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JO et al.

(54) **DISHWASHER**

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(57) **ABSTRACT**

A dishwasher includes a tub that defines a washing chamber, a door configured to open and close the washing chamber, a handle disposed at the door, a handle motor configured to drive the handle in a front-rear direction, a first sensor having a first detection distance, and a second sensor having a second detection distance different from the first detection distance. The handle is configured to, based on the first sensor detecting a user, protrude outward in a forward direction from a first position to a second position. The handle is configured to, based on the second sensor detecting the user, move in the forward direction from the second position to a third position.

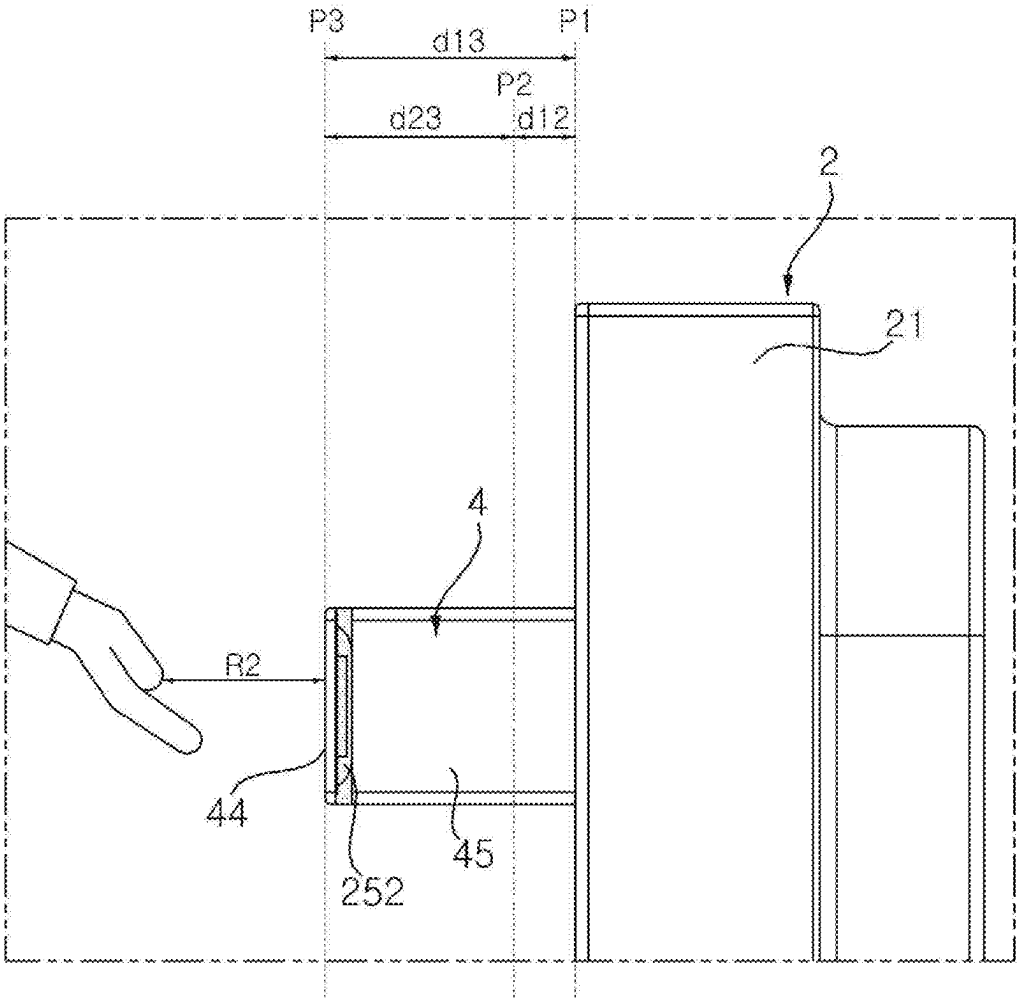

FIG. 1

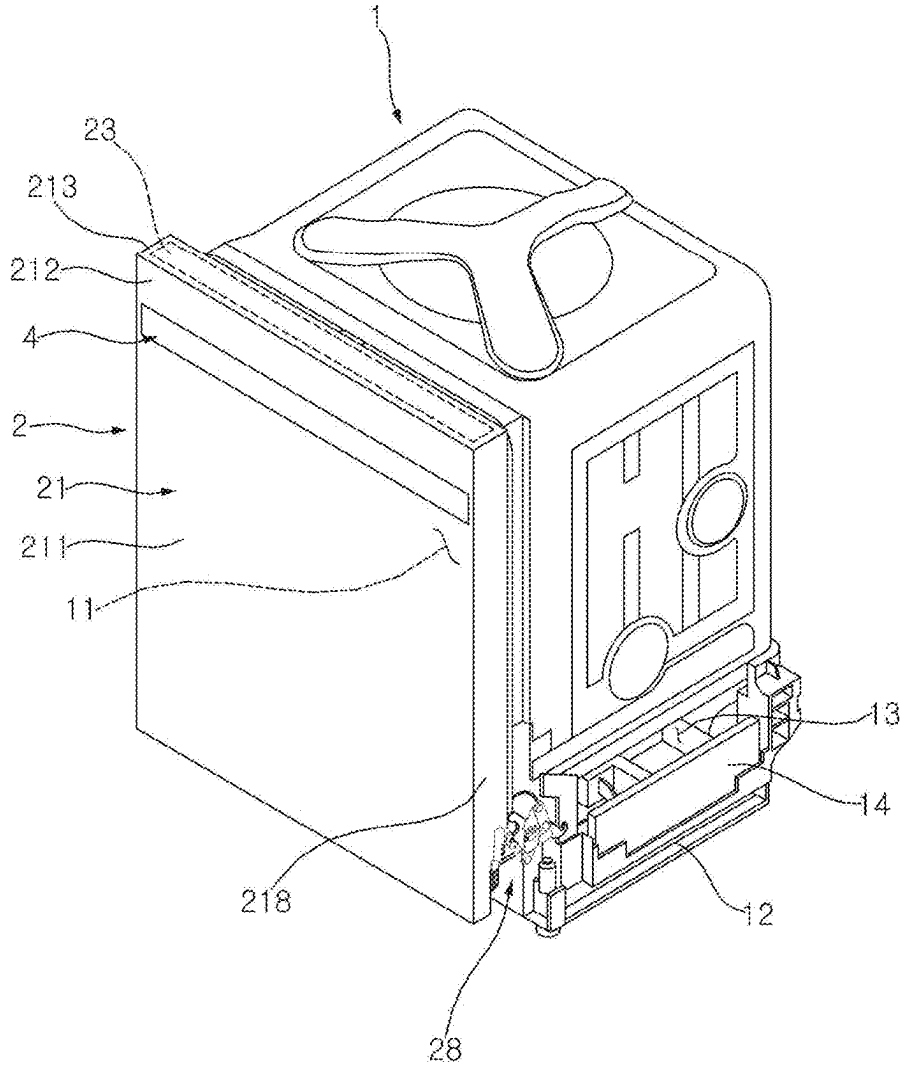

FIG. 2

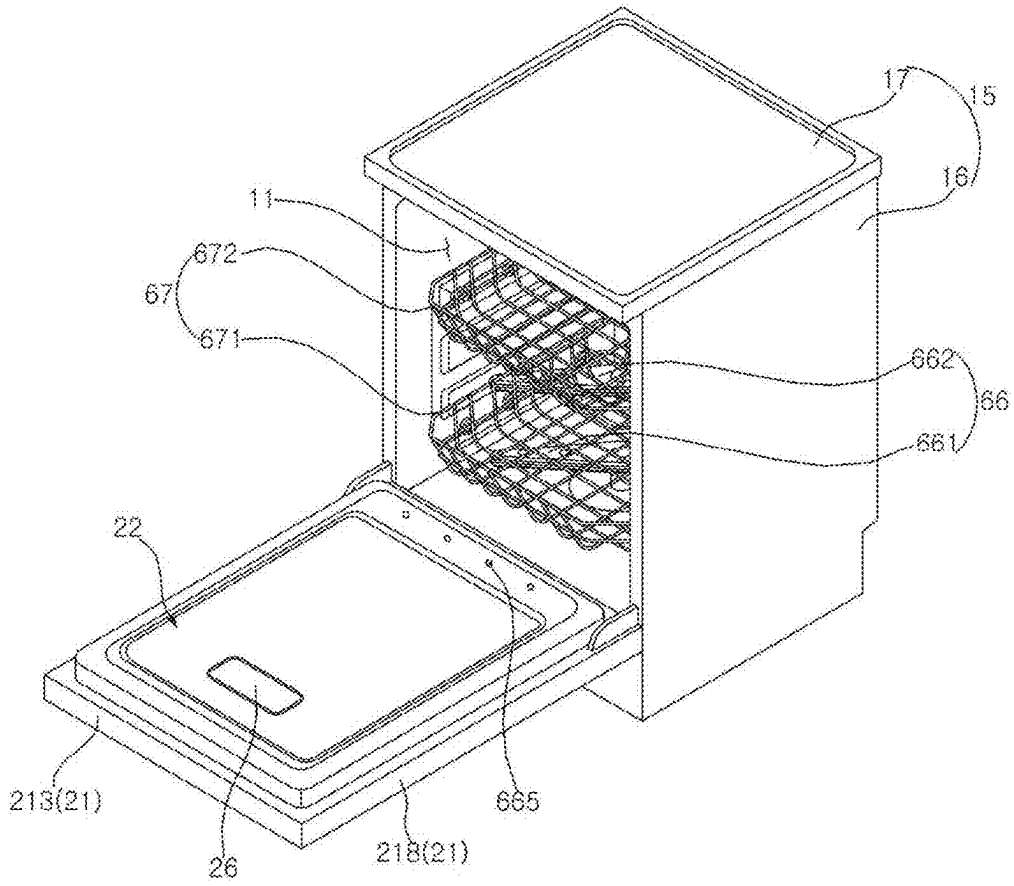

FIG. 3

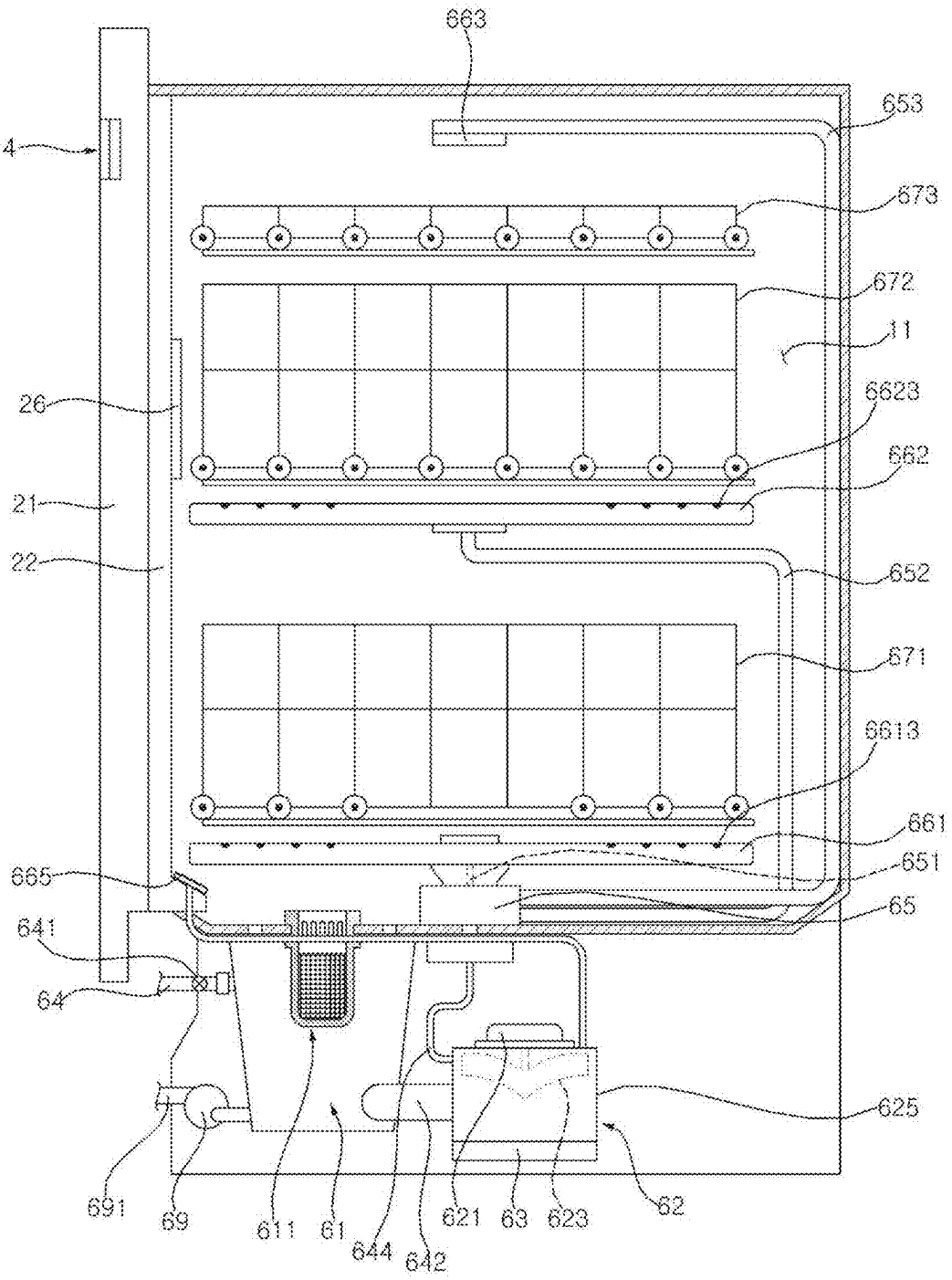
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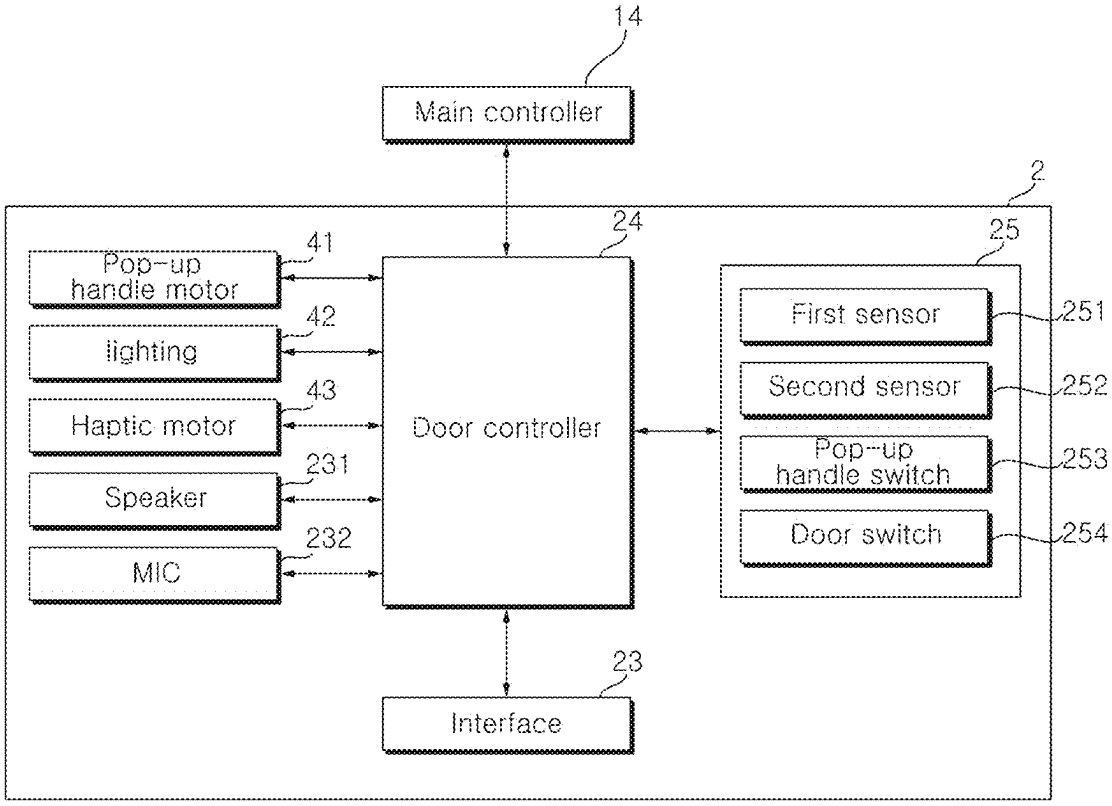
FIG. 4



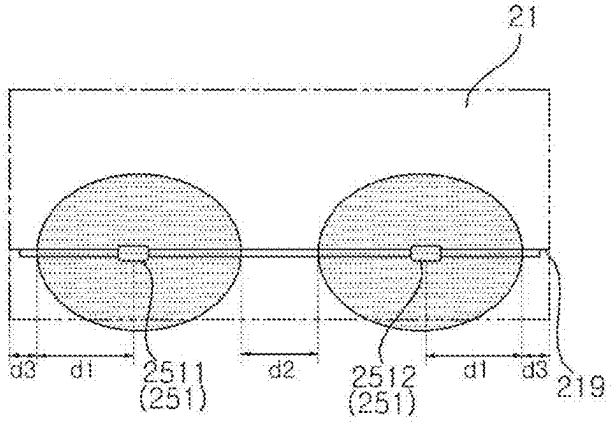


FIG. 5A

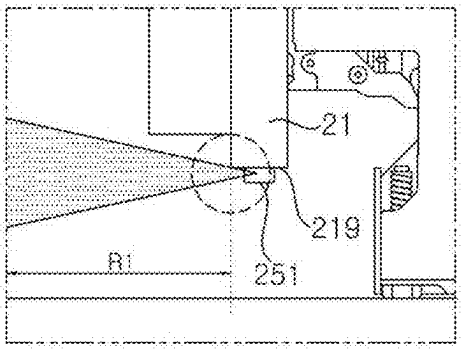
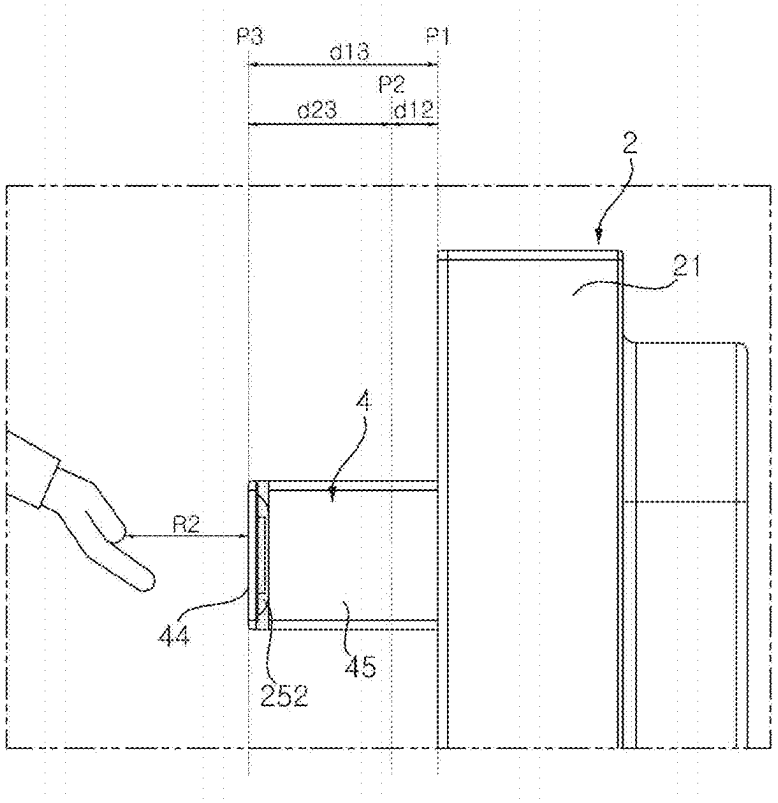
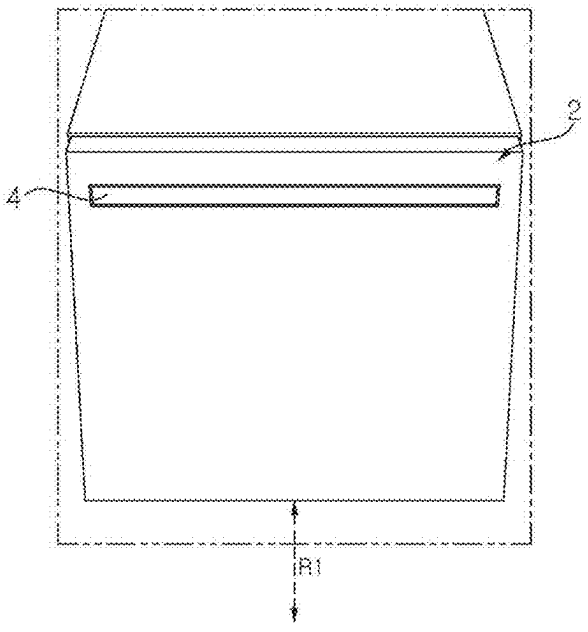


FIG. 5B

FIG. 6





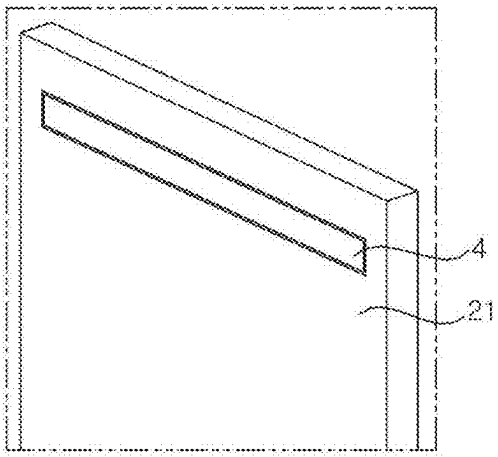


FIG. 7A

FIG. 7B

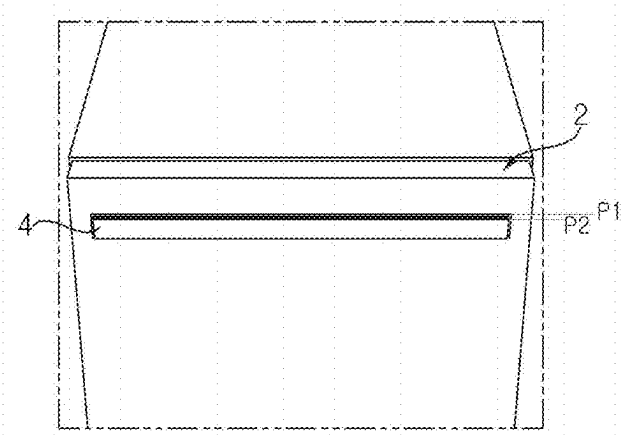


FIG. 8A

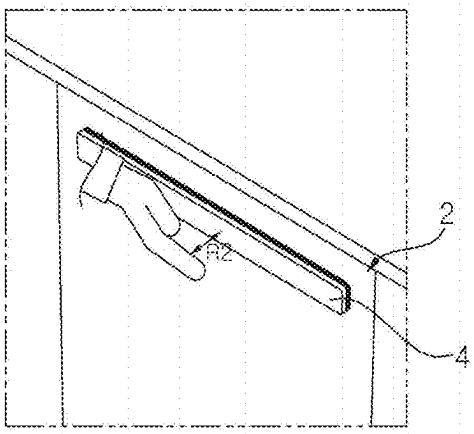


FIG. 8B

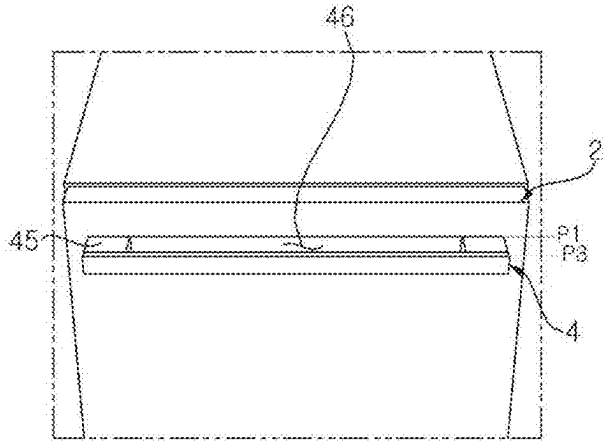


FIG. 9A

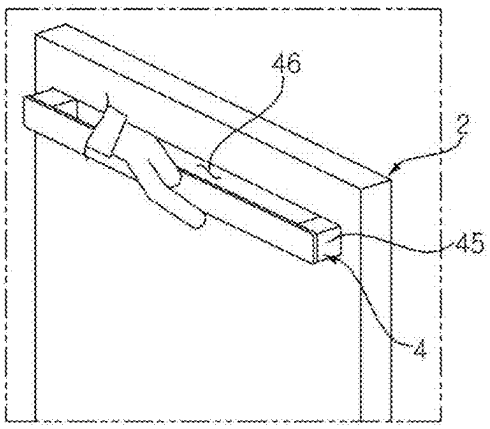


FIG. 9B

FIG. 10

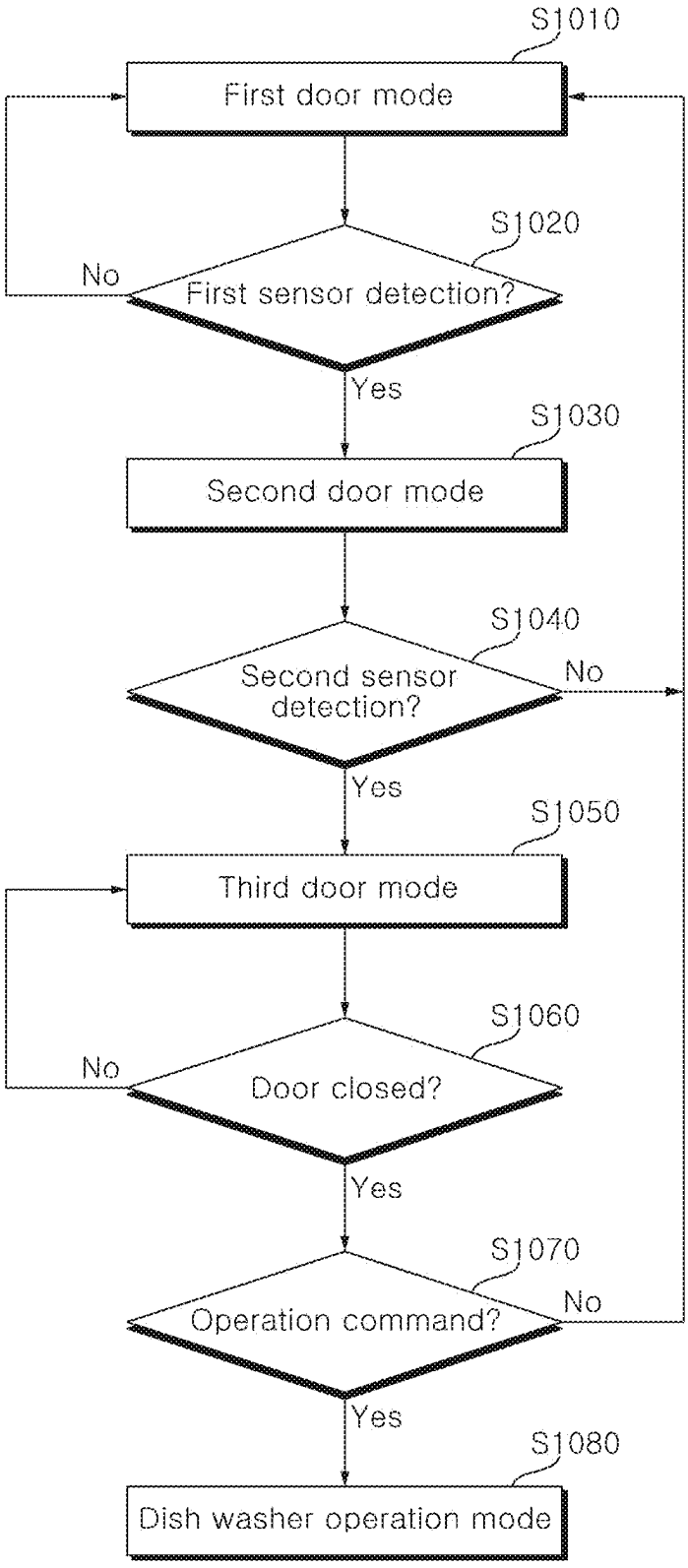

S1010
First door mode
S1020
First sensor detection?
No
Yes
S1030
Second door mode
S1040
Second sensor detection?
No
Yes
S1050
Third door mode
S1060
Door closed?
No
Yes
S1070
Operation command?
No
Yes
S1080
Dish washer operation mode

FIG. 11

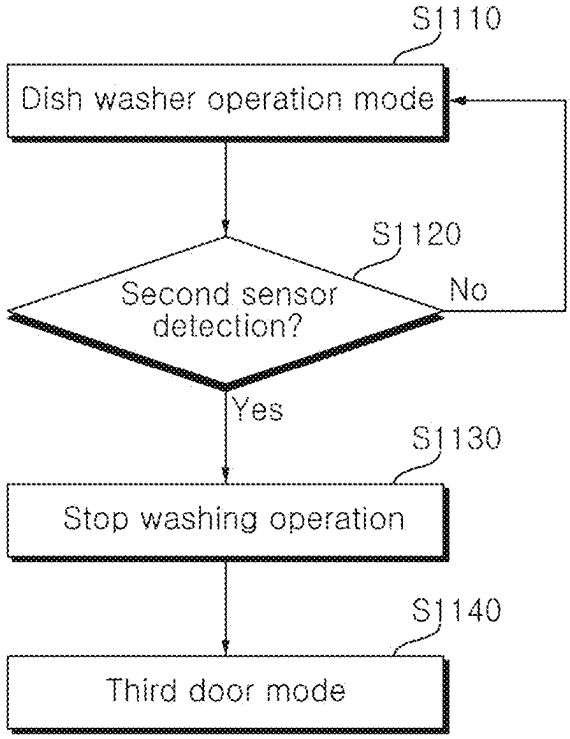

S1110
Dish washer operation mode
S1120
Second sensor detection?
No
Yes
S1130
Stop washing operation
S1140
Third door mode

FIG. 12

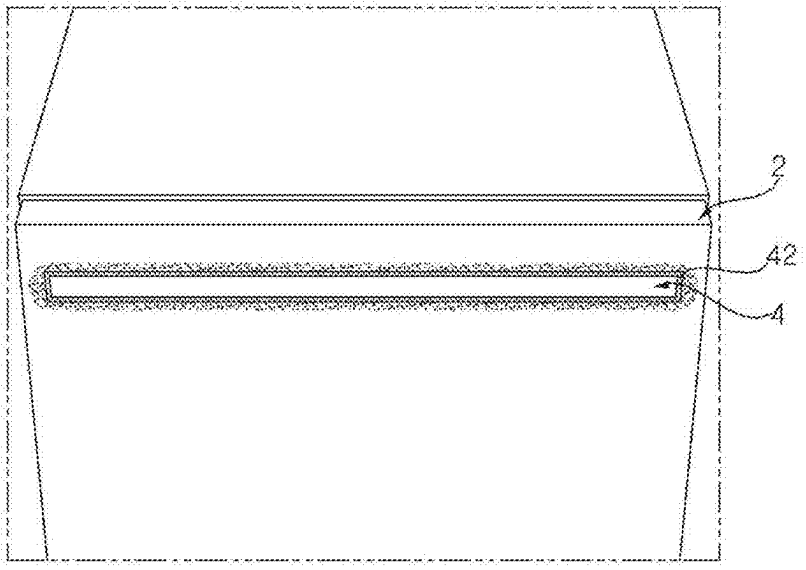

2
42
4

FIG. 13A

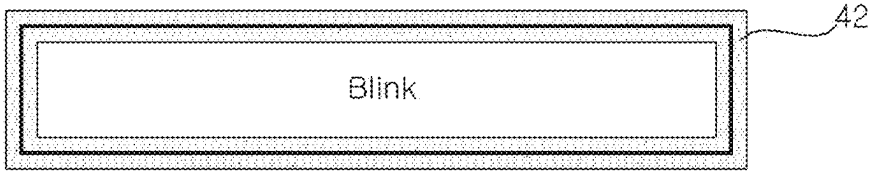


FIG. 13B

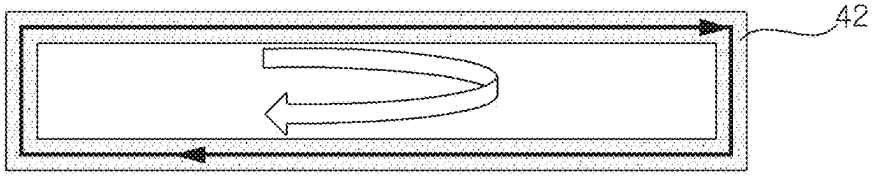


FIG. 13C

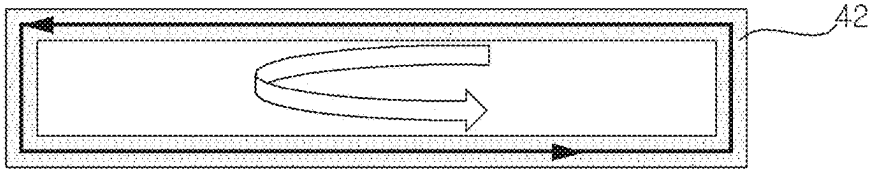


FIG. 13D

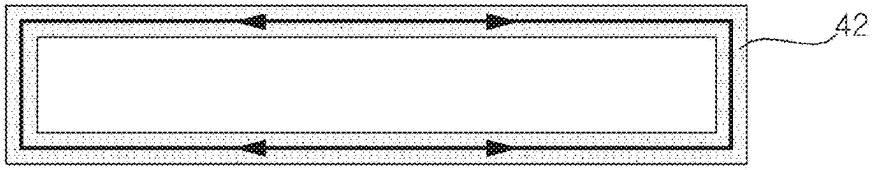


FIG. 13E

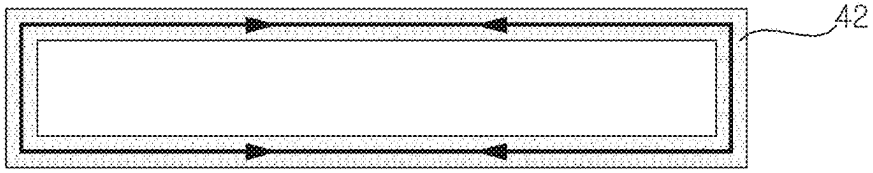


FIG. 14

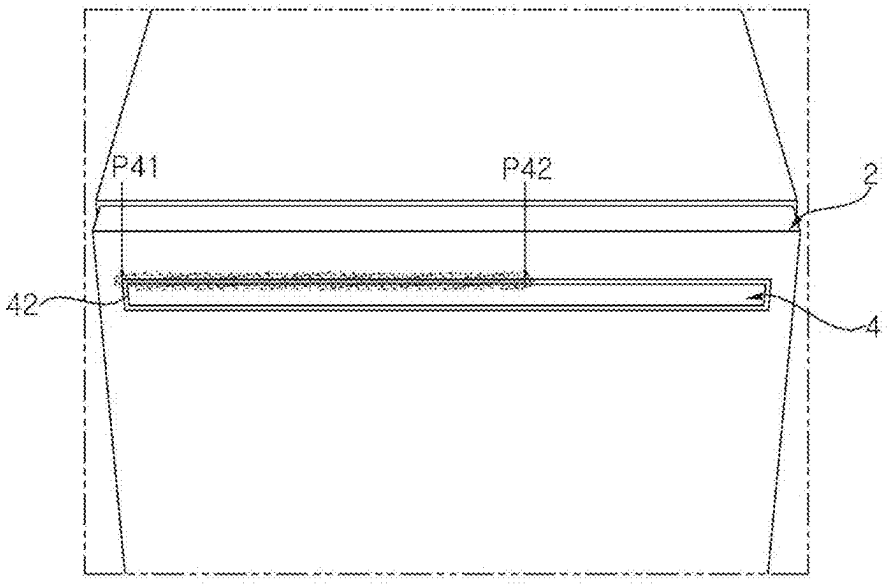


FIG. 15

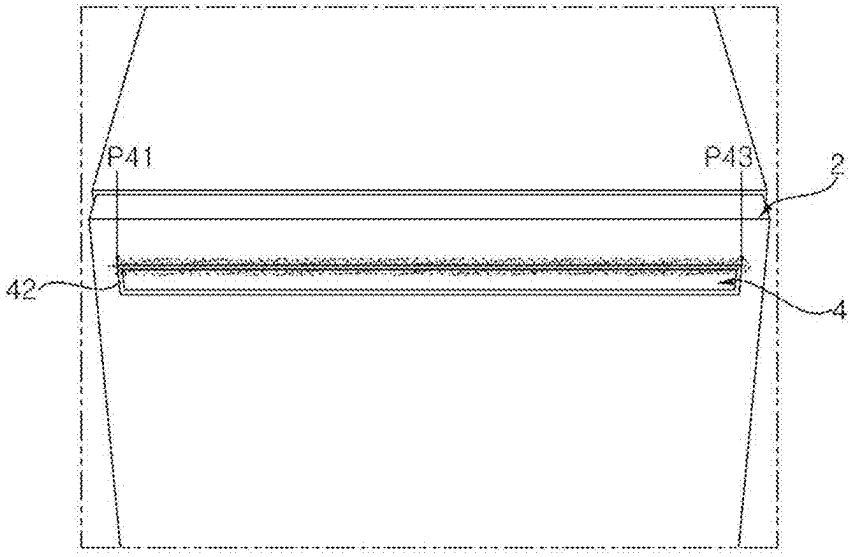


FIG. 16

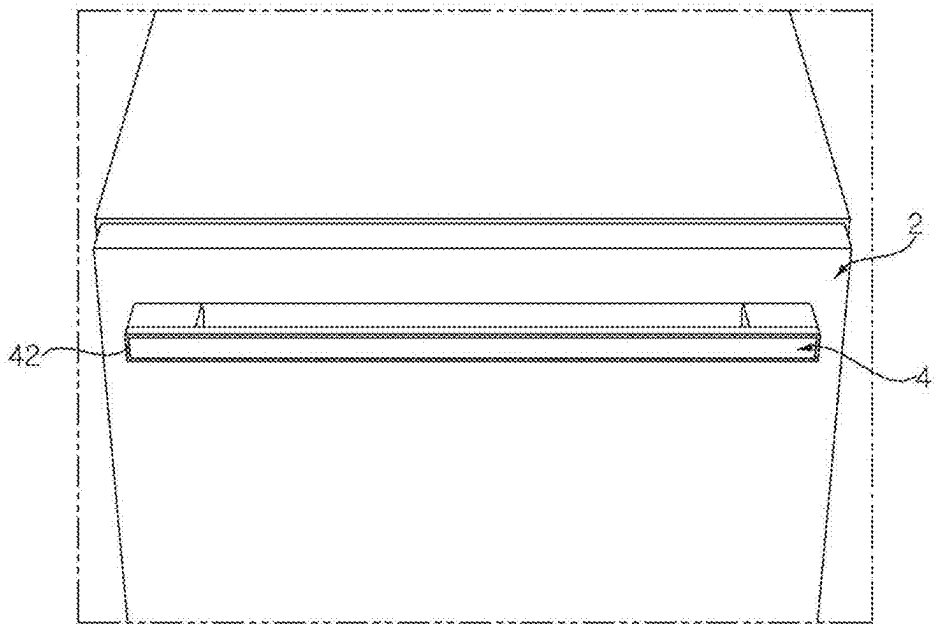


FIG. 17

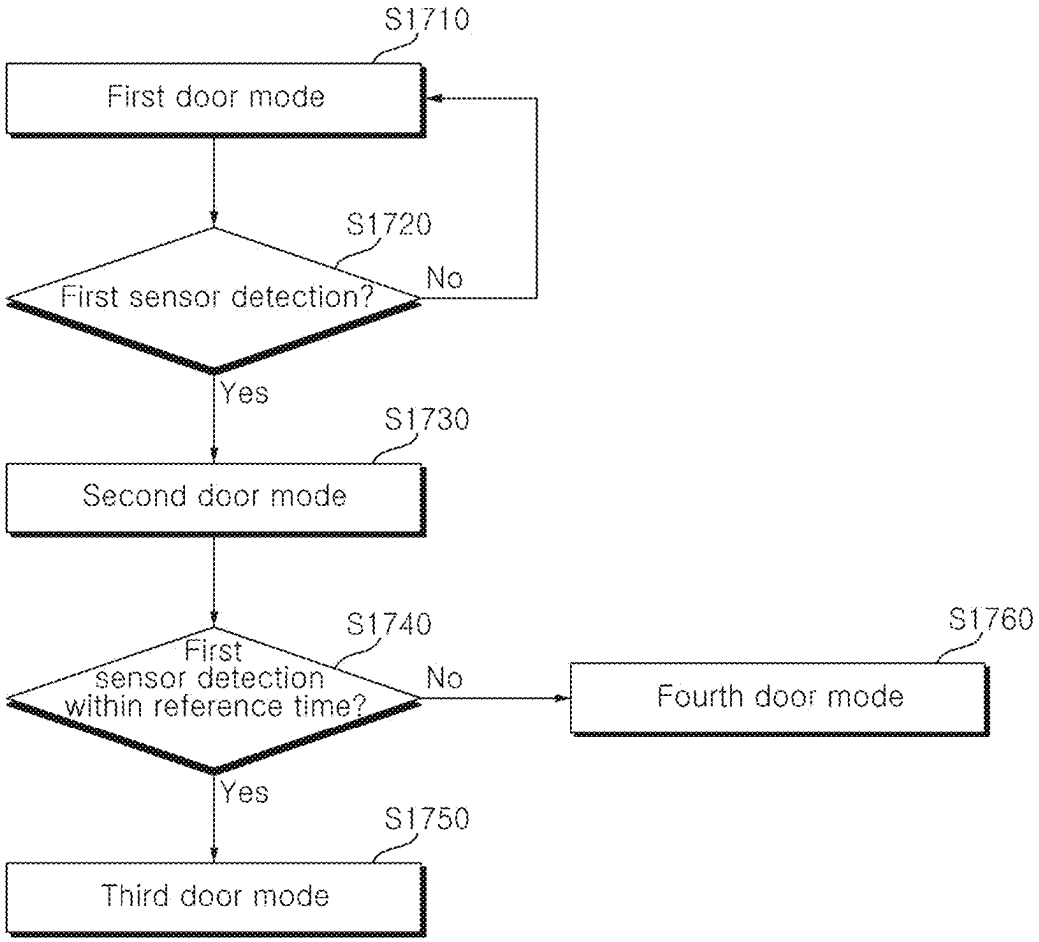

S1710
First door mode
S1720
First sensor detection?
No
Yes
S1730
Second door mode
S1740
First sensor detection within reference time?
No
S1760
Fourth door mode
Yes
S1750
Third door mode

FIG. 18

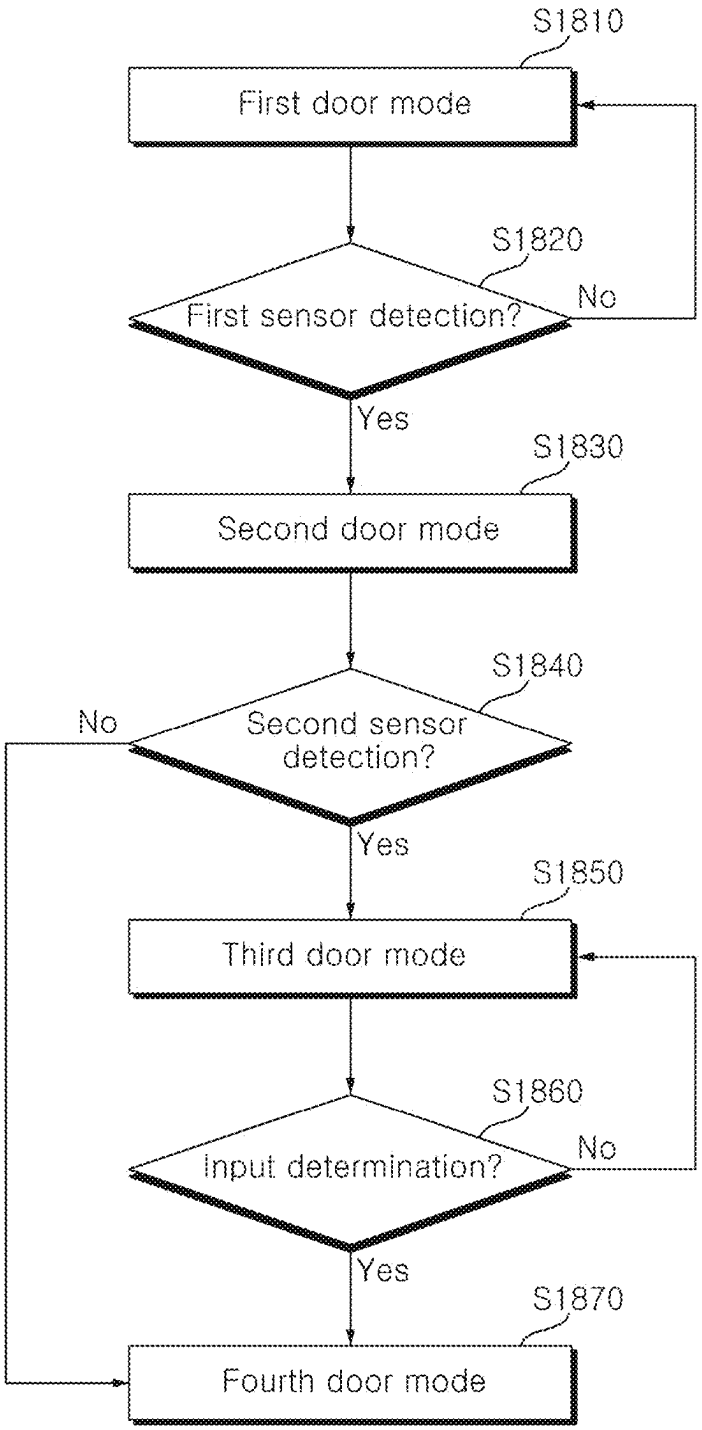

S1810
First door mode
S1820
First sensor detection?
No
Yes
S1830
Second door mode
S1840
Second sensor detection?
No
Yes
S1850
Third door mode
S1860
Input determination?
No
Yes
S1870
Fourth door mode

FIG. 19

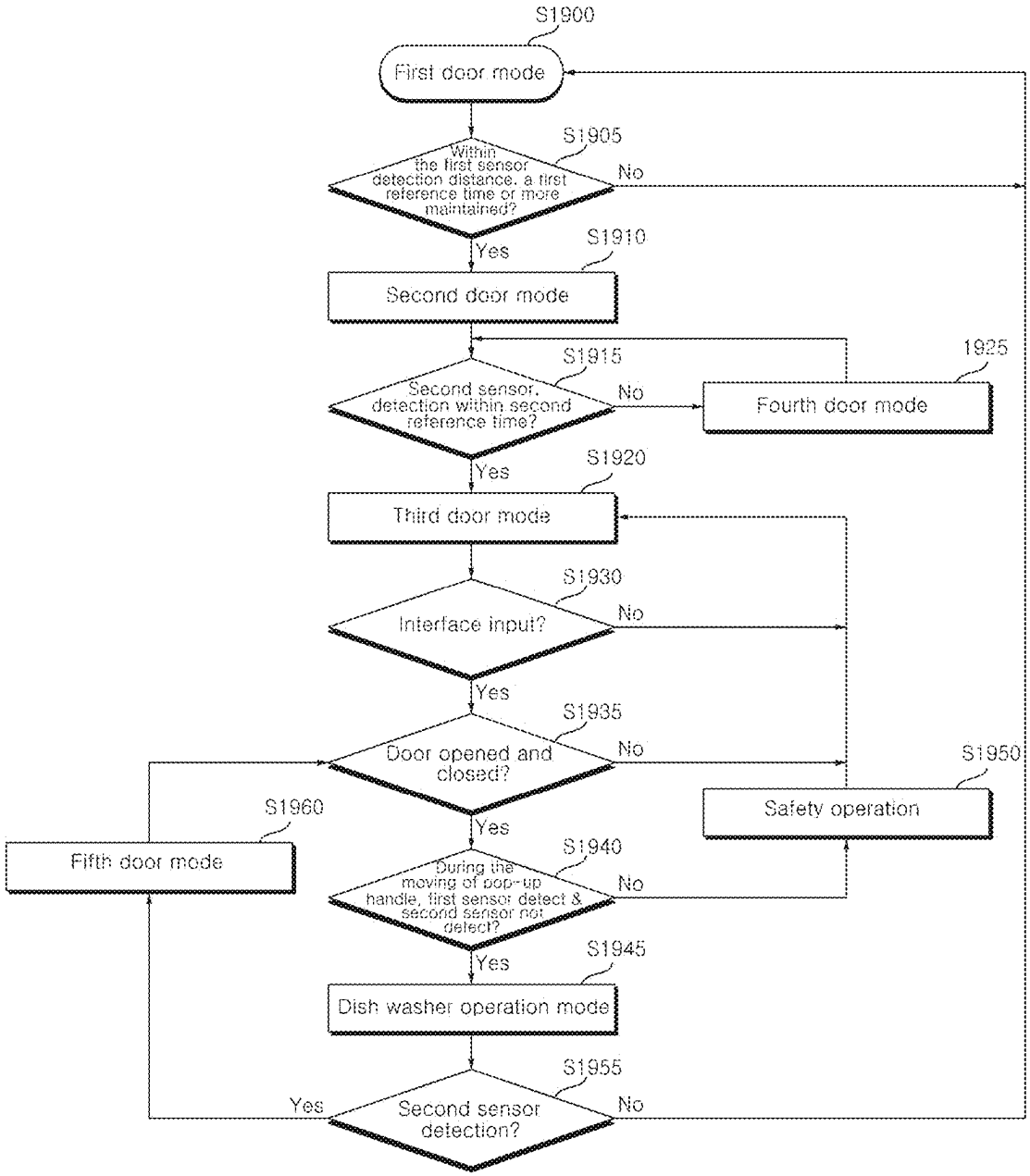

S1900
First door mode
S1905
Within the first sensor detection distance, a first reference time or more maintained?
No
Yes
S1910
Second door mode
S1915
Second sensor detection within second reference time?
No
1925
Fourth door mode
Yes
S1920
Third door mode
S1930
Interface input?
No
Yes
S1935
Door opened and closed?
No
S1950
Safety operation
S1960
Fifth door mode
Yes
S1940
During the moving of pop-up handle, first sensor detect & second sensor not detect?
No
Yes
S1945
Dish washer operation mode
S1955
Second sensor detection?
Yes
No

FIG. 20

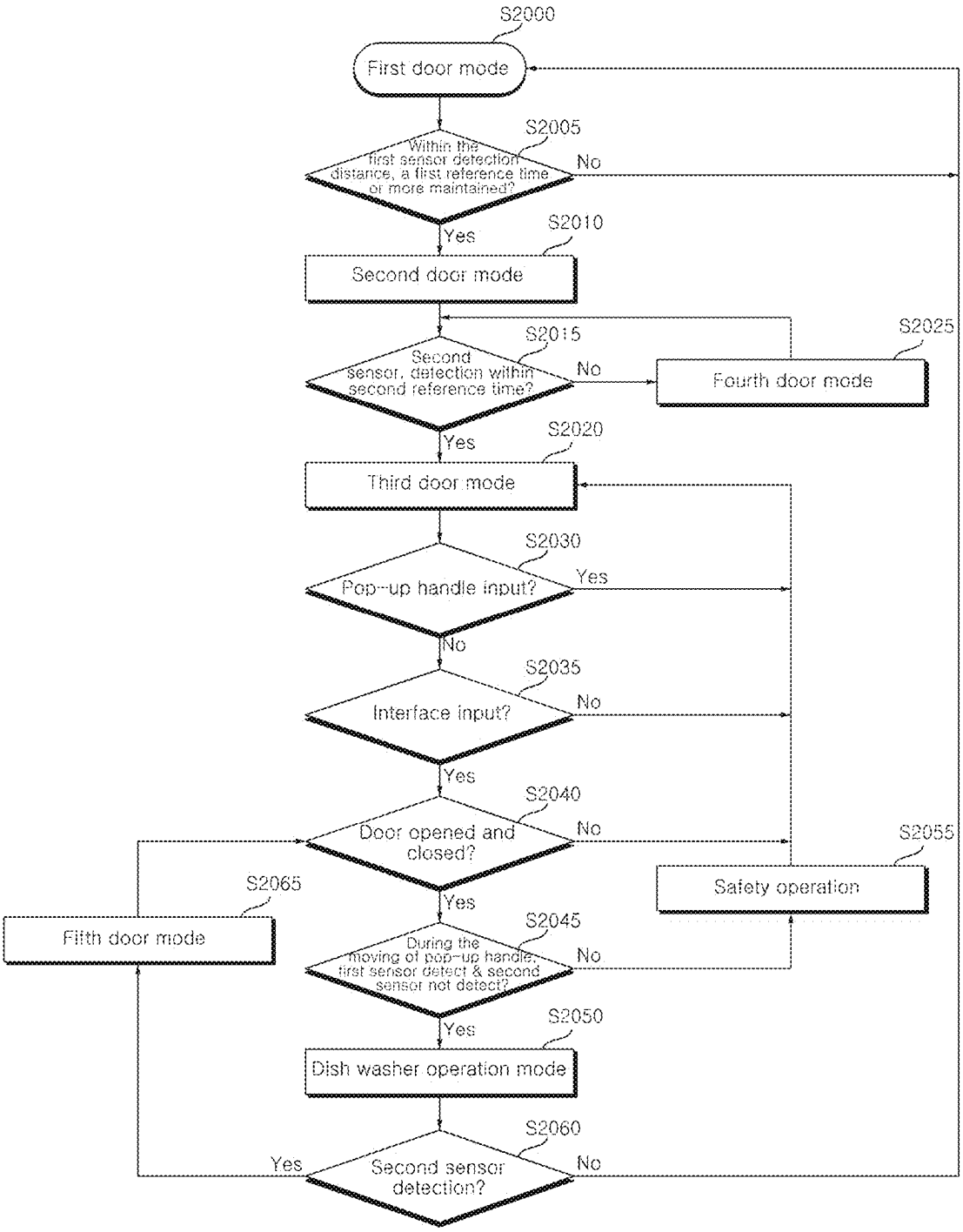

S2000
First door mode
S2005
Within the first sensor detection distance, a first reference time or more maintained?
No
Yes
S2010
Second door mode
S2015
Second sensor, detection within second reference time?
No
S2025
Fourth door mode
Yes
S2020
Third door mode
S2030
Pop-up handle input?
Yes
No
S2035
Interface input?
No
Yes
S2040
Door opened and closed?
No
S2055
Safety operation
S2065
Fifth door mode
Yes
S2045
During the moving of pop-up handle, first sensor detect & second sensor not detect?
No
Yes
S2050
Dish washer operation mode
S2060
Second sensor detection?
Yes
No

FIG. 21

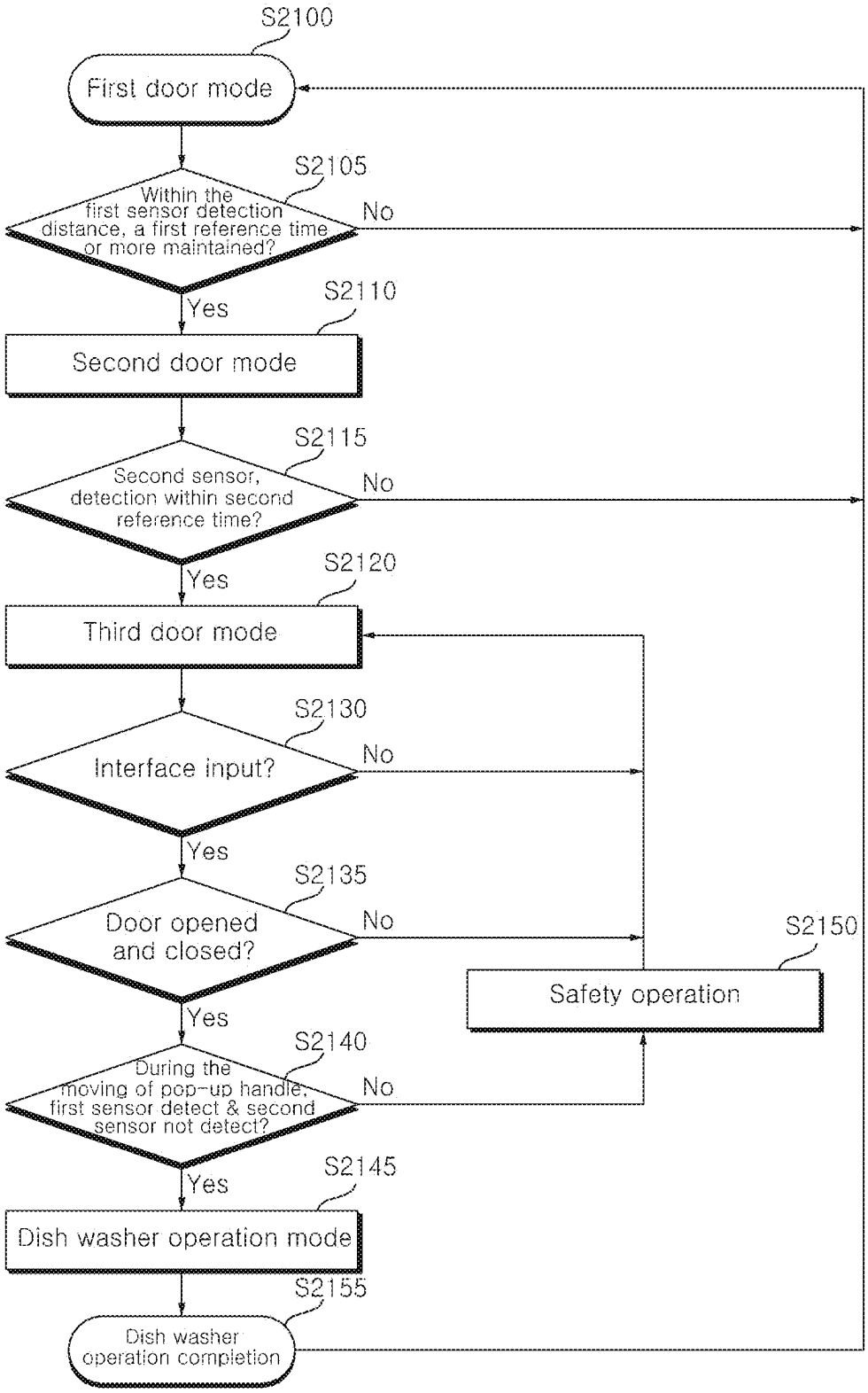

S2100
First door mode
S2105
Within the first sensor detection distance, a first reference time or more maintained?
No
Yes
S2110
Second door mode
S2115
Second sensor, detection within second reference time?
No
Yes
S2120
Third door mode
S2130
Interface input?
No
Yes
S2135
Door opened and closed?
No
Yes
S2140
During the moving of pop-up handle, first sensor detect & second sensor not detect?
No
Yes
S2145
Dish washer operation mode
S2155
Dish washer operation completion
S2150
Safety operation

FIG. 22

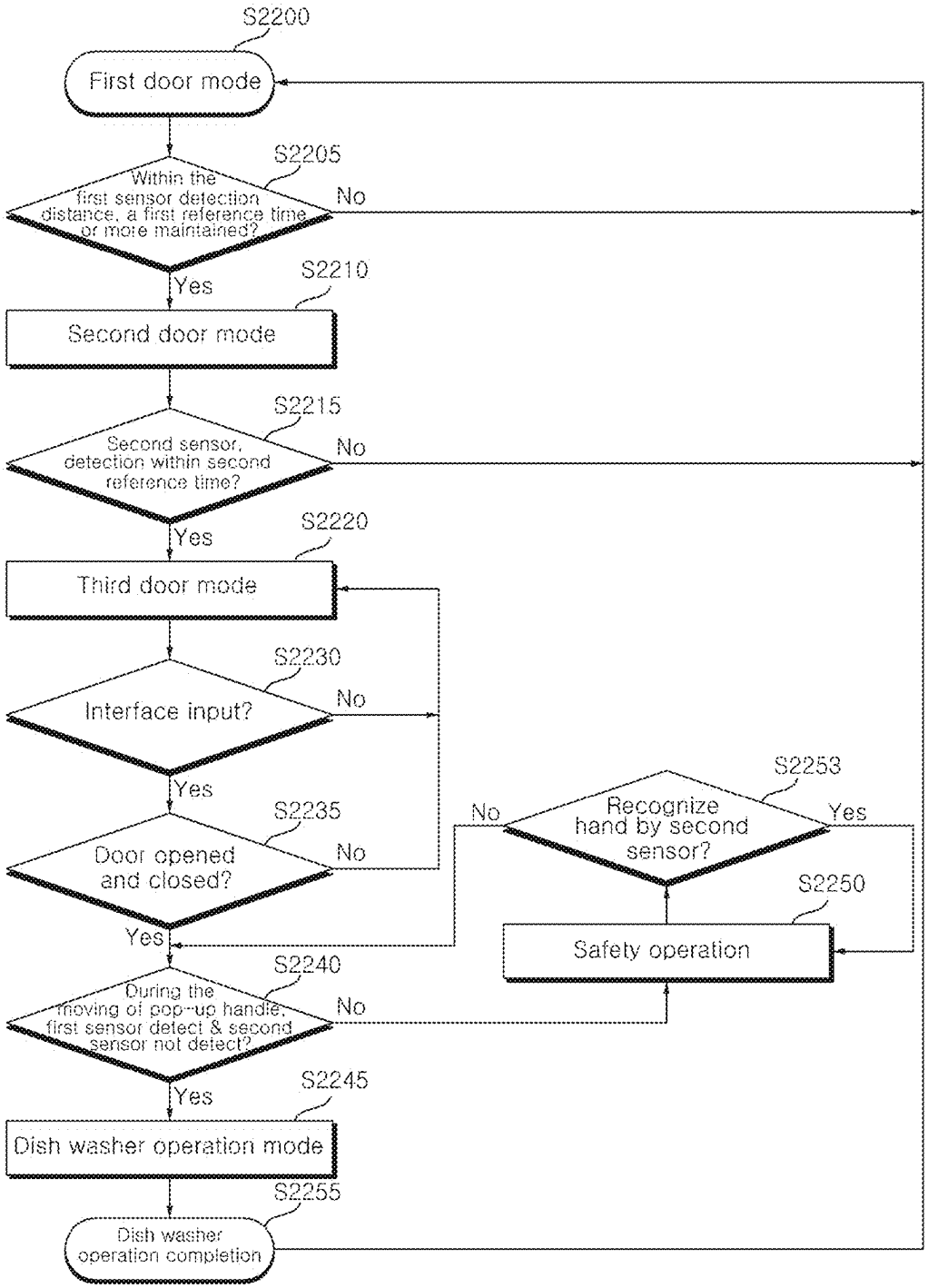

S2200
First door mode
S2205
Within the first sensor detection distance, a first reference time or more maintained?
No
Yes
S2210
Second door mode
S2215
Second sensor, detection within second reference time?
No
Yes
S2220
Third door mode
S2230
Interface input?
No
Yes
S2235
Door opened and closed?
No
Yes
S2253
Recognize hand by second sensor?
No
Yes
S2250
Safety operation
S2240
During the moving of pop-up handle, first sensor detect & second sensor not detect?
No
Yes
S2245
Dish washer operation mode
S2255
Dish washer operation completion

FIG. 23

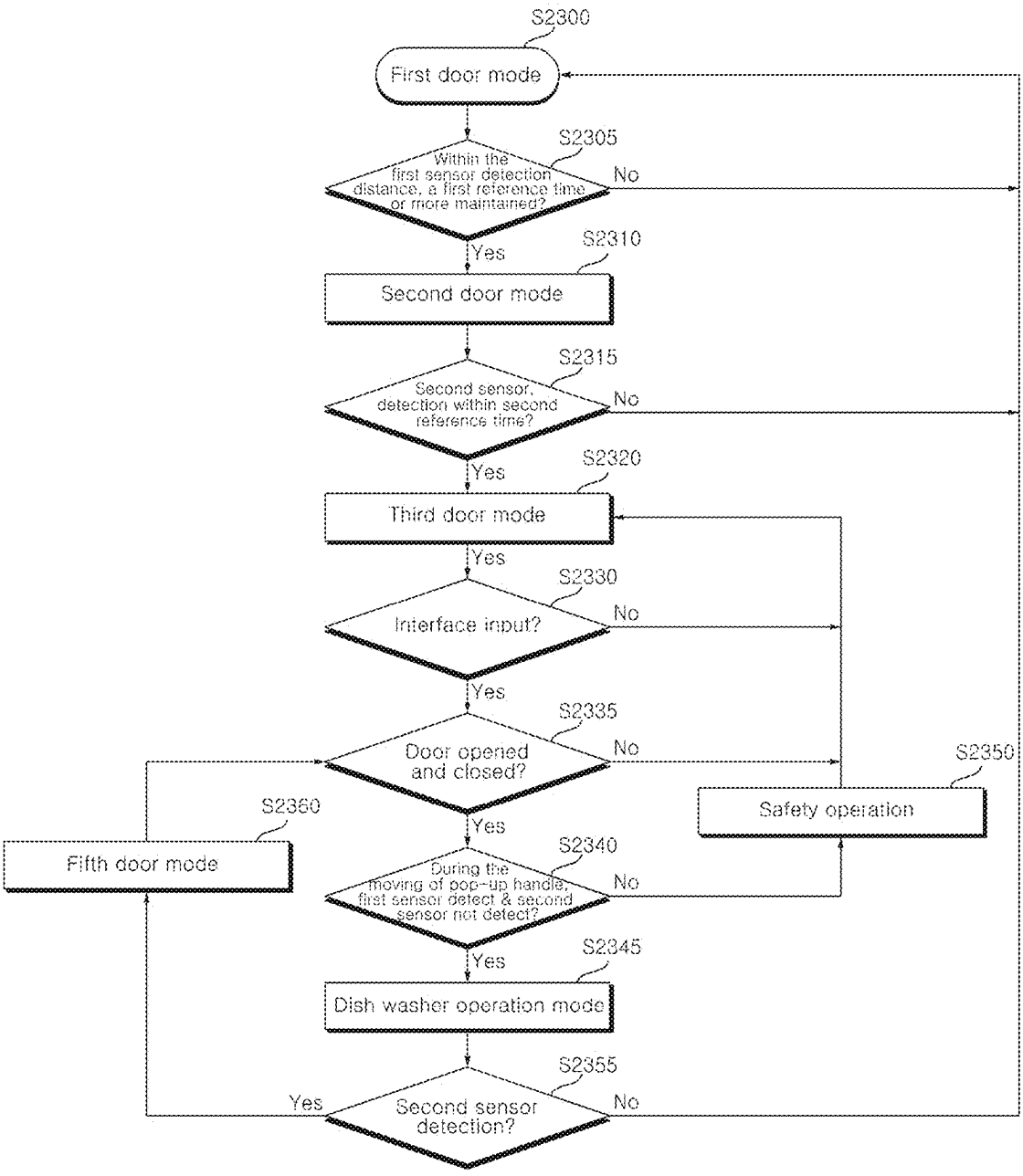

S2300
First door mode
S2305
Within the first sensor detection distance, a first reference time or more maintained?
No
Yes
S2310
Second door mode
S2315
Second sensor, detection within second reference time?
No
Yes
S2320
Third door mode
Yes
S2330
Interface input?
No
Yes
S2335
Door opened and closed?
No
S2350
Safety operation
Yes
S2360
Fifth door mode
S2340
During the moving of pop-up handle, first sensor detect & second sensor not detect?
No
Yes
S2345
Dish washer operation mode
S2355
Second sensor detection?
Yes
No

FIG. 24

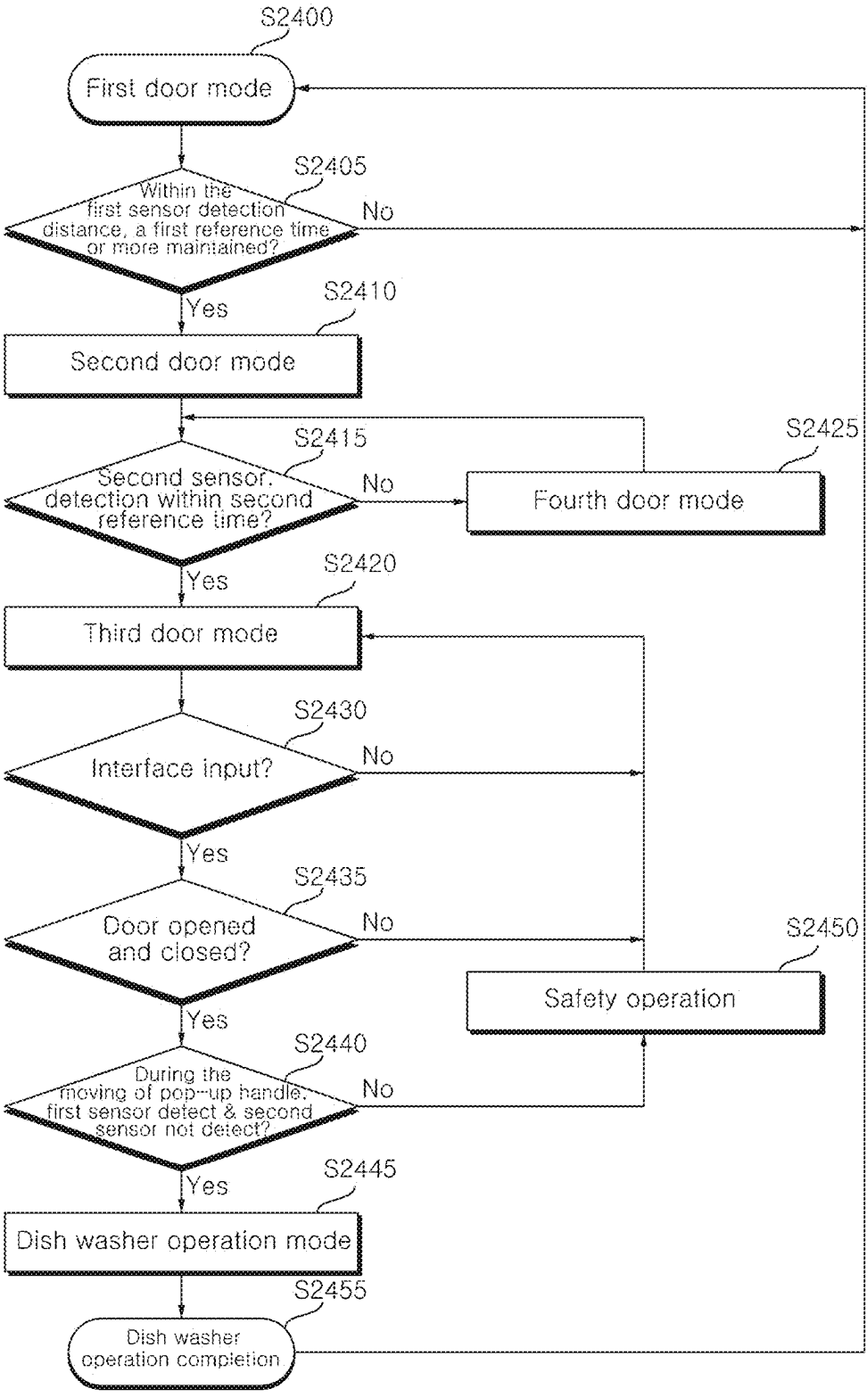
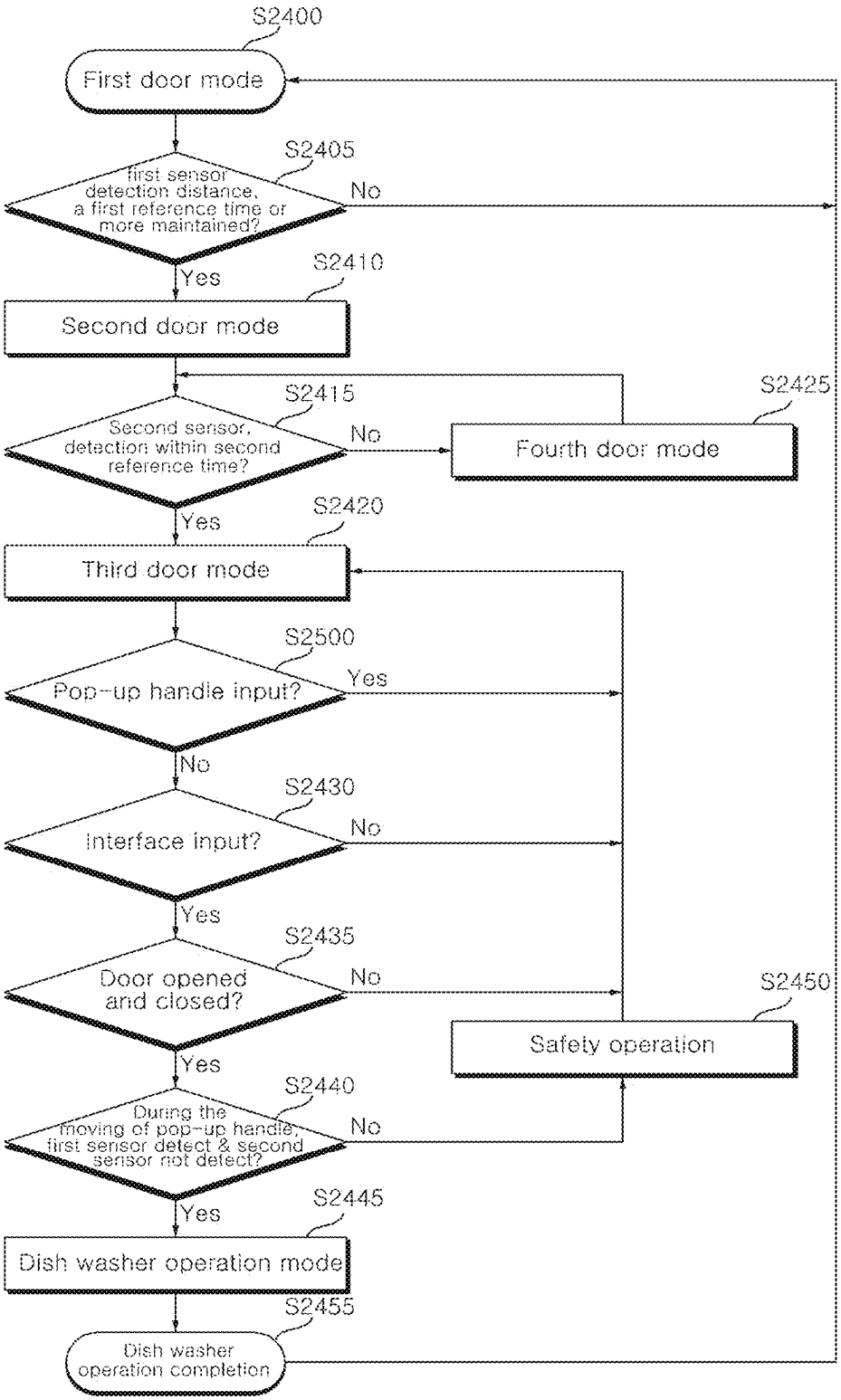

S2400
First door mode
S2405
Within the first sensor detection distance, a first reference time or more maintained?
No
Yes
S2410
Second door mode
S2415
Second sensor: detection within second reference time?
No
S2425
Fourth door mode
Yes
S2420
Third door mode
S2430
Interface input?
No
Yes
S2435
Door opened and closed?
No
S2450
Safety operation
Yes
S2440
During the moving of pop-up handle: first sensor detect & second sensor not detect?
No
Yes
S2445
Dish washer operation mode
S2455
Dish washer operation completion

FIG. 25


S2400
First door mode
S2405
first sensor detection distance, a first reference time or more maintained?
No
Yes
S2410
Second door mode
S2415
Second sensor, detection within second reference time?
No
S2425
Fourth door mode
Yes
S2420
Third door mode
S2500
Pop-up handle input?
Yes
No
S2430
Interface input?
No
Yes
S2435
Door opened and closed?
No
S2450
Safety operation
Yes
S2440
During the moving of pop-up handle, first sensor detect & second sensor not detect?
No
Yes
S2445
Dish washer operation mode
S2455
Dish washer operation completion

DISHWASHER

CROSS-REFERENCE TO RELATED APPLICATION

[0001] This application claims priority to and the benefit of Korean Patent Application No. 10-2024-0022964, filed on Feb. 16, 2024, and Korean Patent Application No. 10-2024-0056846, filed on Apr. 29, 2024, the disclosures of which are incorporated herein by reference in their entirety.

TECHNICAL FIELD

[0002] This disclosure relates to a dishwasher, and more particularly, to a dishwasher equipped with a handle.

BACKGROUND

[0003] A dishwasher is an apparatus that sprays washing water onto a washing target, such as dishes stored in a tub, to remove food residue from the washing target and wash the washing target.

[0004] The dishwasher may be equipped with a door to open and close a tub. In some cases, a handle may be provided on the door so that a user can open and close the door.

[0005] In some cases, dishwashers may open and close the door automatically after washing. In some cases, a user may open the door by hand.

[0006] In some cases, a handle has a space for user's hand to fit into. To provide the user with accessibility, the space of the handle may be often exposed to the outside.

[0007] In some cases, a dishwasher may be equipped with a control panel that opens and closes an inlet of a door handle.

[0008] In some cases, door handles may not automatically move in various ways depending on the operating state of a dishwasher and user's intention, and may be limited to prevention of safety accidents such as pinching. In some cases, the door handle may not provide additional functions and services other than opening and closing the door.

SUMMARY

[0009] The disclosure describes a dishwasher including a door that can be conveniently opened and closed by using an automatically moving handle.

[0010] The disclosure further describes a dishwasher that can prevent accidents that may occur due to misidentification of a baby or companion animal when a handle is automatically driven.

[0011] The disclosure further describes a dishwasher that can maintain a seamless appearance by retracting a handle into the inside of a door when not in use.

[0012] The disclosure further describes a dishwasher including a handle that can move to an optimal position according to the operating state or user's intention.

[0013] The disclosure further describes a dishwasher that allows a user to intuitively recognize the operating state.

[0014] The disclosure further describes a dishwasher that can detect a user's fingers being caught in an automatically moving handle.

[0015] In some implementations, in a dishwasher, when a body or any part of a user is detected, a handle provided on a door automatically can move, so that the user can conveniently hold the handle and open the door.

[0016] In some implementations, a dishwasher can include a plurality of sensors, and the handle can move step by step in response to a sensing sequence, thereby preventing collision, finger jamming, and damage.

[0017] According to one aspect of the subject matter described in this application, a dishwasher includes a tub that defines a washing chamber, a door configured to open and close the washing chamber, a handle disposed at the door, a handle motor configured to drive the handle in a front-rear direction, a first sensor having a first detection distance, and a second sensor having a second detection distance different from the first detection distance. The handle is configured to, based on the first sensor detecting a user, protrude outward from the door in a forward direction from a first position to a second position. The handle is configured to, based on the second sensor detecting the user, move in the forward direction from the second position to a third position.

[0018] Implementations according to this aspect can include one or more of the following features. For example, the first detection distance of the first sensor can be longer than the second detection distance of the second sensor. In some examples, the second sensor can be disposed above the first sensor. For example, the first sensor can be disposed at the door, and the second sensor can be disposed above the first sensor.

[0019] In some examples, the door can include a door cover that defines a front surface of the door, where the first sensor can be one of a plurality of first sensors that are disposed at a bottom surface of the door cover and spaced apart from one another. The second sensor can be disposed inside the handle. In some implementations, a distance between the first position and the second position is shorter than a distance between the second position and the third position.

[0020] In some implementations, the dishwasher can include an interface that is configured to receive a command for operating the dishwasher, where the handle is configured to, based on the interface receiving a washing operation command, move in a rearward direction from the third position to the second position.

[0021] In some implementations, the handle can be configured to, based on the second sensor failing to detect the user within a reference time in a state in which the handle is disposed at the second position, move in a rearward direction from the second position to the first position.

[0022] In some implementations, the second sensor can be configured to be turned on based on the first sensor detecting the user. In some examples, the handle can be configured to, based on the second sensor failing to detect the user within a reference time in a state in which the handle is disposed at the second position, move in a rearward direction from the second position to the first position while the second sensor maintains a turn-on state.

[0023] In some implementations, the dishwasher can be configured to, based on the second sensor detecting the user during a washing operation, stop the washing operation and control the handle motor to move the handle in the forward direction from the second position to the third position.

[0024] In some implementations, the dishwasher can include a lighting system including a light source configured to emit light, the lighting system being configured to define a first pattern of the light at the handle based on the first sensor detecting the user in a state in which the handle is

disposed at the second position. In some examples, the lighting system can be configured to vary a color of the light and a length of the first pattern at the handle based on an operating state of the dishwasher.

[0025] In some examples, the lighting system can be configured to define a second pattern of the light at the handle based on the second sensor detecting the user in a state in which the handle is disposed at the third position.

[0026] In some implementations, the dishwasher can be configured to operate based on (i) the first sensor detecting the user and (ii) the second sensor failing to detect the user while the handle is moving, and, based on the second sensor detecting the user while the handle is moving, perform a safety operation for stopping movement of the handle. In some examples, the dishwasher can include a haptic actuator configured to vibrate the handle during the safety operation.

[0027] In some implementations, the dishwasher can include a door switch configured to detect whether the door is opened or closed, and a handle switch configured to detect whether the handle is moving.

[0028] According to another aspect of the subject matter described in this application, a dishwasher includes a tub that defines a washing chamber, a door configured to open and close the washing chamber, the door being configured to operate in one or more door modes, a handle disposed at the door, the handle being configured to be located at a first position in a first door mode among the one or more door modes, a handle motor configured to drive the handle in a front-rear direction, a first sensor disposed at the door, and a second sensor disposed above the first sensor and configured to maintain an off-state in the first door mode. The door is configured to, based on the first sensor detecting a user in the first door mode, switch to a second door mode in which (i) the handle protrudes outward in a forward direction from the first position to a second position and (ii) the second sensor is turned on.

[0029] Implementations according to this aspect can include one or more of the following features. For example, the door can be configured to, based on the second sensor detecting the user in the second door mode, switch to a third door mode in which the handle moves in the forward direction from the second position to a third position.

[0030] In some implementations, the dishwasher can include an interface configured to receive a command for operating the dishwasher, and a door switch configured to detect whether the door is opened or closed. The door can be configured to, based on (i) the door being opened and closed in the third door mode and (ii) the interface receiving a washing operation command, switch to an operation mode in which the handle moves from the third position to the second position while the second sensor maintains a turn-on state.

[0031] In some implementations, the door can be configured to, based on the second sensor failing to detect the user within a reference time in the second door mode, switch to the first door mode. In some implementations, the door can be configured to, based on the second sensor failing to detect the user within a reference time in the second door mode, switch to a fourth door mode in which the handle moves in a rearward direction from the second position to the first position while the second sensor maintains a turn-on state.

BRIEF DESCRIPTION OF THE DRAWINGS

[0032] The above and other objects, features and advantages of the present disclosure will be more apparent from the following detailed description in conjunction with the accompanying drawings.

[0033] FIG. **1** is a perspective view showing an example of a dishwasher.

[0034] FIG. **2** is a perspective view showing a state in which the door of the dishwasher is open.

[0035] FIG. **3** is a schematic diagram showing an example of an interior of the dishwasher.

[0036] FIG. **4** is an internal block diagram of an example of the dishwasher.

[0037] FIGS. **5**A, **5**B, and **6** are diagrams showing example sensors.

[0038] FIGS. **7**A to **9**B are diagrams showing examples of the position and movement of a handle.

[0039] FIG. **10** is a flowchart of an example of a dishwasher control method.

[0040] FIG. **11** is a flowchart of an example of a dishwasher control method.

[0041] FIGS. **12** to **16** are diagrams showing examples of a lighting operation.

[0042] FIGS. **17-25** are flowcharts of examples of a dishwasher control method.

DETAILED DESCRIPTION

[0043] Hereinafter, implementations of the present disclosure will be described in detail with reference to the attached drawings. However, the present disclosure is not limited to these implementations and can be modified into various forms.

[0044] FIG. **1** is a perspective view showing an example of a dishwasher. FIG. **2** is a perspective view showing an example state in which the door of the dishwasher is open. FIG. **3** is a schematic diagram showing an example of an interior of the dishwasher.

[0045] Referring to FIG. **1**, a dishwasher includes a tub **1**. The tub **1** can provide a washing chamber **11**. The washing chamber **11** can be provided inside the tub **1**.

[0046] In some implementations, the tub **1** can have a hexahedral shape having one side open. The front of the tub **1** can be open.

[0047] The washing chamber **11** can be opened in a forward direction (see FIG. **2**). The direction toward a rear from the opening of the washing chamber **11**, i.e., the front-to-rear direction, can be referred to as a depth direction of the washing chamber **11**.

[0048] The dishwasher can include a door **2** that opens and closes the washing chamber **11**. The door **2** can be provided in front of the tub **1**. The door **2** can be rotatably coupled to the front of the tub **1**.

[0049] The lower portion of the door **2** can be coupled to the tub **1**. The door **2** can be hinged to the front lower portion of the tub **1**. The dishwasher can include a hinge **28** that rotatably couples the door **2** to the tub **1**.

[0050] The door **2** can be opened so that the upper portion of the door **2** faces in a forward direction (see FIG. **2**). For example, the door **2** can rotate downward to close the tub **1**. The door **2** can rotate upward to open the tub **1**.

[0051] The door **2** can include a front surface **211**. The door **2** can include a door cover **21**. The door cover **21** can provide the front surface **211** of the door **2**. The door cover

21 can provide a side surface 218 of the door 2. The door cover 21 can provide an upper surface 213 of the door 2.

[0052] The dishwasher can include a handle 4. The handle 4 can be provided in front of the door 2. The handle 4 can be provided on the upper portion of the door 2. The handle 4 can be provided on the upper portion of the front surface 211 of the door. An upper portion 212 of the front surface of the door 2 can be disposed on the upper side of the handle 4.

[0053] The dishwasher can include a base 12. The base 12 can provide a bottom surface of the dishwasher.

[0054] The bottom of the tub 1 can be spaced upward from the base 12. A space 13 can be provided between the bottom of the tub 1 and the base 12. Components such as a printed circuit board (PCB) 14 (or main controller), a sump 61, and a pump 62, which will be described later, can be disposed in the space. Hereinafter, the space 13 is referred to as a machine room 13.

[0055] An interface 23 can be provided on the upper portion of the door 2. The interface 23 can be disposed on the upper surface 213 of the door.

[0056] The interface 23 can receive commands from a user. The interface 23 can provide information related to a dishwasher to a user.

[0057] For example, a user can input commands for a washing cycle and an operation option through the interface 23. For example, the interface 23 can display information related to a washing cycle and an operation option.

[0058] The main controller 14 can control the dishwasher. The main controller 14 can receive commands from a user through the interface 23. The main controller 14 can provide information related to the dishwasher to a user through the interface 23. For example, the main controller 14 can include an electric circuit, a PCB, a processor, a computer, etc.

[0059] Hereinafter, components described later can be controlled by the main controller 14.

[0060] Referring to FIG. 2, the dishwasher can further include a casing 15. The casing 15 can be disposed outside the tub 1.

[0061] The casing 15 can include a cabinet 16 and a top plate 17. The cabinet 16 can cover the side wall of the tub 1. The top plate 17 can cover the upper surface of the tub 1.

[0062] As described above, the washing chamber 11 is opened in a forward direction, and the door 2 can open and close the washing chamber 11.

[0063] The dishwasher can include a rack 67 disposed in the washing chamber 11. Washing target such as dishes, plates, and spoons can be disposed on the rack 67.

[0064] The rack 67 can include a first rack 671. The first rack 671 can be disposed in the lower portion of the washing chamber 11.

[0065] The rack 67 can include a second rack 672 disposed in an upper side of the first rack 671. The height of the position where the second rack 672 is disposed can be adjusted.

[0066] The dishwasher can include spray arms 661, 662. The spray arms 661, 662 can spray washing water toward the rack 67.

[0067] The spray arms 661, 662 can be disposed on the lower side of the rack 67. The spray arms 661, 662 can spray washing water toward the upper side.

[0068] The spray arms 661, 662 can include a first spray arm 661. The first spray arm 661 can be disposed on the lower side of the first rack 671.

[0069] The spray arms 661, 662 can include a second spray arm 662. The second spray arm 662 can be disposed in the lower side of the second rack 672. The door 2 can be opened so that the upper portion of the door 2 faces forward. The door 2 can include an inner panel 22. The inner panel 22 can face upward in a state where the door 2 is open. When a user places a washing object on a rack, water dripping from the washing object or the rack can fall on the inner panel 22.

[0070] The dishwasher can include a steam nozzle 665. The steam nozzle 665 can be provided on the door 2. The steam nozzle 665 can be provided on the inner panel 22.

[0071] The dishwasher can include a dispenser 26. The dispenser 26 can be provided on the inner panel 22.

[0072] Referring to FIG. 3, the rack 67 can be pulled out in a forward direction from the washing chamber 11. The rack 67 can be retracted into the rear and disposed in the washing chamber 11.

[0073] The rack 67 can include a third rack 673. The third rack 673 can be disposed on the upper side of the first rack 671. The third rack 673 can be disposed on the upper side of the second rack 672. The third rack 673 can be disposed at the uppermost position among the plurality of racks 67.

[0074] The spray arms 661, 662 can include a nozzle. The nozzle can spray washing water. The spray arms 661, 662 can be rotatable. The first spray arm 661 can be disposed on the lower side of the first rack 671. The first spray arm 661 can spray washing water toward the first rack 671.

[0075] The first spray arm 661 can be rotatably provided. The first spray arm 661 can be rotated by a motor. Alternatively, the washing water can rotate due to the reaction force of the force sprayed from the first nozzle 6613.

[0076] The second spray arm 662 can be disposed on the lower side of the second rack 672. The second spray arm 662 can be coupled to the second rack 672. The second spray arm 662 can spray washing water toward the second rack 672.

[0077] The second spray arm 662 can be rotatably provided. The washing water can rotate due to the reaction force of the force sprayed from the second nozzle 6623. Alternatively, the second spray arm 662 can be rotated by a motor.

[0078] The dishwasher can include a top nozzle 663. The top nozzle 663 can be disposed on the upper side of the rack 67. The top nozzle 663 can be provided on the ceiling of the washing chamber 11. The top nozzle 663 can spray washing water downward. The top nozzle 663 can spray washing water toward the rack 67. The top nozzle 663 can spray washing water toward the third rack 673.

[0079] The door 2 can include a door cover 21. In a state where the door 2 closes the washing chamber 11, the door cover 21 can be exposed to the outside.

[0080] The door 2 can include an inner panel 22. In a state where the door 2 closes the washing chamber 11, the inner panel 22 can face the washing chamber 11. In a state where the door 2 closes the washing chamber 11, the inner panel 22 can provide the front surface of the washing chamber 11.

[0081] The dishwasher can include a dispenser 26. The dispenser 26 can accommodate detergent. The dispenser 26 can accommodate tablet-type detergent. Alternatively, the dispenser can contain powdered detergent.

[0082] In some examples, some of the nozzles of the spray arms 661, 662 can be directed toward the dispenser 26 provided in the door 2.

[0083] The dishwasher can supply steam to the washing chamber **11**. The steam nozzle **665** can supply steam to the washing chamber **11**. The steam nozzle **665** is provided in the front of the washing chamber **11** and can supply steam toward the rear. The steam nozzle **665** is provided on the lower portion of the washing chamber **11** and can supply steam upward. The steam nozzle **665** is provided at the front lower portion of the washing chamber **11** and can supply steam toward the upper-rear side.

[0084] The steam nozzle **665** can be provided on the door **2**. The steam nozzle **665** can be provided on the inner panel **22**. The steam nozzle **665** can be provided on the lower portion of the inner panel **22**. The steam nozzle **665** can be disposed at an angle with respect to a horizontal.

[0085] The dishwasher can include a sump **61**. The sump **61** can receive water from an external water source such as a tap. The sump **61** can store water supplied from outside.

[0086] The sump **61** can receive water from an external water source through a water supply pipe **64**. The water supply pipe **64** can be connected to an external water source. The water supply pipe **64** can connect the external water source and the sump **61**.

[0087] A water supply valve **641** can isolate the water supply pipe **64**. The water supply valve **641** can control the flow of water from an external water source to the sump **61**.

[0088] The sump **61** can be provided on the lower side of the tub **1**. The sump **61** can be disposed on the lower side of the bottom of the tub **1**. The sump **61** can be disposed in the machine room **13**. The sump **61** can be connected to the bottom of the tub **1** and can be disposed in the machine room **13**.

[0089] The sump **61** can store water drained from the washing chamber **11**.

[0090] The dishwasher can include a filter **611**. The filter **611** can filter out foreign substances from the water flowing from the washing chamber **11** to the sump **61**. The filter **611** can be disposed in the sump.

[0091] The dishwasher can include a pump **62** that supplies washing water to the washing chamber **11**. The pump **62** can pump water from sump **61**. The pump **62** can pump water and supply it to the spray arms **661**, **662**. The pump **62** can pump water and supply it to the top nozzle **663**.

[0092] The pump **62** can include an impeller **623**, a pump housing **625** that accommodates the impeller **623**, and a washing motor **621** that rotates the impeller **623**. The washing motor **621** can be a motor whose rotation speed can be varied. For example, the washing motor **621** can be a Brushless DC (BLDC) motor.

[0093] The dishwasher can include a heater **63** that heats wash water. The heater **63** can be connected to pump **62**. The heater **63** can heat the water flowed into the pump **62**.

[0094] A switching valve **65** can be connected to the washing pump **62**. The switching valve **65** can receive washing water from the pump **62**.

[0095] The switching valve **65** can be connected to the spray arms **661**, **662** and the top nozzle **663**. The switching valve **65** can distribute washing water. The switching valve **65** can selectively supply washing water to at least one of the first spray arm **661**, the second spray arm **662**, and the top nozzle **663**.

[0096] A pump inlet pipe **642** can connect the sump **61** and the pump **62**. When the pump **62** operates, water in the sump **61** can flow into the pump **62** through the pump inlet pipe **642**.

[0097] A discharge pipe **644** can be connected to pump **62**. The discharge pipe **644** can guide the water discharged from the pump **62** toward the spray arms **661**, **662** and the top nozzle **663**.

[0098] The discharge pipe **644** can be connected to the switching valve **65**. The discharge pipe **644** can connect the pump **62** and the switching valve **65**.

[0099] In some examples, connection pipes **651**, **652**, **653** can connect the spray arms **661**, **662** and the top nozzle **663** to the switching valve **65**.

[0100] The connection pipes **651**, **652**, **653** can include a first connection pipe **651** connected to the first spray arm **661**. The first connection pipe **651** can be provided inside the first spray arm **661**.

[0101] The connection pipes **651**, **652**, **653** can include a second connection pipe **652** connected to the second spray arm **662**. The second connection pipe **652** can be provided on the rear wall of the tub **1**.

[0102] The connection pipes **651**, **652**, **653** can include a third connection pipe **653** connected to the top nozzle **663**. The third connection pipe **653** can be provided on the upper surface of the tub **1**.

[0103] When the pump **62** operates, the washing water discharged from the pump **62** can flow into the switching valve **65**. Washing water flowing into the switching valve **65** can flow into at least one of the plurality of connection pipes **651**, **652**, and **653** by the switching valve **65**.

[0104] When the washing water flows into the first connection pipe **651**, the washing water can be sprayed from the nozzle **6613** of the first spray arm **661**.

[0105] When the washing water flows into the second connection pipe **652**, the washing water can be sprayed from the nozzle **6623** of the second spray arm **662**. When the washing water flows into the third connection pipe **653**, the washing water can be sprayed from the top nozzle **663**.

[0106] The washing water sprayed into the washing chamber **11** collects on the bottom and flows into the sump **61**. The washing water flowing into the sump **61** can be sprayed into the washing chamber by the pump **62** and can be circulated again.

[0107] The sump **61** can be connected to a drain pump **69**. A drain pipe **691** can connect the sump **61** and the drain pump **69**. When the drain pump **69** operates, water in the sump **61** can be drained to the outside of the dishwasher.

[0108] A dishwasher includes a door **2**, a handle **4** provided on the door **2**, and a handle motor **41** that drives the handle **4**.

[0109] The door **2** can include a door cover **21** providing a front surface **211**, an upper surface **213**, and a side surface **218**. The front surface **211** of the door **2** can include an upper portion **212** disposed in the upper side of the handle **4**.

[0110] An interface **23** can be disposed on the upper surface **213** of the door **2**.

[0111] The door **2** can include an inner panel **22**. The inner panel **22** can be narrower in the left-right direction than the door cover **21**. Hereinafter, the left-right direction is also referred to as a width direction of door.

[0112] The handle **4** can extend in the width direction of the door **2**. Both side ends of the handle **4** can be adjacent to the side surface **218** of the door **2**. Alternatively, the handle **4** can extend to the side surface **218** of the door **2**.

[0113] FIG. **4** is an internal block diagram of a dishwasher, and discloses main components for door control.

[0114] Referring to FIG. **4**, the dishwasher can include a main controller **14** that controls overall operation. The main controller **14** can control the pump **62**, the heater **63**, the water supply valve **641**, and the switch valve **65** in response to user commands input through the interface **23**, and perform a washing operation (washing cycle), etc.

[0115] The interface **23** can include a mechanical input means (or mechanical key, a jog wheel, a jog switch, etc.) and a touch input means. For example, the touch input means can be configured as a virtual key, soft key, or visual key displayed on a touch screen through software processing, or as a touch key that is disposed on a part excluding the touch screen.

[0116] In addition, the main controller **14** can receive a user's voice input through the microphone **232** and control the dishwasher in response to the voice input. The microphone **232** can process external acoustic signals into electrical voice data.

[0117] The speaker **231** can output various notifications and information as sound.

[0118] In some examples, the speaker **231** and the microphone **232** can be configured as part of the interface **23**.

[0119] In some examples, the door **2** can be equipped with a door controller **24** that controls the operation of the door. The door controller **24** can be mounted on a certain PCB, and the door controller **24** PCB can be accommodated inside the door **2**. The door controller **24** and the main controller **14** can be connected through a signal line and can transmit and receive various signals. In addition, the door controller **24** can be connected to the main controller **14** through a power line to receive power.

[0120] For example, the door controller **14** can include an electric circuit, a PCB, a processor, a computer, etc.

[0121] In some implementations, the door controller **24** is integrated into the main controller **14**, so that the operation of the door **2** can be directly controlled by one controller **14**.

[0122] The door **2** is equipped with a handle motor **41** that drives the handle **4** in the front-rear direction. The door controller **24** can control the handle motor **41** to move the handle **4** in a forward or rearward direction.

[0123] When not in use, the handle **4** does not protrude from the front surface **211**, but is retracted into the door **2**, and is pulled out toward the front of the front surface **211** when in use. When not in use, the handle **4** is retracted into the door **2**, thereby reducing the possibility of collision and damage to the handle **4** and maintaining a seamless design.

[0124] Since the handle **4** pops up when in use, the handle **4** can be referred to as a pop-up handle **4**, and the handle motor **41** can be referred to as a pop-up handle motor **41**.

[0125] In some examples, the handle **4** can be equipped with a lighting system **42** including one or more light sources (e.g. LED). The lighting system **42** can indicate the current state of the dishwasher through the color and pattern of the output light and intuitively provide various information to a user.

[0126] In some implementations, the handle **4** can be equipped with a haptic actuator **43**. The haptic actuator **43** can include a vibration actuator or a haptic motor including a rotary motor, a linear motor, a vibration motor, or a particular type of motor, etc.

[0127] For instance, in an emergency situation, the haptic actuator **43** can vibrate, thereby allowing a user holding the handle **4** to immediately recognize the emergency situation.

[0128] The dishwasher is equipped with a number of sensors **25**. The door **2** is equipped with a first sensor **251** and a second sensor **252** that detect a body in front of the dishwasher. The first sensor **251** and the second sensor **252** can detect the presence of a body or object in a non-contact manner.

[0129] The door controller **24** can control the motors **41**, **43** and the interface **23** of the door **2** according to the control of the main controller **14**. The door controller **24** can control the handle motor **41** based on data detected by the first and second sensors **251**, **252**.

[0130] The second sensor **252** can be positioned above the first sensor **251**. The second sensor **252** can be disposed in an area adjacent to the handle **4**. For example, the second sensor **252** can be provided on the handle **4**.

[0131] The first sensor **251** and the second sensor **252** can use a sensor to determine the position and/or motion of objects and bodies in a non-contact manner, such as a position sensor, a proximity sensor, an infrared sensor, an ultrasonic sensor, a heat sensor, a radar sensor, and a lidar sensor.

[0132] In some examples, the second sensor **252**, as a safety sensor to prevent malfunction, can use a sensor to which a design structure having no hole can be applicable such as a short-range electric field sensor (gesture sensor) or a capacitive touch sensor, and can be provided inside the handle **4**.

[0133] The capacitive touch sensor can detect a human body by detecting capacitance and detecting the difference between the minute change in capacitance of the human body and a set value.

[0134] The short-range electric field sensor enables gesture/position tracking by recognizing multiple points using a short-range electric field.

[0135] FIGS. **5**A and **5**B and **6** are diagrams for explaining sensors.

[0136] FIGS. **5**A and **5**B illustrate a case where the first sensor **251** is disposed on the lower side of the door cover **21**. FIG. **5**A is a front view of the lower side of the door cover **21**, and FIG. **5**B is a side view of the lower side of the door cover **21**.

[0137] Referring to FIGS. **5**A and **5**B, the first sensor **251** is disposed on the bottom surface **219** of the door cover **21**. The first sensor **251** can include two first sensors **2511** and **2512** disposed at a certain distance apart on the bottom surface **219** of the door cover **21**.

[0138] The first sensor **251** can detect whether there is a body in front with a first detection distance R**1**. The first detection distance R**1** is a distance at which the first sensor **251** can detect a body, and when a body is within the first detection distance R**1**, the first sensor **251** can detect it. The first sensor **251** can detect a user's body, such as legs and feet, positioned within the front first detection distance R**1**, and transmit the detection result to the door controller **24**.

[0139] Depending on the size of the door cover **21**, a plurality of first sensors **2511** and **2512** can be disposed to be spaced apart. Referring to FIGS. **5**A and **5**B, a first-first sensor **2511** and a first-second sensor **2512** are disposed to be spaced apart from each other on the bottom surface **219** of the door cover **21**.

[0140] Since a user's body, such as legs and feet, has a certain size even for a baby, even if a plurality of first sensors **2511** and **2512** are disposed so that there is an additional

distance d2, d3 that is not sensed, the body positioned in front of the dishwasher can be monitored.

[0141] If a first-first sensor **2511** and a first-second sensor **2512** have a sensing range of a circle with a certain radius d1 when viewed from the front, the first-first sensor **2511** and the first-second sensor **2512** can be disposed to be spaced apart from each other by a certain distance d3 at a radius d1 on both sides of the door cover **21**. In addition, the first-first sensor **2511** and the first-second sensor **2512** can be disposed to be further spaced apart by a certain distance d2 from the sum 2*d*1 of their respective radii d1.

[0142] FIG. **6** illustrates a case in which the second sensor **252** is disposed inside the handle **4**. Referring to FIG. **6**, the handle includes a front cover **44**, and the second sensor **252** can be disposed on the inner surface of the front cover **44**.

[0143] The second sensor **252** can include a plurality of sensors that extend in the width direction or are spaced apart in the width direction.

[0144] The first sensor **251** and the second sensor **252** can have a different detection distance. The detection distance R1 of the first sensor **251** can be longer than the detection distance R2 of the second sensor **252**. The second detection distance R2 is a distance at which the second sensor **252** can detect the body. When a body is within the second detection distance R2, the second sensor **252** can detect the body.

[0145] The first sensor **251** is a primary sensor and can detect a body from a distance, and the second sensor **252** is a secondary sensor and can detect a body from a short distance. The first sensor **251** and the second sensor **252** can use a different type of sensing method.

[0146] In some implementations, by using the sensors **251** and **252** having different detection distances and disposing each of the sensors at an optimal position, it can be possible to appropriately respond to various situations. The first sensor **251** can have a first detection distance R1 in a forward direction, and the second sensor **252** can have a second detection distance R2 in a forward direction, where the second detection distance R2 can be different from the first detection distance R1. For example, the first detection distance R1 of the first sensor **251** can be longer than the second detection distance R2 of the second sensor **252**.

[0147] FIGS. **7**A to **9**B are diagrams for explaining the positions and movements of a handle for various situations.

[0148] First, referring to A and B of FIGS. **6** and **7**, when not in use, as a default state, the handle **4** can be positioned in a first position P1, and the first sensor **251**, as a turned-on state, can detect whether a body exists at the first detection distance R1.

[0149] The first position P1 is a position where the front cover **44** of the handle **4** forms the door cover **21** and the front surface **211**, and the front cover **44** can be positioned to be connected on an imaginary line of the front surface **211**.

[0150] Referring to FIGS. **6** and **8**A, when a body is detected by the first sensor **251**, the handle motor **41** is driven, and the handle **4** is pulled out in a forward direction from the first position P1 to a second position P2.

[0151] In some examples, the second sensor **252** can be turned off and then turned on when a body is detected by the first sensor **251**. The second sensor **252**, which is a secondary sensor, can be turned on only in response to the detection of the first sensor **251**, thereby reducing power consumption.

[0152] Referring to FIGS. **6** and **8**B, in a state where the handle **4** is in the first position P1, when a body is detected by the second sensor **252**, the handle motor **41** is driven, thereby allowing the handle **4** to move further forward.

[0153] Referring to FIGS. **6** and **9**A, **9**B, when a body is detected by the second sensor **252**, the handle motor **41** is driven, so that the handle **4** moves forward from the second position P2 to a third position P3.

[0154] If the automatic pop-up of the handle **4** is controlled based on the sensing data of one sensor or one type of sensor, when a baby or pet is at a specific position in front of the dishwasher, the handle **4** can move and the door **2** can be opened or closed, so that collision, jamming, etc. can occur.

[0155] According to the present disclosure, the occurrence of an accident can be prevented by controlling the automatic movement of the handle **4**, based on at least one of the sensing status, sensing order, and sensing time of the sensors **251** and **252** disposed at different positions.

[0156] For example, when the first sensor **251** detects a body at a distance, the handle **4** moves slightly up to the second position P2 where there is no space **46** for a user's hand to hold the handle **4**, as there is a possibility of using a dishwasher.

[0157] Thereafter, the second sensor **252** inside the handle **4** secondly checks whether a user's hand is detected at close range, and the handle **4** moves to a third position P3 where a user can sufficiently hold the handle **4** to open the door **2**, so that the user can conveniently open the door **2**.

[0158] When the handle **4** moves forward to the third position P3, a space **46** where a hand can hold the handle **4** is formed between supports **45** on both sides of the handle **4**.

[0159] The handle **4** can move in a front-rear direction within a range d13 between the first position P1 and the third position P3.

[0160] A distance d12 between the first position P1 and the second position P2 is shorter than a distance d23 between the second position P2 and the third position P3. That is, the distance d12 by which the handle **4** moves between the first position P1 and the second position P2 is shorter than the distance d23 by which the handle **4** moves between the second position P2 and the third position P3.

[0161] Not only the position of the handle **4** but also the light output state of the lighting system **42** can be adjusted to the situation. The lighting system **42** emits light, thereby allowing a user to intuitively recognize that the dishwasher is operating and that its own movement has been sensed. For example, when the first sensor **251** detects a body from a distance, the lighting system **42** can output light of a certain color as welcoming lighting.

[0162] When a body is detected by the first sensor **251**, the lighting system **42** can emit LED in a certain pattern while the handle **4** moves to the second position P2. For example, white light can be output as welcoming lighting. Depending on the operating state of the dishwasher, the color and length of light output by the lighting system **42** can vary. Accordingly, a user can intuitively recognize the current operating state.

[0163] When the second sensor **252** detects a body, the lighting system **42** can output light in a certain pattern while the handle **4** moves to the third position P3. The lighting system **42** can output light in different patterns when the handle **4** is positioned in the first position P1 and when the handle **4** is positioned in the third position P3.

[0164] The second sensor **252** provided on the handle **4** serves as a safety sensor and confirms the user's intention to use, and the lighting system **42** outputs light appropriate for the situation, thereby improving user interface and user experience (UI/UX).

[0165] In some examples, when there is a user's washing operation command through the interface **23** or the microphone **232**, the door controller **24** drives the handle motor **41** to move the handle **4** in a rearward direction. The handle **4** can be moved in a rearward direction from the third position P**3** to the second position P**2**.

[0166] Thereafter, the main controller **14** can control the dishwasher to perform a washing operation.

[0167] In some examples, the dishwasher can further include a door switch **254** that detects whether the door **2** is opened or closed, and a handle switch **253** that detects whether the handle **4** is moved.

[0168] For example, the door switch **254** can have a switch type that is pressed when the door **2** is closed to transmit a signal to the door controller **24**. The handle switch **253** can have a switch type that is pressed when the handle **4** is in the first position P**1** where it is retracted to transmit a signal to the door controller **24**.

[0169] Alternatively, the dishwasher can further include a door position sensor for detecting the position of the door **2** and a handle position sensor for detecting the position of the handle **4**.

[0170] Based on the signal from the door switch **254**, when it is determined that the door **2** is opened and then closed, the main controller **14** can switch the dishwasher into the operation mode and perform a washing operation.

[0171] Alternatively, the dishwasher can further include a sensor or camera that detects the internal state of the washing chamber **11**, and when the door **2** is closed while a washing target such as dishes is disposed in the washing chamber **11**, the main controller **14** can switch the dishwasher into the operating mode and perform a washing operation.

[0172] In some examples, while the handle **4** moves to the second position P**2**, the second sensor **252** detects a body for a reference time. If a body is not detected within the reference time, the handle **4** can move in a rearward direction from the second position P**2** to the first position P**1**.

[0173] When the handle **4** is located in the first position P**1**, the second sensor **252** can be turned off.

[0174] Alternatively, the second sensor **252** can maintain an on-state for a certain period of time from a time when the handle **4** moves to the second position P**2** and then returns to the first position P**1**.

[0175] In some examples, during the washing operation, when the second sensor **252** detects a body, the main controller **14** stops the washing operation. At this time, the door controller **24** can move the handle **4** in a forward direction from the second position P**2** to the third position P**3**. Accordingly, even during a washing operation, the door **2** can be conveniently and safely opened if a user wishes.

[0176] In some examples, when the handle **4** is moving, if a body is detected by the first sensor **251** and a body is not detected by the second sensor **252**, the dishwasher can operate normally according to the input from the interface **23** or the microphone **242**. Otherwise, the dishwasher can perform a safety operation that stops the movement of the handle **4**. The safety operations can include a notification operation that notifies a user of an emergency situation. For example, the haptic actuator **43** can vibrate the handle **4**. In addition, the speaker **231** can output voice guidance such as, "Please lift your hand. I will close the handle." In addition, the lighting system **42** can output red light that blinks in a certain cycle.

[0177] Hereinafter, a dishwasher control method according to various examples of the present disclosure will be described with reference to the drawings.

[0178] FIG. **10** is a flowchart of a dishwasher control method.

[0179] Referring to FIG. **10**, in a first door mode state (S**1010**), the dishwasher detects a body in front by using the first sensor **251** (S**1020**).

[0180] The first door mode can be a default mode. In the first door mode, the handle **4** can be located in the first position P**1**, the first sensor **251** can be in an on state, and the second sensor **252** can be in an off state.

[0181] In the first door mode, the lighting system **42** can also be in an off state.

[0182] In some examples, there are a model that supports an automatic door opening drying function (slightly opening the door) and a model that does not support the function. Accordingly, the state of the door **2** in the first door mode can vary depending on the model.

[0183] When a body is detected by the first sensor **251** (S**1020**), the dishwasher switches to a second door mode (S**1030**). The second door mode can be a welcoming mode.

[0184] When the body is detected by the first sensor **251** (S**1020**), the handle motor **41** is driven and the handle **4** can be moved in a forward direction.

[0185] In the second door mode, the handle **4** is in the second position P**2** and the second sensor **252** is also turned on, so that both the first and second sensors **251** and **252** can be turned on.

[0186] In the second door mode, the lighting system **42** is also turned on and welcoming lighting of a certain pattern (e.g. gradation) can be output.

[0187] When a body is detected by the second sensor **252** (S**1040**), the dishwasher switches to a third door mode (S**1050**). The third door mode can be a pop-up mode.

[0188] When the body is detected by the second sensor **252** (S**1040**), the handle motor **41** is driven and the handle **4** can be moved further in a forward direction.

[0189] In the third door mode, the handle **4** is in the third position P**3**, and the lighting system **42** is also turned on to output light in a certain pattern (e.g. white dimming).

[0190] Thereafter, the dishwasher switches to an operation mode that operates according to commands input by a user, such as washing operation (S**1080**).

[0191] The dishwasher can determine the open/closed state of the door **2** and the state of the washing chamber **11** by using the door switch **254** or other sensors (S**1060**).

[0192] In the third door mode, when the door **2** is opened and closed (S**1060**) and there is a washing operation command through the interface **23**, etc. (S**1070**), the handle **4** moves from the third position P**3** to the second position P**2**.

[0193] In the operation mode (S**1080**), the second sensor **252** maintains the on state to prepare for situations such as opening during operation.

[0194] In some examples, in the second door mode, if the second sensor **252** does not detect a body within a reference time (S**1040**), the dishwasher can be switched to the first door mode (S**1010**).

[0195] FIG. **11** is a flowchart of a dishwasher control method, and shows logic corresponding to door opening during operation.

[0196] Referring to FIG. **11**, when the dishwasher is in an operation mode with washing operation (S**1110**), the second sensor **252** can detect a body (S**1120**).

[0197] When the second sensor **252** detects a body (S**1120**), the main controller **14** stops the washing operation (S**1130**). In addition, the dishwasher switches again to the second door mode (S**1140**). Accordingly, the handle **4** can be moved in a forward direction from the second position P**2** to the third position P**3** so that a user can open the door **2**. The user can hold the handle **4** that moved to the third position P**3** and open the door **2**.

[0198] FIGS. **12** to **16** are diagrams for explaining a lighting operation.

[0199] FIG. **12** illustrates the second door mode. When in the second door mode, the lighting system **42** is turned on and welcoming lighting of a certain pattern can be output.

[0200] FIGS. **13**A-**13**E illustrate various example patterns. FIG. **13**A illustrates a pattern that blinks light of a certain color. FIG. **13**B illustrates a clockwise rotating pattern, and FIG. **13**C illustrates a counterclockwise rotating pattern.

[0201] FIG. **13**D illustrates a left-right gradation lighting pattern from the inside to the outside, and FIG. **13**E illustrates a left-right gradation lighting pattern from the outside to the inside.

[0202] In some examples, when the door is open during the operation described with reference to FIG. **11**, the lighting system **42** can indicate whether the door **2** can be opened by using the color of the output light.

[0203] For example, to provide caution when opening the door because the internal temperature is high, the lighting system **42** can output red light. When the internal temperature is low, the lighting system **42** can output blue light.

[0204] FIGS. **14** and **15** illustrate the operation of the lighting system **42** in the operating mode of dishwasher.

[0205] Referring to FIG. **14**, during a washing operation, the lighting system **42** can vary the length of output light depending on the degree of washing progress. When the lighting system **42** can emit light from a starting point P**41** to an ending point P**43**, a section from the starting point P**41** to the ending point P**43** is mapped to the entire washing operation time, and light can be output up to a current point P**42**. Accordingly, a user can intuitively recognize the current step.

[0206] Referring to FIG. **15**, when the washing operation is completed, the lighting system **42** can emit light throughout the entire section from the starting point P**41** to the ending point P**43**.

[0207] In addition to the washing operation, the current step can be guided in the same way for other operations. In addition, depending on the type of operation, light can be output in different colors.

[0208] For example, the current operation and step can be guided to a user by using blue light for a washing operation, red light for a drying operation, white light for a steam operation, and black light for other operations.

[0209] FIG. **16** illustrates the operation of the lighting system **42** in the third door mode. Even in this case, the lighting system **42** can output light in one or more of various patterns, as described with reference to FIGS. **13**A-**13**E.

[0210] FIG. **17** is a flowchart of a dishwasher control method.

[0211] Referring to FIG. **17**, in the first door mode of the dishwasher, the handle **4** is located in the first position P**1**, the first sensor **251** is in the on state, and the lighting system **42** is in the off state (S**1710**).

[0212] When a body is detected by the first sensor **251** (S**1720**), in the turned-on dishwasher, the handle **4** moves to the second position P**2**, and it is switched to the second door mode the second sensor **252** is turned on (S**1730**).

[0213] In addition, in the second door mode, the lighting system **42** can also be turned on and welcoming lighting of a certain pattern can be output.

[0214] In some examples, when a body is detected by the second sensor **252** within a reference time (S**1740**), the dishwasher switches to the third door mode (S**1750**).

[0215] If the second sensor **252** does not detect a body within the reference time (S**1750**), in the dishwasher, the handle **4** moves in a rearward direction from the second position P**2** to the second position P**1**, and the second sensor **252** can be switched to a fourth door mode that maintains the on-state (S**1760**). That is, the fourth door mode can be another default mode that is different from the first door mode only in the state of the second sensor **252**.

[0216] There exists often an induction cooker, a microwave oven, a gas stove, and other cooking appliances above the dishwasher. Therefore, a user in front of the dishwasher can respond quickly when the user wants to open the door **2**, by operating the second sensor **252** for a reference time to determine whether to switch to the third door mode, and then not turning off the second sensor **252** even if it returns to the default mode.

[0217] When in the fourth door mode, if the second sensor **252** detects a body, it can quickly switch to the third door mode without switching to the second door mode.

[0218] FIG. **18** is a flowchart of an example of a dishwasher control method.

[0219] Steps S**1810**, S**1820**, S**1830**, and S**1840** of FIG. **18** can correspond to steps S**1010**, S**1020**, S**1030**, and S**1040**, respectively. Hereinafter, descriptions of the same steps will be omitted or briefly explained.

[0220] In some examples, if a body is not detected by the second sensor (S**1840**), the dishwasher can be switched to the fourth door mode described above (S**1870**).

[0221] If a body is not detected by the second sensor (S**1840**), the dishwasher can be switched to the third door mode (S**1870**). At this time, it can be determined whether the detection of the second sensor **252** is occurred during a user's input (S**1860**).

[0222] For example, when a user's hand or other body part that operates the interface **23** is detected by the second sensor **252** in the process of operating the interface **23**, the door controller **24** can determine that the detection of the second sensor **252** corresponds to a user input.

[0223] In addition, when a long key, a gesture input, or a double tap input can be performed through the second sensor **252**, the door controller **24** can check whether the operation corresponds to the input, and determine that the detection of the second sensor **252** corresponds to a user input.

[0224] If the detection of the second sensor **252** is determined to correspond to the user input (S**1860**), the dishwasher can be switched to the fourth door mode (S**1870**).

[0225] FIG. **19** is a flowchart of an example of a dishwasher control method.

[0226] Referring to FIG. **19**, in the first door mode state, the dishwasher can detect a body in front through the first

sensor **251**. In the first door mode state, the handle **4** is located in the first position P**1** and the lighting system **42** is in an off-state (S**1900**).

[0227] If the state in which a body is detected within the detection distance R**1** by the first sensor **251** is equal to or longer than a first reference time (S**1905**), the dishwasher switches to the second door mode in which the handle **4** moves to the second position P**2**, and the sensor **252** is turned on (S**1910**).

[0228] In addition, in the second door mode, the lighting system **42** can also be turned on and welcoming lighting in certain pattern can be output.

[0229] In some examples, when a body is detected by the second sensor **252** within a second reference time (S**1915**), the dishwasher switches to the third door mode (S**1920**).

[0230] If the second sensor **252** does not detect a body within the second reference time (S**1915**), the dishwasher can be switched to the fourth door mode in which the handle **4** moves in a rearward direction from the second position P**2** to the first position P**1** and the second sensor **252** maintains the on-state (S**1925**).

[0231] In some examples, when in the fourth door mode (S**1925**), when the second sensor **252** detects a body (S**1915**), the dishwasher can quickly switch to the third door mode (S**1920**).

[0232] In some examples, if there is a user input through the interface **23** (S**1930**) and the door is opened and closed (S**1935**), the dishwasher can be switched to the operation mode (S**1945**).

[0233] Whether the door is opened or closed can be detected through the door switch **254** or other door position sensor.

[0234] In some examples, when it is switched from the third door mode (S**1920**) to the dishwasher operation mode (S**1945**), the handle **4** moves from the third position P**3** to the second position P**2** (S**1940**). When the handle **4** is moving in a rearward direction (S**1940**), a user's hand can become caught in the increasingly narrow space **46**.

[0235] When the handle **4** is moving in a rearward direction, if a body is detected by the first sensor **251** and a body is not detected by the second sensor **252** (S**1940**), the dishwasher can be switched to the operation mode (S**1945**).

[0236] Otherwise (S**1940**), the dishwasher can perform a safety operation (S**1940**). The safety operation includes an operation that stops the movement of the handle **4**. In addition, the safety operation can include a notification operation that notifies a user of an emergency situation. For example, the haptic actuator **43** can vibrate the handle **4**. In addition, the speaker **231** can output voice guidance. In addition, the lighting system **42** can output red light that blinks at a certain period. In some examples, when the washing machine is in a washing operation mode (S**945**), a body can be detected by the second sensor **252** (S**1955**).

[0237] When the second sensor **252** detects a body (S**1955**), the dishwasher can be switched to a fifth door mode (S**1960**). The fifth door mode is a mode in which washing is stopped and the lighting system **42** indicates the internal temperature in color, and can be another pop-up mode.

[0238] In addition, if the first sensor **251** detects a body and the second sensor **252** detects a body within a certain time (S**1955**), the dishwasher can be switched to the fifth door mode (S**1960**).

[0239] In some examples, if the second sensor **252** does not detect a body (S**1955**), the dishwasher completes a set operation such as washing and drying. After the operation is completed, according to the settings, it can return to the first door mode.

[0240] FIG. **20** is a flowchart of an example of a dishwasher control method.

[0241] Steps S**2000**, S**2005**, S**2010**, S**2015**, and S**2020** of FIG. **20** can correspond to steps S**1900**, S**1905**, S**1910**, S**1915**, and S**1920**, respectively. In addition, steps S**2035**, S**2040**, S**2045**, S**2050**, S**2055**, S**2060**, and S**2065** of FIG. **20** can correspond to steps S**1930**, S**1935**, S**1940**, S**1945**, S**1950**, S**1955**, and S**1960**, respectively.

[0242] In some examples, a sensor is provided in the handle **4** and a certain input is possible from the handle **4** side. For example, when a long key, a gesture input, or a double tap input can be performed through the second sensor **252**, the door controller **24** checks whether the operation corresponds to the input, and determines that the detection of the second sensor **252** corresponds to a user's input (S**2030**).

[0243] If the detection of the second sensor **252** is not determined to correspond to a user input (S**2030**), the dishwasher can be switched to the third door mode (S**2020**).

[0244] If the detection of the second sensor **252** is not determined to correspond to a user input (S**2030**), depending on whether the interface is input (S**2035**) and whether sensing is performed during movement (S**2045**), it can be switched to the dishwasher operation mode (S**2050**).

[0245] FIG. **21** is a flowchart of an example of a dishwasher control method.

[0246] Steps S**2100**, S**2105**, S**2110**, S**2015**, and S**2020** of FIG. **21** can correspond to steps S**1900**, S**1905**, S**1910**, S**1915**, and S**1920** of FIG. **19**, respectively.

[0247] In some examples, if the second sensor **252** does not detect a body within the second reference time (S**2115**), the dishwasher can be returned to the first door mode as the handle **4** moves in a rearward direction from the second position P**2** to the first position P**1**. (S**2100**).

[0248] If a body is detected by the second sensor **252** within the second reference time (S**2115**), the dishwasher is switched to the third door mode (S**2120**).

[0249] In addition, steps S**2130**, S**2135**, S**2140**, S**2145**, and S**2150** of FIG. **20** can correspond to steps S**1930**, S**1935**, S**1940**, S**1945**, and S**1950** of FIG. **19**, respectively.

[0250] In some examples, when the dishwasher completes a set operation such as washing and drying (S**2155**), it can return to the first door mode (S**2100**).

[0251] FIG. **22** is a flowchart of a dishwasher control method.

[0252] Steps S**2200**, S**2205**, S**2210**, S**2215**, S**2220**, S**2230**, S**2235**, and S**2240** of FIG. **22** can correspond to steps S**2100**, S**2105**, S**2110**, S**2015**, S**2020**, S**2030**, S**2035**, and S**2040** of FIG. **21**, respectively.

[0253] In some examples, if the safety operation is performed (S**2250**) and a hand is detected by the second sensor **252** (S**2253**), the safe operating state is maintained (S**2250**) because the situation has not yet been resolved.

[0254] If the safety operation is performed (S**2250**) and a hand is not detected by the second sensor **252** (S**2253**), the dishwasher can return to the third door mode (S**2220**).

[0255] In some examples, when the dishwasher completes a set operation such as washing and drying (S**2255**), it can return to the first door mode (S**2200**).

[0256] FIG. **23** is a flowchart of an example of a dishwasher control method.

[0257] Steps S**2300**, S**2305**, S**2310**, S**2315**, and S**2320** of FIG. **23** can correspond to steps S**1900**, S**1905**, S**1910**, S**1915**, and S**1920** of FIG. **19**, respectively.

[0258] In some examples, if the second sensor **252** does not detect a body within the second reference time (S**2315**), the dishwasher can be returned to the first door mode as the handle **4** moves in a rearward direction from the second position P**2** to the first position P**1** (S**2300**).

[0259] If a body is detected by the second sensor **252** within the second reference time (S**2315**), the dishwasher is switched to the third door mode (S**2320**).

[0260] In addition, steps S**2330**, S**2335**, S**2340**, S**2345**, S**2350**, S**2355**, and S**2360** of FIG. **23** can correspond to steps S**1930**, S**1935**, S**1940**, S**1945**, S**1950**, S**1955**, and S**1960** of FIG. **19**, respectively.

[0261] FIG. **24** is a flowchart of an example of a dishwasher control method.

[0262] Steps S**2400**, S**2405**, S**2410**, S**2415**, and S**2420** of FIG. **24** can correspond to steps S**1900**, S**1905**, S**1910**, S**1915**, and S**1920** of FIG. **19**, respectively.

[0263] In addition, steps S**2430**, S**2435**, S**2440**, and S**2445** of FIG. **24** can correspond to steps S**1930**, S**1935**, S**1940**, and S**1945** of FIG. **19**, respectively.

[0264] In some examples, when the dishwasher completes a set operation such as washing and drying (S**2455**), it can return to the first door mode (S**2400**).

[0265] FIG. **25** is a flowchart of an example of a dishwasher control method.

[0266] The example of FIG. **25** is a case in which a sensor is provided in the handle **4**, and a certain input is possible from the handle **4** in the example of FIG. **24**.

[0267] Accordingly, the control method further includes a step S**2500** in which the door controller **24** checks whether the operation corresponds to the input and determines that the detection of the second sensor **252** corresponds to a user input.

[0268] If it is determined that the detection of the second sensor **252** corresponds to a user input (S**2500**), the dishwasher can be switched to the third door mode (S**2420**).

[0269] If it is not determined that the detection of the second sensor **252** corresponds to a user input (S**2500**), depending on whether the interface is input (S**2430**) or whether sensing is performed during movement (S**2440**), it can be switched to the dishwasher operation mode (S**2445**).

[0270] In some implementations, a dishwasher includes a door that can be conveniently opened and closed by using an automatically moving handle.

[0271] In some implementations, it can be possible to prevent accidents that may occur due to misidentification of a baby or companion animal when a handle is automatically driven, by using sensors that differ in at least one of the position, detection order, and detection distance.

[0272] In some implementations, it can be possible to maintain a seamless appearance of the dishwasher by retracting a handle into the inside of a door when not in use.

[0273] In some implementations, a handle can be moved to an optimal position according to the operating state or user's intention.

[0274] In some implementations, a user can intuitively recognize the operating state.

[0275] In some implementations, it can be possible to prevent user's fingers from being caught in an automatically moving handle.

[0276] While the present disclosure has been particularly shown and described with reference to exemplary implementations thereof, it will be understood by those of ordinary skill in the art that various changes in form and detail can be made herein without departing from the spirit and scope of the present disclosure as defined by the following claims and such modifications and variations should not be understood individually from the technical idea or aspect of the present disclosure.

What is claimed is:

1. A dishwasher comprising:
- a tub that defines a washing chamber;
- a door configured to open and close the washing chamber;
- a handle disposed at the door;
- a handle motor configured to drive the handle in a front-rear direction;
- a first sensor having a first detection distance; and
- a second sensor having a second detection distance different from the first detection distance of the first sensor,
- wherein the handle is configured to:
  - based on the first sensor detecting a user, protrude outward from the door in a forward direction from a first position to a second position, and
  - based on the second sensor detecting the user, move in the forward direction from the second position to a third position.

2. The dishwasher of claim **1**, wherein the first detection distance of the first sensor is longer than the second detection distance of the second sensor.

3. The dishwasher of claim **1**, wherein the second sensor is disposed above the first sensor.

4. The dishwasher of claim **1**, wherein the first sensor is disposed at the door, and the second sensor is disposed above the first sensor.

5. The dishwasher of claim **1**, wherein the door comprises a door cover that defines a front surface of the door,
- wherein the first sensor is one of a plurality of first sensors that are disposed at a bottom surface of the door cover and spaced apart from one another, and
- wherein the second sensor is disposed inside the handle.

6. The dishwasher of claim **1**, wherein a distance between the first position and the second position is shorter than a distance between the second position and the third position.

7. The dishwasher of claim **1**, further comprising an interface that is configured to receive a command for operating the dishwasher,
- wherein the handle is configured to, based on the interface receiving a washing operation command, move in a rearward direction from the third position to the second position.

8. The dishwasher of claim **1**, wherein the handle is configured to, based on the second sensor failing to detect the user within a reference time in a state in which the handle is disposed at the second position, move in a rearward direction from the second position to the first position.

9. The dishwasher of claim **1**, wherein the second sensor is configured to be turned on based on the first sensor detecting the user.

10. The dishwasher of claim **9**, wherein the handle is configured to, based on the second sensor failing to detect

the user within a reference time in a state in which the handle is disposed at the second position, move in a rearward direction from the second position to the first position while the second sensor maintains a turn-on state.

11. The dishwasher of claim **1**, wherein the dishwasher is configured to, based on the second sensor detecting the user during a washing operation, stop the washing operation and control the handle motor to move the handle in the forward direction from the second position to the third position.

12. The dishwasher of claim **1**, further comprising a lighting system comprising a light source configured to emit light, the lighting system being configured to define a first pattern of the light at the handle based on the first sensor detecting the user in a state in which the handle is disposed at the second position.

13. The dishwasher of claim **12**, wherein the lighting system is configured to vary a color of the light and a length of the first pattern at the handle based on an operating state of the dishwasher.

14. The dishwasher of claim **12**, wherein the lighting system is configured to define a second pattern of the light at the handle based on the second sensor detecting the user in a state in which the handle is disposed at the third position.

15. The dishwasher of claim **1**, wherein the dishwasher is configured to:

operate based on (i) the first sensor detecting the user and (ii) the second sensor failing to detect the user while the handle is moving; and

based on the second sensor detecting the user while the handle is moving, perform a safety operation for stopping movement of the handle.

16. The dishwasher of claim **15**, further comprising a haptic actuator configured to vibrate the handle during the safety operation.

17. The dishwasher of claim **1**, further comprising:

a door switch configured to detect whether the door is opened or closed; and

a handle switch configured to detect whether the handle is moving.

18. A dishwasher comprising:

a tub that defines a washing chamber;

a door configured to open and close the washing chamber, the door being configured to operate in one or more door modes;

a handle disposed at the door, the handle being configured to be located at a first position in a first door mode among the one or more door modes;

a handle motor configured to drive the handle in a front-rear direction;

a first sensor disposed at the door; and

a second sensor disposed above the first sensor and configured to maintain an off-state in the first door mode,

wherein the door is configured to, based on the first sensor detecting a user in the first door mode, switch to a second door mode in which (i) the handle protrudes outward in a forward direction from the first position to a second position and (ii) the second sensor is turned on.

19. The dishwasher of claim **18**, wherein the door is configured to, based on the second sensor detecting the user in the second door mode, switch to a third door mode in which the handle moves in the forward direction from the second position to a third position.

20. The dishwasher of claim **19**, further comprising:

an interface configured to receive a command for operating the dishwasher; and

a door switch configured to detect whether the door is opened or closed,

wherein the door is configured to, based on (i) the door being opened and closed in the third door mode and (ii) the interface receiving a washing operation command, switch to an operation mode in which the handle moves from the third position to the second position while the second sensor maintains a turn-on state.

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