execute at least one program or instruction stored in the memory **192**. For example, the at least one processor **191** may execute at least one instruction stored in the memory **192** to perform a method according to at least one embodiment of the disclosure.

[0189] In an embodiment, the controller **190** may control the mop driver **161** according to a defined condition. Controlling the mop driver **161** may include rotating or moving the mop **160**.

[0190] In an embodiment, the controller **190** may control the driving device **120** according to a defined condition. Controlling the driving device **120** may include moving the robot cleaner **10**.

[0191] In an embodiment, the controller **190** may control the brush motor and/or the intake motor **142** according to a defined condition.

[0192] The controller **190** may perform a drying operation for drying the mop **160** according to a defined condition.

[0193] The drying operation for drying the mop **160** may include operating the intake motor **142** to perform dry cleaning for a defined period of time and/or returning to the docking station **20** and transmitting a drying request command to the docking station **20**.

[0194] The controller **190** may determine whether to reclean the contaminated area based on processing the sensor

data obtained by the front sensor **175** and the rear sensor **176**, which will be described below. Here, re-cleaning may refer to an operation where the robot cleaner **10** passes over an area that the robot cleaner **10** has passed through once again.

[0195] FIG. **11** is a block diagram illustrating an example configuration of a docking station according to an embodiment.

[0196] The docking station **20** may include a docking sensor **270**, a user interface device **281**, a communication interface **282**, a washing device **250**, the drying device **260**, and/or a controller **290**.

[0197] The docking station **20** may further include various components in addition to those shown in FIG. **11**. For example, the docking station **20** may further include an intake motor that generates a suction force for drawing in waste from the dust bin **141** of the docked robot cleaner **10**.

[0198] The controller **290** may operate the intake motor (not shown) of the docking station **20** to draw the waste from the dust bin **141** of the robot cleaner **10** into the dirt container **203** of the docking station **20**.

[0199] As another example, the docking station **20** can further include a water supply device for supplying water to the water tank **115** of the docked robot cleaner **10**.

[0200] The controller **290** may fill the water tank **115** of the robot cleaner **10** with water by controlling the water supply device of the docking station **20**.

[0201] The docking sensor **270** may detect whether the robot cleaner **10** is docked at the docking station **20**. The docking sensor **270** may include at least one sensor that detects mechanical and/or electrical changes when the robot cleaner **10** is docked at the docking station **20**.

[0202] For example, the docking sensor **270** may include a sensor detecting whether a charging terminal **151** of the robot cleaner **10** is electrically connected to a charging terminal **218** of the docking station **20**. As another example, the docking sensor **270** may include a sensor (e.g., an elastic sensor) that detects mechanical deformation when the robot cleaner **10** is docked.

[0203] The controller **290** may determine whether the robot cleaner is docked at the docking station **20** based on an output value of the docking sensor **270**.

[0204] The user interface device **281** may include an output interface and an input interface.

[0205] At least one output interface may generate sensory information and transmit various information related to operations of the docking station to a user.

[0206] For example, the at least one output interface may transmit information related to the settings and an operation time of the docking station **20** to the user. Information about the operation of the docking station **20** may be output through a display, indicator, and/or may be output as voice. The at least one output interface may include, for example, a liquid crystal display (LCD) panel, an indicator, a light emitting diode (LED) panel, a speaker, and the like.

[0207] In a case where the display includes a touch screen display, the touch screen display may correspond to an example of the output interface and the input interface.

[0208] In an embodiment, the at least one output interface may output sensory information (e.g., visual information, auditory information, etc.) related to control of the docking station **20**.

[0209] At least one input interface may convert the sensory information received from the user into an electrical signal.

[0210] The at least one input interface may include a power button for turning on the docking station **20**.

[0211] Each button may include a visual indicator (e.g. text, icon, etc.) that may indicate its function. The at least one input interface may include, for example, a tact switch, a push switch, a slide switch, a toggle switch, a micro switch, a touch switch, a touch pad, a touch screen, a jog dial, and/or a microphone, and the like.

[0212] In the disclosure, a "button" may be replaced by a user interface element (UI element), a tact switch, a push switch, a slide switch, a toggle switch, a micro switch, a touch switch, a touch pad, a touch screen, a jog dial, and/or a microphone, and the like.

[0213] The docking station **20** may process a user input received via the user interface device **281** and may output information related to the docking station **20** via the user interface device **281**.

[0214] The communication interface **282** may communicate with an external device (e.g., a server, a user device, the robot cleaner **10**) wired and/or wirelessly.

[0215] The communication interface **282** may transmit data to an external device (e.g., a server, a user device, and/or the robot cleaner **10**) or receive data from the external device. For the communication, the communication interface **282** may establish a direct (e.g., wired) communication channel or a wireless communication channel between external devices, and support the performance of the communication through the established communication channel. According to an embodiment, the communication interface **282** may include a wireless communication module (e.g., a cellular communication module, a short-range wireless communication module, or a global navigation satellite system (GNSS) communication module) or a wired communication module (e.g., a local area network (LAN) communication module, or a power line communication module). Among these communication modules, the corresponding communication module may communicate with an external device through a first network (e.g., a short-range wireless communication network such as Bluetooth, wireless fidelity (Wi-Fi) direct, or infrared data association (IrDA)) or a second network (e.g., a long-range wireless communication network such as a legacy cellular network, a 5G network, a next-generation communication network, the Internet, or a computer network (e.g., LAN or wide area network (WAN)). These various types of communication modules may be integrated as one component (e.g., a single chip) or implemented as a plurality of separate components (e.g., multiple chips).

[0216] The short-range wireless communication module may include a Bluetooth communication module, a Bluetooth Low Energy (BLE) communication module, a near field communication module, a WLAN (Wi-Fi) communication module, and a Zigbee communication module, an infrared data association (IrDA) communication module, a Wi-Fi Direct (WFD) communication module, an ultrawideband (UWB) communication module, an Ant+ communication module, a microwave (uWave) communication module, etc., but is not limited thereto.

[0217] The long-range wireless communication module may include a communication module that performs various types of long-range wireless communication, and may

include a mobile communication interface. The mobile communication interface transmits and receives radio signals with at least one of a base station, an external terminal, or a server on a mobile communication network.

[0218] In an embodiment, the communication interface **282** may communicate with an external device through an access point (AP). The AP may connect a local area network (LAN), to which the robot cleaner **10** is connected, to a wide area network (WAN) to which a server is connected. The docking station **20** may be connected to the server through the wide area network (WAN).

[0219] In an embodiment, the communication interface **282** may communicate wirelessly with the robot cleaner **10**.

[0220] A variety of examples may be employed as a communication method between the robot cleaner **10** and the docking station **20**.

[0221] In an embodiment, the robot cleaner **10** and the docking station **20** may communicate directly through a short-range communication module.

[0222] In an embodiment, the robot cleaner **10** and the docking station **20** may communicate directly through wired communication in a state where the robot cleaner **10** is docked at the docking station **20**.

[0223] In an embodiment, the robot cleaner **10** and the docking station **20** may communicate indirectly through a long-range communication module via an external server.

[0224] Indirect communication via an external server may include, in response to transmitting a defined signal to an external server from the robot cleaner **10**, transmitting the defined signal received from the robot cleaner **10** to the docking station **20** by the external server, and/or in response to transmitting a defined signal to an external server from the docking station **20**, transmitting the defined signal received from the docking station **20** to the robot cleaner **10** by the external server.

[0225] The washing device **250** may wash the mop **160** using the water stored in the water storage container **201**.

[0226] To this end, the washing device **250** may include at least one pump and/or valve for flowing the water stored in the water storage container **201** to the washing chamber **230**.

[0227] The wastewater generated by washing the mop **160** in the washing chamber **230** may be supplied to the wastewater container **202**. To this end, the washing device **250** may include at least one pump and/or valve for flowing the wastewater stored in the washing chamber **230** to the wastewater container **202**.

[0228] The controller **290** may control the washing device **250** to perform a washing process for washing the mop **160** placed in the washing chamber **230**.

[0229] In the disclosure, the washing process may include a process in which water is supplied from the water storage container **201** to the washing chamber **230**, the mop **160** is washed, and the generated wastewater is supplied to the wastewater container **202**.

[0230] The drying device **260** may dry the mop **160** received in the washing chamber **230**. To this end, the drying device **260** may include the drying duct **261** for guiding air blown by the fan **262** into the washing chamber **230**, and the heater **263** for heating air blown by the fan **262** into the washing chamber **230**.

[0231] The controller **290** may control the drying device **260** to perform a drying process for drying the mop **160** placed in the washing chamber **230**.

[0232] In the disclosure, the drying process may include a process of operating the drying device **260** to dry the mop **160**.

[0233] In an embodiment, the controller **290** may perform the washing process and/or the drying process based on a user input received via the user interface device **281**.

[0234] In an embodiment, the controller **290** may perform the washing process and/or the drying process based on a control command received from an external device via the communication interface **282**.

[0235] FIG. **12** is a flowchart illustrating an example method for controlling a robot cleaner according to an embodiment.

[0236] Referring to FIG. **12**, the robot cleaner **10** according to an embodiment may obtain front sensor data about a contaminated area through the front sensor **175** before the mop **160** passes over the contaminated area (**1000**).

[0237] The controller **190** may process the front sensor data about the contaminated area obtained by the front sensor **175** before the mop **160** passes over the contaminated area.

[0238] The controller **190** may identify the contaminated area based on the processing of the front sensor data.

[0239] The controller **190** may control the movement of the robot cleaner **10** to allow the mop **160** to clean the contaminated area detected by the front sensor **175**.

[0240] The contaminated area detected by the front sensor **175** may include the contaminated area identified based on the processing of the front sensor data.

[0241] According to an embodiment, the robot cleaner **10** may obtain rear sensor data about the contaminated area through the rear sensor **176** after the mop **160** has passed over the contaminated area (**1100**).

[0242] The controller **190** may process the rear sensor data about the contaminated area obtained by the rear sensor **176** after the mop **160** has passed over the contaminated area.

[0243] FIG. **13** illustrates an example of a robot cleaner passing over a contaminated area according to an embodiment.

[0244] Referring to FIG. **13**, the robot cleaner **10** may identify a contaminated area PA based on front sensor data collected from the front sensor **175**.

[0245] The contaminated area PA may refer to an area where a foreign substance FA is present. The foreign substance FA may be a liquid contaminant, a stain, and/or dust.

[0246] In an embodiment, the robot cleaner **10** may perform wet cleaning according to a preset cleaning plan, and may perform wet cleaning to allow the mop **160** to pass over the contaminated area PA based on identification of the contaminated area PA containing the foreign substance FA during wet cleaning.

[0247] In an embodiment, the robot cleaner **10** may perform dry cleaning according to a preset cleaning plan, and based on identification of the contaminated area PA containing the foreign substance FA during dry cleaning, may temporarily stop dry cleaning and perform wet cleaning to allow the mop **160** to pass over the contaminated area PA.

[0248] In an embodiment, performing dry cleaning by the robot cleaner **10** may include moving the mop **160** to a position where the mop **160** does not touch the floor, and then operating the brush motor and/or the intake motor **142**.

[0249] In an embodiment, performing wet cleaning by the robot cleaner **10** may include moving the mop **160** to a position where the mop **160** touches the floor and then rotating the mop **160**.

[0250] The robot cleaner **10** may store front sensor data about the contaminated area PA collected by the front sensor **175** before passing over the contaminated area PA, and may store rear sensor data about the contaminated area PA collected by the rear sensor **176** after passing over the contaminated area PA. The controller **190** may process the front sensor data about the contaminated area PA collected by the front sensor **175** before passing over the contaminated area PA and store the front sensor data in the memory **192**, and may process the rear sensor data about the contaminated area PA collected by the rear sensor **176** after passing over the contaminated area PA and store the rear sensor data in the memory **192**.

[0251] The robot cleaner **10** may determine whether re-cleaning of the contaminated area PA is required based on the rear sensor data about the contaminated area PA (**1200**).

[0252] In an embodiment, the robot cleaner **10** may determine whether re-cleaning of the contaminated area PA is required based on processing of the rear sensor data about the contaminated area PA.

[0253] In an embodiment, the robot cleaner **10** may also determine whether re-cleaning of the contaminated area PA is required based on the front sensor data and the rear sensor data about the contaminated area PA.

[0254] As described above, the front sensor data may be front image data, and the rear sensor data may be rear image data.

[0255] As another example, the front sensor data may include light reception data (e.g., ToF data, light intensity data) obtained by emitting light to the contaminated area PA and then receiving the reflected light, and the rear sensor data may include light reception data (e.g., ToF data, light intensity data) obtained by emitting light to the contaminated area PA and then receiving the reflected light.

[0256] Determining whether re-cleaning of the contaminated area PA is required may include determining whether dry mopping of the contaminated area PA is required and/or determining whether wet mopping of the contaminated area PA is required.

[0257] FIG. **14** illustrates an example of front sensor data obtained by a front sensor and rear sensor data obtained by a rear sensor of a robot cleaner according to an embodiment. FIG. **15** illustrates another example of front sensor data obtained by a front sensor and rear sensor data obtained by a rear sensor of a robot cleaner according to an embodiment.

[0258] For convenience of description, although it is illustrated in FIG. **14** and FIG. **15** that front sensor data and rear sensor data are each image data, the front sensor data and the rear sensor data are not limited thereto.

[0259] Referring to FIG. **14** and FIG. **15**, the front sensor data FI may include information related to a foreign substance FA before a contaminated area PA is cleaned by the mop **160**. The rear sensor data RI may include information related to a foreign substance FA after a contaminated area PA has been cleaned by the mop **160**.

[0260] The information related to the foreign substance FA may include information about the color of the foreign substance FA, the amount of the foreign substance FA, the size of the foreign substance FA, the outline of the foreign substance FA, the shape of the foreign substance FA, and the like.

[0261] Referring to FIG. **14**, it may be seen that a large lump of liquid contaminant is separated into a plurality of small lumps of liquid contaminant, in a case where the liquid contaminant is not completely absorbed by the mop **160**.

[0262] Here, the liquid contaminant may refer to a foreign substance that may be absorbed by the dried mop **160**. For example, the liquid contaminant may refer to a foreign substance that maintains a liquid state, such as water or juice.

[0263] Referring to FIG. **15**, it may be seen that a large foreign substance stain becomes a small foreign substance stain, in a case where the stain is not completely wiped off by the mop **160**.

[0264] Here, the foreign substance stain (hereinafter, referred to as the "stain") may refer to a foreign substance that may be wiped off by the wet mop **160**. For example, the stain may include spilled coffee stains, oil stains, and the like.

[0265] In an embodiment, the controller **190** may determine whether re-cleaning is required based on the rear sensor data RI.

[0266] For example, the controller **190** may determine that re-cleaning is not required for the contaminated area PA based on no foreign substance being detected in the rear sensor data RI, and may determine that re-cleaning is required for the contaminated area PA based on a foreign substance being detected in the rear sensor data RI.

[0267] In an embodiment, the controller **190** may identify whether the type of the foreign substance is a liquid contaminant or a stain based on the rear sensor data RI.

[0268] Determining whether re-cleaning is required based on the rear sensor data RI may include determining whether re-cleaning is required based on processing only the rear sensor data RI and/or determining whether re-cleaning is required based on processing both the front sensor data FI and the rear sensor data RI.

[0269] In an embodiment, the controller **190** may determine whether re-cleaning is required based on a difference between the front sensor data FI and the rear sensor data RI.

[0270] For example, the controller **190** may determine that re-cleaning is not required based on a foreign substance being detected in the front sensor data FI and the foreign substance not being detected in the rear sensor data RI.

[0271] Conversely, the controller **190** may determine that re-cleaning is required based on a foreign substance being detected in the front sensor data FI and the foreign substance still being detected in the rear sensor data RI.

[0272] The controller **190** may identify whether the type of foreign substance is a liquid contaminant or a stain based on the front sensor data FI and the rear sensor data RI.

[0273] For example, the controller **190** may identify that a liquid contaminant is not completely removed from the contaminated area PA based on a large lump of liquid contaminant being detected in the front sensor data FI and multiple small lumps of liquid contaminant being detected in the rear sensor data RI.

[0274] As another example, the controller **190** may identify that a stain is not completely removed from the contaminated area PA based on a large stain being detected in the front sensor data FI and a small stain being detected in the rear sensor data RI.

[0275] To this end, the controller **190** may perform image preprocessing on the front sensor data FI and the rear sensor data RI. The image preprocessing process may include one or more processes for processing an image into a form more suitable for detecting foreign substance.

[0276] For example, the image preprocessing process may include a process of removing noise from the image, a process of increasing the contrast of the image, a deblurring process of removing blur from the image, a process of removing a background region, a warping process of correcting distortion included in the image, a process of binarizing the image, and the like.

[0277] The controller **190** may detect a foreign substance area in the image. The controller **190** may use, for example, a Haar-based cascade adaboost classifier, a neural network-based classifier, or a support vector machine to detect the foreign substance area in the image. However, the scope of the embodiment is not limited thereto, and the controller **190** may detect the foreign substance area in the image using various foreign substance area detection techniques.

[0278] The controller **190** may normalize the detected foreign substance area. In an embodiment, the controller **190** may detect landmarks of the foreign substance from the detected foreign substance area and normalize the foreign substance area based on the detected landmarks. The controller **190** may detect landmarks of a foreign substance from the foreign substance area by using, for example, a landmark detection technique based on an active contour model (ACM), an active shape model (ASM), an active appearance model (AAM), a supervised descent method (SDM), or a neural network. The landmarks of the foreign substance may be main landmarks for the foreign substance, e.g., landmarks for identifying the outline of the foreign substance. Normalization may include, for example, an image cropping process for extracting a foreign substance image representing a foreign substance area from an image, a process for matching the positions of landmarks detected in the foreign substance area with predefined reference positions, a process for adjusting the size of the extracted foreign substance area, and the like.

[0279] According to various embodiments, the controller **190** may also identify the type of the foreign substance by inputting the front sensor data FI and/or the rear sensor data RI into an artificial intelligence (AI) model.

[0280] The AI model is characterized in that it is created through training. Here, being created through training means that a basic AI model is trained using a large number of training data by a learning algorithm, thereby creating a predefined operation rule or AI model set to perform desired characteristics (or purpose). Such training may be performed in the device itself in which the AI according to the disclosure is performed, or may be performed through a separate server and/or system. Examples of learning algorithms include supervised learning, unsupervised learning, semi-supervised learning, or reinforcement learning, but are not limited thereto.

[0281] The AI model may be composed of a plurality of neural network layers. Each of the plurality of neural network layers has a plurality of weight values, and a neural network operation is performed through an operation result of the previous layers and an operation between the plurality of weight values. The plurality of weights of the plurality of neural network layers may be optimized by the training result of the AI model. For example, the plurality of weights may be updated so that a loss value or a cost value obtained from the AI model during the training process is reduced or minimized. Artificial neural networks may include deep neural networks (DNN), for example, convolutional neural network (CNN), deep neural network (DNN), recurrent neural network (RNN), restricted Boltzmann Machine (RBM), deep belief network (DBN), bidirectional recurrent deep neural network (BRDNN), or deep Q-networks, but is not limited thereto.

[0282] The AI model may use the front sensor data FI and/or the rear sensor data RI as input data to output result data about the type of foreign substance, whether re-cleaning is required, whether dry mopping is required, and/or whether wet mopping is required.

[0283] The controller **190** may determine that re-cleaning is required in a case where a foreign substance left on the contaminated area PA is detected in response to processing the rear sensor data.

[0284] In response to a determination that re-cleaning is not required for the contaminated area PA, the controller **190** may clean another cleaning area.

[0285] As described above, determining whether re-cleaning is required may include determining whether dry mopping or wet mopping is required.

[0286] The controller **190** may identify the type of foreign substance left on the contaminated area based on the front sensor data about the contaminated area PA and the rear sensor data about the contaminated area, and may determine whether dry mopping or wet mopping is required based on the type of foreign substance left on the contaminated area.

[0287] The controller **190** may determine that dry mopping is required for the contaminated area PA (Yes in operation **1300**), based on the foreign substance FA left on the contaminated area PA being identified as a liquid contaminant.

[0288] That is, the controller **190** may determine whether dry mopping is required for the contaminated area PA, based on information about the contaminated area PA obtained by the rear sensor **176** after the contaminated area PA detected by the front sensor **175** has been cleaned.

[0289] FIG. **16** is a flowchart illustrating an example method of re-cleaning in a case where a robot cleaner according to an embodiment determines that dry mopping is required.

[0290] Referring to FIG. **16**, the controller **190** may determine whether to perform a drying operation on the mop **160** in response to a determination that dry mopping is required for the contaminated area (Yes in operation **1300** in FIG. **12**).

[0291] The robot cleaner **10** may perform the drying operation on the mop **160** before re-cleaning (**1410**), based on a humidity of the mop **160** detected by the humidity sensor **171** being greater than a reference humidity (Yes in operation **1400**).

[0292] In this instance, the reference humidity may be stored in advance in the memory **192**. The reference humidity may be settable according to a user input. For example, a user may adjust the reference humidity through the user interface device **182** or **282** or the user device.

[0293] In an embodiment, the controller **190** may perform the drying operation on the mop **160** by returning the robot cleaner **10** to the docking station **20** and transmitting a drying request signal to the docking station **20**.

[0294] For example, based on the humidity of the mop **160** detected by the humidity sensor **171** being greater than the

reference humidity (Yes in operation **1400**), the controller **190** may control the driving device **120** to allow the robot cleaner **10** to return to the docking station **20** and may transmit the drying request signal to the docking station **20** through the communication interface **182**. Based on receiving the drying request signal, the docking station **20** may perform the drying operation for drying the mop **160** for the robot cleaner **10** that is docked or to be docked.

[0295] Here, the drying request signal may include a signal requesting the docking station **20** to perform a drying process and/or a signal requesting the docking station **20** to perform a washing process and the drying process.

[0296] In an embodiment, in response to the humidity of the mop **160** detected by the humidity sensor **171** being greater than the reference humidity and a contamination level of a liquid contaminant being greater than or equal to a defined reference value, the controller **190** may control the driving device **120** to return the robot cleaner **10** to the docking station **20**, and may transmit the drying request signal to the docking station **20** through the communication interface **182**. The drying request signal transmitted from the robot cleaner **10** to the docking station **20** in a case where the contamination level of the liquid contaminant (or a contamination level of the mop **160**) is greater than or equal to the defined reference value may be the signal requesting the washing process and the drying process. Based on receiving the drying request signal, the docking station **20** may perform the washing process to wash the mop **160** and the drying process to dry the mop **160** for the robot cleaner **10** that is docked or to be docked.

[0297] Upon completion of the drying process, the docking station **20** may transmit, to the robot cleaner **10**, a completion signal indicating that the drying operation on the mop **160** is completed.

[0298] Based on receiving the completion signal from the docking station **20**, the controller **190** may move the robot cleaner **10** to the contaminated area to perform re-cleaning.

[0299] According to the disclosure, a situation in which a user may be endangered by a liquid contaminant remaining even after the robot cleaner **10** has completed cleaning may be prevented.

[0300] According to the disclosure, the mop **160** of the robot cleaner **10** may be prevented from inefficiently cleaning a liquid contaminant in a state where the mop **160** can no longer absorb liquid, i.e., in a sufficiently wet state, and may clean the liquid contaminant with the dry mop **160**, thereby increasing the efficiency of removing the liquid contaminant.

[0301] In an embodiment, the controller **190** may perform the drying operation on the mop **160** by operating the intake motor **142**.

[0302] As described above, according to various embodiments, the robot cleaner **10** may include the outlets **164** and **114** to discharge air drawn into the main body **110** in a direction toward the mop **160** by an operation of the intake motor **142**. Accordingly, by operating the intake motor **142** of the robot cleaner **10**, the mop **160** may be naturally dried.

[0303] In a case where the robot cleaner **10** returns to the docking station **20** to perform the drying process, the time required for cleaning may be extended. Accordingly, for efficient cleaning, the robot cleaner **10** may perform the drying operation on the mop **160** by operating the intake motor **142**.

[0304] The robot cleaner **10** may control a height of the mop **160** to prevent the mop **160** from touching the floor while the intake motor **142** is operating.

[0305] That is, the controller **190** may control the height of the mop **160** to prevent the mop **160** from touching the floor while the intake motor **142** is operating for the drying operation.

[0306] Controlling the height of the mop **160** to prevent the mop **160** from touching the floor may include controlling the mop driver **161** to raise the mop **160**.

[0307] The controller **190** may move the robot cleaner **10** to allow the robot cleaner **10** to clean a cleaning area excluding the contaminated area while performing the drying operation on the mop **160** by operating the intake motor **142**.

[0308] Moving the robot cleaner **10** to clean the cleaning area excluding the contaminated area may include performing dry cleaning on the cleaning area excluding the contaminated area.

[0309] In a case where the humidity of the mop **160** detected by the humidity sensor **171** falls below the reference humidity while performing the drying operation on the mop **160** by operating the intake motor **142**, the controller **190** may perform re-cleaning to allow the mop **160** to pass over the contaminated area again.

[0310] In a case where re-cleaning of the contaminated area is performed, the controller **190** may stop the dry cleaning (stop the operation of the intake motor) and control the height of the mop **160** to allow the mop **160** to touch the floor.

[0311] That is, the controller **190** may control the height of the mop **160** to allow the mop **160** to touch the floor during re-cleaning.

[0312] According to the disclosure, dry cleaning may be performed on another cleaning area while the mop **160** is drying, thereby maximizing cleaning efficiency.

[0313] As such, the robot cleaner **10** may perform re-cleaning to allow the mop **160** to pass over the contaminated area again after performing the drying operation on the mop **160** (**1420**) based on the humidity of the mop **160** detected by the humidity sensor **171** being greater than the reference humidity (Yes in operation **1400**).

[0314] The robot cleaner **10** may perform re-cleaning to allow the mop **160** to pass over the contaminated area again without performing the drying operation on the mop **160** (**1420**), based on the humidity of the mop **160** detected by the humidity sensor **171** being less than or equal to the reference humidity (No in operation **1400**).

[0315] In an embodiment, in a case where it is determined that dry mopping is required for the contaminated area and the humidity of the mop **160** detected by the humidity sensor **171** is less than or equal to the reference humidity, the controller **190** may perform re-cleaning by reversing the robot cleaner **10**.

[0316] That is, because the mop **160** may sufficiently absorb a liquid contaminant when the mop **160** is not sufficiently wet, the robot cleaner **10** may completely remove the liquid contaminant by immediately reversing, in a case where the liquid contaminant on the contaminated area is not sufficiently removed in a state where the mop **160** is not sufficiently wet.

[0317] In an embodiment, in a case where it is determined that re-cleaning of the contaminated area is required again even though re-cleaning (dry mopping) of the contaminated

area has been performed, the controller **190** may perform the operations of FIG. **16** again or may transmit information about the contaminated area to the user through the communication interface **182**.

[0318] FIG. **17** is a flowchart illustrating an example drying operation of a robot cleaner according to an embodiment.

[0319] In an embodiment, the robot cleaner **10** may perform the drying operation on the mop **160** by returning the robot cleaner **10** to the docking station **20** and transmitting the drying request signal to the docking station **20**, or may perform the drying operation on the mop **160** by operating the intake motor **142**.

[0320] Drying the mop **160** by operating the intake motor **142** has limitations in drying efficiency because the mop **160** is dried using unheated wind.

[0321] Referring to FIG. **17**, in an embodiment, based on the humidity of the mop **160** being greater than a first humidity (Yes in operation **1411**), the robot cleaner **10** may perform the drying operation on the mop **160** by returning the robot cleaner **10** to the docking station **20** and transmitting a drying request signal to the docking station **20** (**1413**).

[0322] In this instance, the first humidity is greater than the reference humidity and may be stored in advance in the memory **192**.

[0323] According to the disclosure, in a case where it is not easy to dry the mop **160** by operating the intake motor **142**, the mop **160** may be completely dried by using the drying device of the docking station **20**.

[0324] In an embodiment, the robot cleaner **10** may perform the drying operation on the mop **160** by operating the intake motor (**1415**), based on the humidity of the mop **160** being less than or equal to the first humidity (No in operation **1411**).

[0325] According to the disclosure, in a situation where the mop **160** may be sufficiently dried by operating the intake motor **142**, the robot cleaner **10** may prevent cleaning from being delayed by returning to the docking station **20**.

[0326] Meanwhile, although not illustrated, even though the humidity of the mop **160** is not greater than the first humidity, in a case where the contamination level of the liquid contaminant (or the contamination level of the mop **160**) is greater than or equal to the defined reference value, the robot cleaner **10** may perform the drying operation on the mop **160** by returning the robot cleaner **10** to the docking station **20** and transmitting a drying request signal to the docking station **20** (**1413**).

[0327] According to the disclosure, a likelihood of spreading contamination by re-cleaning a liquid contaminant with a contaminated mop may be prevented in advance.

[0328] Referring again to FIG. **12**, the robot cleaner **10** may determine that wet mopping of the contaminated area is required based on the foreign substance left on the contaminated area being identified as a stain (No in operation **1300**).

[0329] In a case where there is a stain on the floor, the stain may be wiped off by moisture. However, in a case where the humidity of the mop **160** is low, the stain may not be wiped off well.

[0330] FIG. **18** is a flowchart illustrating an example method of re-cleaning in a case where a robot cleaner according to an embodiment determines that wet mopping is required.

[0331] Referring to FIG. **18**, the controller **190** may determine whether to perform a water filling operation on the mop **160**, based on determining that wet mopping is required for the contaminated area (No in operation **1300** of FIG. **12**).

[0332] The robot cleaner **10** may perform the water filling operation on the mop **160** before performing re-cleaning (**1510**), based on the humidity of the mop **160** detected by the humidity sensor **171** being less than a second humidity (Yes in operation **1500**).

[0333] In this instance, the second humidity may be stored in advance in the memory **192**. The second humidity may be lower than the reference humidity described above.

[0334] In an embodiment, the controller **190** may perform the water filling operation on the mop **160** by controlling the water tank valve **115***v* to supply water stored in the water tank **115** to the mop **160**.

[0335] The controller **190** may perform re-cleaning by moving the robot cleaner **10** to the contaminated area, upon completion of the water filling operation on the mop **160** by controlling the water tank valve **115***v*.

[0336] In this instance, the controller **190** may control the water tank valve **115***v* to allow the humidity of the mop **160** to become the second humidity or higher, and then reverse the robot cleaner **10** to perform re-cleaning.

[0337] In an embodiment, the controller **190** may perform the water filling operation on the mop **160** by returning the robot cleaner **10** to the docking station **20** and transmitting a washing request signal or a water filling request signal to the docking station **20**.

[0338] For example, based on the humidity of the mop **160** detected by the humidity sensor **171** being less than the second humidity (Yes in operation **1500**), the controller **190** may control the driving device **120** to allow the robot cleaner **10** to return to the docking station **20**, and may transmit the washing request signal or the water filling request signal to the docking station **20** through the communication interface **182**. Based on receiving the washing request signal, the docking station **20** may perform a washing process to wash the mop **160** for the robot cleaner **10** that is docked or to be docked. Based on receiving the water filling request signal, the docking station **20** may perform a water filling process to fill the water tank **115** with water for the robot cleaner **10** that is docked or to be docked. Here, the washing request signal may include a signal requesting the docking station **20** to perform the washing process. In an embodiment, the washing request signal may include a signal requesting the docking station **20** to perform the washing process and the drying process. In this instance, the washing request signal may be a signal to maintain the humidity of the mop **160** at a defined level compared to the drying request signal described above. That is, the docking station **20** may perform the drying process for a first time period in response to receiving the drying request signal, and may perform the drying process for a second time period shorter than the first time period in response to receiving the washing request signal.

[0339] Upon completion of the washing process or the water filling process, the docking station **20** may transmit a completion signal indicating that the drying operation on the mop **160** is completed to the robot cleaner **10**.

[0340] Based on receiving the completion signal of the water filling process from the docking station **20**, the controller **190** may replenish the humidity of the mop **160** by controlling the water tank valve **115***v* to supply water stored

in the water tank **115** to the mop **160** and then move the robot cleaner **10** to the contaminated area, thereby performing re-cleaning.

[0341] Based on receiving the completion signal of the washing process from the docking station **20**, the controller **190** may perform re-cleaning by moving the robot cleaner **10** to the contaminated area.

[0342] According to the disclosure, in a case where the mop **160** is required to remove a stain, the efficiency of stain cleaning may be maximized by increasing the humidity of the mop **160** and then performing re-cleaning.

[0343] As such, based on the humidity of the mop **160** detected by the humidity sensor **171** being less than the second humidity (Yes in operation **1500**), the robot cleaner **10** may perform the water filling operation on the mop **160** and then allow the mop **160** to pass over the contaminated area again to perform re-cleaning (**1520**).

[0344] Based on the humidity of the mop **160** detected by the humidity sensor **171** being greater than or equal to the second humidity (No in operation **1500**), the robot cleaner **10** may allow the mop **160** to pass over the contaminated area again without performing the water filling operation on the mop **160** to perform re-cleaning (**1520**).

[0345] In an embodiment, in a case where it is determined that wet mopping is required for the contaminated area and the humidity of the mop **160** detected by the humidity sensor **171** is greater than or equal to the second humidity, the controller **190** may perform re-cleaning by reversing the robot cleaner **10**.

[0346] That is, because the mop **160** may sufficiently wipe off a stain when the mop **160** is sufficiently wet, in a case where the stain on the contaminated area is not sufficiently removed when the mop **160** is sufficiently wet, the robot cleaner **10** may completely remove the stain by immediately reversing.

[0347] In an embodiment, in a case where it is determined that re-cleaning of the contaminated area is required again even though re-cleaning (wet mopping) of the contaminated area has been performed, the controller **190** may perform the operations of FIG. **18** again or transmit information about the contaminated area to the user through the communication interface **182**.

[0348] FIG. **19** is a flowchart illustrating an example water filling operation of a robot cleaner according to an embodiment.

[0349] Referring to FIG. **19**, the controller **190** may return the robot cleaner **10** to the docking station **20** (**1513**), based on the mop **160** being required to be washed or water in the water tank **115** being insufficient (Yes in operation **1511**).

[0350] The controller **190** may determine that the mop **160** is required to be washed in response to the contamination level of the mop **160** being greater than or equal to a defined value. The controller **190** may determine that the water in the water tank **115** is insufficient based on an output value of a sensor detecting a water level in the water tank **115**. The controller **190** may determine that the water in the water tank **115** is insufficient, based on the humidity of the mop **160** not increasing despite controlling the water tank valve **115***v* to supply water in the water tank **115** to the mop **160**.

[0351] In response to a determination that the mop **160** is required to be washed, the controller **190** may return the robot cleaner **10** to the docking station **20** and transmit a washing request signal to the docking station **20**.

[0352] In response to a determination that the water in the water tank **115** is insufficient, the controller **190** may return the robot cleaner **10** to the docking station **20** and transmit a water filling request signal to the docking station **20**.

[0353] Based on the mop **160** not being required to be washed or water in the water tank **115** being sufficient (No in operation **1511**), the controller **190** may control the water tank valve **115***v* to supply water in the water tank **115** to the mop **160** (**1515**).

[0354] According to the disclosure, the efficiency of stain cleaning may be increased by wiping a stain with the wet clean mop **160**.

[0355] In addition to the operations described above, the robot cleaner **10** according to an embodiment may perform various operations that may increase cleaning efficiency.

[0356] In an embodiment, the robot cleaner **10** may call another robot cleaner **10** in a case where a foreign substance remains on a contaminated area despite performing re-cleaning.

[0357] Calling the other robot cleaner **10** by the robot cleaner **10** may include transmitting information about the contaminated area (e.g., location information about the contaminated area) to the other robot cleaner **10** through the communication interface **182**.

[0358] In an embodiment, in a case where a foreign substance remains on the contaminated area despite performing re-cleaning, the robot cleaner **10** may transmit information about the contaminated area (e.g., location information about the contaminated area) to a user device. The user may confirm the information about the contaminated area via the user device, and may clean the contaminated area himself/herself.

[0359] In an embodiment, in a case where a foreign substance remains on the contaminated area despite performing re-cleaning, the robot cleaner **10** may transmit a signal to request replacement of the mop **160** to the user device. The user may confirm that the mop **160** is required to be replaced via the user device, and may replace the mop **160**.

[0360] In an embodiment, in a case where a liquid contaminant remains on the contaminated area despite performing re-cleaning, the robot cleaner **10** may transmit a signal to request a dehumidification operation to an air conditioner. The air conditioner may perform the dehumidification operation in response to receiving the dehumidification request signal.

[0361] According to the disclosure, the robot cleaner **10** may efficiently remove a liquid contaminant and/or a stain on the floor.

[0362] According to an embodiment of the disclosure, a robot cleaner **10** may include: a main body **110**: a mop **160** configured to be detachably mountable to a lower portion of the main body **110**; a front sensor **175** configured to have a front field of view of the main body **110**; a rear sensor **176** configured to have a rear field of view of the main body **110**; a humidity sensor **171** configured to detect a humidity of the mop **160**; and a controller **190** configured to: determine whether dry mopping is required for a contaminated area PA based on information about the contaminated area PA obtained by the rear sensor **176** after the mop **160** cleaned the contaminated area PA detected by the front sensor **175**, and in response to a determination that dry mopping is required for the contaminated area PA and the humidity of the mop **160** detected by the humidity sensor **171** being

greater than a reference humidity, perform a re-cleaning to allow the mop **160** to pass over the contaminated area PA again after performing a drying operation on the mop **160**.

[0363] The controller **190** may be configured to perform a re-cleaning to allow the mop **160** to pass over the contaminated area PA again without the drying operation, in response to the determination that dry mopping is required for the contaminated area PA and the humidity of the mop **160** detected by the humidity sensor **171** being less than or equal to the reference humidity.

[0364] The controller **190** may be configured to perform the re-cleaning by reversing the robot cleaner **10**, in response to the determination that dry mopping is required for the contaminated area PA and the humidity of the mop **160** detected by the humidity sensor **171** being less than or equal to the reference humidity.

[0365] The controller **190** may be configured to perform the drying operation on the mop **160** by returning the robot cleaner **10** to a docking station **20** and transmitting a drying request signal to the docking station **20**.

[0366] The controller **190** may be configured to move the robot cleaner **10** to the contaminated area PA in response to receiving a completion signal indicating that the drying operation on the mop **160** is completed from the docking station **20**.

[0367] The controller **190** may be configured to move the robot cleaner **10** to the contaminated area PA in response to receiving a completion signal indicating that the drying operation on the mop **160** is completed from the docking station **20**.

[0368] The robot cleaner **10** may further include: an intake motor **142**; and an outlet **164** and **114** configured to discharge air, drawn into the main body **110** by an operation of the intake motor **142**, in a direction toward the mop **160**, wherein the controller **190** may be configured to perform the drying operation on the mop **160** by operating the intake motor **142**.

[0369] The controller **190** may be configured to control a height of the mop **160** to prevent the mop **160** from touching a floor while the intake motor **142** operates, and control the height of the mop **160** to allow the mop **160** to touch the floor during the re-cleaning.

[0370] The controller **190** may be configured to move the robot cleaner **10** to clean an area other than the contaminated area PA while the drying operation on the mop **160** is performed by operating the intake motor **142**.

[0371] The controller **190** may be configured to identify a type of a foreign substance left on the contaminated area PA based on the information about the contaminated area PA obtained by the rear sensor **176**, and determine that dry mopping is required for the contaminated area PA based on identifying that the foreign substance left on the contaminated area PA is a liquid contaminant.

[0372] The controller **190** may be configured to identify a type of a foreign substance left on the contaminated area PA based on the information about the contaminated area PA obtained by the rear sensor **176**, and determine that wet mopping is required for the contaminated area PA based on identifying that the foreign substance left on the contaminated area PA is a stain.

[0373] The controller **190** may be configured to perform a re-cleaning to allow the mop **160** to pass over the contaminated area PA again without the drying operation, in response to a determination that wet mopping is required for the contaminated area PA.

[0374] The robot cleaner **10** may further include: a water tank **115** configured to store water supplied to the mop **160**, wherein the controller **190** may be configured to: in response to a determination that wet mopping is required for the contaminated area PA and the humidity of the mop **160** detected by the humidity sensor **171** being less than a defined humidity, perform a re-cleaning to allow the mop **160** to pass over the contaminated area PA again after performing a water filling operation to supply the water stored in the water tank to the mop **160**.

[0375] The controller **190** may be configured to, in response to a determination that wet mopping is required for the contaminated area PA and the humidity of the mop **160** detected by the humidity sensor **171** being less than a defined humidity, return the robot cleaner **10** to a docking station **20**, and transmit a washing request signal or a water filling request signal to the docking station **20**.

[0376] The reference humidity may be set according to a user input.

[0377] According to an embodiment of the disclosure, a method for controlling a robot cleaner **10** may include: determining whether dry mopping is required for a contaminated area PA based on information about the contaminated area obtained by a rear sensor **176** after a mop **160** cleaned the contaminated area PA detected by a front sensor **175**, and in response to a determination that dry mopping is required for the contaminated area PA and a humidity of the mop **160** detected by the humidity sensor **171** being greater than a reference humidity, performing a re-cleaning to allow the mop **160** to pass over the contaminated area PA again after performing a drying operation on the mop **160**.

[0378] The method may further include performing a re-cleaning to allow the mop **160** to pass over the contaminated area PA again without the drying operation, in response to the determination that dry mopping is required for the contaminated area PA and the humidity of the mop **160** detected by the humidity sensor **171** being less than or equal to the reference humidity.

[0379] The performing of the drying operation may include returning the robot cleaner **10** to a docking station **20** and transmitting a drying request signal to the docking station **20**.

[0380] The performing of the drying operation may include operating an intake motor **142** configured to draw external air into the main body **110** and discharge the air drawn into the main body **110** in a direction toward the mop **160**.

[0381] The method may further include identifying a type of a foreign substance left on the contaminated area PA based on the information about the contaminated area PA obtained by the rear sensor **176**, and determining that dry mopping is required for the contaminated area PA based on identifying that the foreign substance left on the contaminated area PA is a liquid contaminant.

[0382] The method may further include determining that wet mopping is required for the contaminated area PA based on identifying that the foreign substance left on the contaminated area PA is a stain.

[0383] Meanwhile, the disclosed embodiments may be implemented in the form of a recording medium that stores instructions executable by a computer. The instructions may

be stored in the form of program codes, and when executed by a processor, the instructions may create a program module to perform operations of the disclosed embodiments. The recording medium may be implemented as a computer-readable recording medium.

[0384] The computer-readable recording medium may include all kinds of recording media storing instructions that may be interpreted by a computer. For example, the computer-readable recording medium may be a read only memory (ROM), a random access memory (RAM), a magnetic tape, a magnetic disk, a flash memory, an optical data storage, etc.

[0385] The computer-readable recording medium may be provided in the form of a non-transitory storage medium. Here, when a storage medium is referred to as "non-transitory", it may be understood that the storage medium is tangible and does not include a signal (e.g., an electromagnetic wave), but rather that data is semi-permanently or temporarily stored in the storage medium. For example, a "non-transitory storage medium" may include a buffer in which data is temporarily stored.

[0386] According to an embodiment, the method according to the various embodiments disclosed herein may be provided in a computer program product. The computer program product may be traded between a seller and a buyer as a product. The computer program product may be distributed in the form of a machine-readable storage medium (e.g., compact disc read only memory (CD-ROM)), or may be distributed (e.g., download or upload) through an application store (e.g., Play Store™) online or directly between two user devices (e.g., smartphones). In the case of online distribution, at least a portion of the computer program product (e.g., downloadable app) may be stored at least semi-permanently or may be temporarily generated in a storage medium, such as a memory of a server of a manufacturer, a server of an application store, or a relay server.

[0387] Although embodiments of the disclosure have been described with reference to the accompanying drawings, a person having ordinary skilled in the art will appreciate that other specific modifications may be easily made without departing from the technical spirit or essential features of the disclosure. Therefore, the foregoing embodiments should be regarded as illustrative rather than limiting in all aspects.

1. A robot cleaner, comprising:
- a main body;
- a mop configured to be coupleable to and decoupleable from a lower portion of the main body;
- a front sensor configured to have a front field of view of the main body;
- a rear sensor configured to have a rear field of view of the main body;
- a humidity sensor configured to detect a humidity of the mop; and
- a controller configured to:
  - determine whether dry mopping is required, for an area to be cleaned that is detected by the front sensor, based on information about the area obtained by the rear sensor after the mop coupled to the lower portion of the main body cleans the area detected by the front sensor, and
  - based on the dry mopping being determined as being required for the area and the humidity of the mop detected by the humidity sensor being greater than a reference humidity, perform a re-cleaning to allow the mop to pass over the area again after performing a drying operation on the mop.

2. The robot cleaner of claim **1**, wherein the controller is configured to perform the re-cleaning without requiring the drying operation on the mop, based on the dry mopping being determined as being required for the area and the humidity of the mop detected by the humidity sensor being less than or equal to the reference humidity.

3. The robot cleaner of claim **2**, wherein the controller is configured to perform the re-cleaning by reversing the robot cleaner, based on the dry mopping being determined as being required for the area and the humidity of the mop detected by the humidity sensor being less than or equal to the reference humidity.

4. The robot cleaner of claim **1**, wherein the controller is configured to perform the drying operation on the mop by returning the robot cleaner to a docking station and transmitting a drying request signal to the docking station.

5. The robot cleaner of claim **4**, wherein the controller is configured to move the robot cleaner to the area based on receiving a completion signal indicating that the drying operation on the mop is completed from the docking station.

6. The robot cleaner of claim **1**, further comprising:
- an intake motor; and
- an outlet configured to discharge air, drawn into the main body by an operation of the intake motor, in a direction toward the mop,
- wherein the controller is configured to perform the drying operation on the mop by operating the intake motor.

7. The robot cleaner of claim **6**, wherein the controller is configured to control the mop to prevent the mop from touching a floor while the intake motor operates, and control the mop to allow the mop to touch the floor during the re-cleaning.

8. The robot cleaner of claim **6**, wherein the controller is configured to move the robot cleaner to clean an area other than the area while the drying operation on the mop is performed by operating the intake motor.

9. The robot cleaner of claim **1**, wherein the controller is configured to identify a type of a foreign substance left on the area based on the information about the area obtained by the rear sensor, and determine that the dry mopping is required for the area based on identifying that the foreign substance left on the area is a liquid contaminant.

10. The robot cleaner of claim **1**, wherein the controller is configured to identify a type of a foreign substance left on the area based on the information about the area obtained by the rear sensor, and determine that wet mopping is required for the area based on identifying that the foreign substance left on the area is a stain.

11. The robot cleaner of claim **10**, wherein the controller is configured to perform a re-cleaning to allow the mop to pass over the area again without the drying operation, in response to a determination that wet mopping is required for the area.

12. The robot cleaner of claim **10**, further comprising:
- a water tank configured to store water supplied to the mop,
- wherein the controller is configured to:
  - based on determining that wet mopping is required for the area and the humidity of the mop detected by the humidity sensor being less than a defined humidity, perform a re-cleaning to allow the mop to pass over

the area again after performing a water filling operation to supply the water stored in the water tank to the mop.

13. The robot cleaner of claim **10**, wherein the controller is configured to, based on determining that wet mopping is required for the area and the humidity of the mop detected by the humidity sensor being less than a defined humidity, return the robot cleaner to a docking station, and transmit a washing request signal or a water filling request signal to the docking station.

14. The robot cleaner of claim **1**, wherein the reference humidity is settable according to a user input.

15. A method for controlling a robot cleaner, comprising:

determining whether dry mopping by a mop coupleable to and decoupleable from a lower portion of a main body of the robot cleaner is required for an area to be cleaned that is detected by a front sensor having a front field of view of the main body based on information about the area obtained by a rear sensor having a rear field of view of the main body after the mop coupled to the lower portion of the main body cleans the area detected by the front sensor, and

based on the dry mopping being determined as being required for the area and humidity of the mop detected by a humidity sensor being greater than a reference humidity, performing a re-cleaning to allow the mop to pass over the area again after performing a drying operation on the mop.

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