

CLEANING APPARATUS AND SYSTEM

FIELD OF THE INVENTION

[0001] The present disclosure relates to a cleaning apparatus and a system.

5 BACKGROUND ART

[0002] The following discussion of the background to the disclosure is intended to facilitate an understanding of the present disclosure only. It should be appreciated that the discussion is not an acknowledgement or admission that any of the material referred to was published, known or part of the common general
10 knowledge of the person skilled in the art in any jurisdiction as at the priority date of the disclosure.

[0003] Some cleaning apparatus comprise a module, such as a mop to perform one or more cleaning processes, such as to clean a surface of a floor. In the case where a user wishes to clean or perform maintenance operations on the module,
15 the user may have to interrupt the cleaning process and manually clean the module. In other words, the maintenance of the module has to take place separately from the actual cleaning operation(s). There exists a need to alleviate at least one of the aforementioned problems.

SUMMARY

20 [0004] The present disclosure seeks to address and/or ameliorate the problem in the prior art by providing a cleaning apparatus and a system.

[0005] Throughout this document, unless otherwise indicated to the contrary, the terms 'comprising', 'consisting of', 'having' and the like, are to be construed as non-exhaustive, or in other words, as meaning 'including, but not limited to'.

25 [0006] Furthermore, throughout the document, unless the context requires otherwise, the word 'include' or variations such as 'includes' or 'including' will be understood to imply the inclusion of a stated integer or group of integers but not the exclusion of any other integer or group of integers.

[0007] According to one aspect of the disclosure, there is provided a cleaning apparatus comprising at least one module configured to clean a surface, the at least one module comprises a first part and a second part and comprising a cleaning module configured to clean the second part simultaneously when the first part is operated to clean the surface.

[0008] In some embodiments, the first part or second part is operated to clean the surface via a movement of the cleaning apparatus along a first direction such that the first part moves while in contact with the surface, the movement of the first part causes the cleaning module to clean the second part.

[0009] In some embodiments, the cleaning module is further configured to clean the first part when the second part is operated to clean the surface.

[0010] According to another aspect of the disclosure, there is provided a cleaning apparatus comprising a first member configured to clean a surface and a plurality of second members configured to be attached to the first member, wherein the first member is shaped and dimensioned to absorb liquid on the surface when the first member is moved along the surface, and wherein each of the plurality of second members is configured to adjust a distance between the first member and the surface.

[0011] In some embodiments, the first member comprises a rubber material.

[0012] In some embodiments, each of the plurality of second members comprises an elastic member to move the first member between a first position and a second position.

[0013] In some embodiments, the first member has at least one opening formed at an outer surface of the first member, and wherein the first member has a first space therein in fluid communication with an exterior of the first member via the at least one opening.

[0014] According to a further aspect of the disclosure, there is provided a system for controlling a cleaning apparatus comprising a transmitter configured to transmit a first data to a server, the server arranged in data communication with a

database and comprising a receiver configured to receive a second data from the server, the second data for interacting with a user or for effecting a cleaning operation of the cleaning apparatus, the second data determined based on the first data and the database and comprising a controller configured to control at least one part of the cleaning apparatus to change at least one state of the at least one part of the cleaning apparatus, based on the received second data.

[0015] In some embodiments, the at least one state of the at least one part of the cleaning apparatus includes a movement state, change in speed of a movement.

[0016] In some embodiments, the controller is configured to control the first part or the second part to perform one or more of the following cleaning actions: sweeping, vacuuming, scrubbing, mopping, window cleaning, table cleaning, garbage collecting, arrangement of furniture for facilitating cleaning.

[0017] In some embodiments, the first data includes a current movement state of the cleaning apparatus, geographic information of the apparatus, battery management information of the apparatus, hours of operation of the apparatus, error status of the apparatus.

[0018] In some embodiments, the database includes at least one of personality data, user defined personality data, personification data, geographical personality data, seasonal greetings data, and state expressive personality data, and wherein the second data includes at least one data selected from the database based on the first data.

[0019] In some embodiments, the cleaning apparatus is arranged in data communication with the server, wherein the server is a remote server.

[0020] In some embodiments, the database includes map data of one or more locations for controlling the movement of the cleaning apparatus within said location(s).

[0021] In some embodiments, the map data further includes preset zones dictating the operation of the cleaning apparatus within the location(s).

[0022] In some embodiments, the map data can be accessed by one or more said cleaning apparatus.

BRIEF DESCRIPTION OF THE DRAWINGS

5 [0023] Various embodiments are described, by way of example only, with reference to the accompanying drawings, in which:

Figure 1 illustrates a side view of the apparatus 1000 according to some embodiments of the present disclosure.

10 Figure 2 illustrates a perspective view of the apparatus 1000 according to some embodiments of the present disclosure.

Figure 3 illustrates a front view of the apparatus 1000 according to some embodiments of the present disclosure.

Figure 4 illustrates an enlarged view of the apparatus 1000 according to some embodiments of the present disclosure.

15 Figure 5 illustrates an enlarged view of the apparatus 1000 according to some embodiments of the present disclosure.

Figure 6 illustrates the second height adjustment member 212 of the apparatus 1000 according to some embodiments of the present disclosure.

20 Figure 7 illustrates a schematic diagram of the cleaning module 600 of the apparatus 1000 according to some embodiments of the present disclosure.

Figure 8 illustrates a flowchart according to some embodiments of the present disclosure.

Figure 9 illustrates another flowchart according to some embodiments of the present disclosure.

25 Figure 10 illustrates an example of motions of some elements of the apparatus 1000 according to some embodiments of the present disclosure.

Figure 11 illustrates a block diagram of the apparatus 1000 according to some embodiments of the present disclosure.

Figure 12 illustrates an example of a unit 300 according to some embodiments of the present disclosure.

- 5 Figure 13 illustrates an example of a plurality of guiding units 341 and a cartridge 360 according to some embodiments of the present disclosure.

Figure 14 illustrates an example of a guiding unit 341 according to some embodiments of the present disclosure.

- 10 Figure 15 illustrates an example of a cartridge 360 according to some embodiments of the present disclosure.

Figure 16 illustrates an example of an assembly 349 according to some embodiments of the present disclosure.

Figure 17 illustrates an example of a unit 300 according to some embodiments of the present disclosure.

- 15 Figure 18 illustrates an example of a movement of a unit 300 according to some embodiments of the present disclosure.

Figure 19 illustrates a block diagram of a cloud communication according to some embodiments of the present disclosure.

- 20 Figure 20 illustrates a block diagram of the cloud server 1800 according to some embodiments of the present disclosure.

Figure 21 illustrates a block diagram of the base module 2001 according to some embodiments of the present disclosure.

Figure 22 illustrates a block diagram of the scrub module 2100 according to some embodiments of the present disclosure.

- 25 Figure 23 illustrates a block diagram of the mopping module 2200 according to some embodiments of the present disclosure.

Figure 24 illustrates a block diagram of the vacuum module 2300 according to some embodiments of the present disclosure.

Figure 25 illustrates an example of data stored in the database 1820 according to some embodiments of the present disclosure.

5 DETAILED DESCRIPTION

[0024] The present disclosure may be suited for a cleaning apparatus, a system.

[0025] Unless defined otherwise, all other technical and scientific terms used herein have the same meaning as is commonly understood by a skilled person to which the subject matter herein belongs.

10 [0026] Apparatus 1000

[0027] As shown in figures 1 to 6, the apparatus 1000 may comprise a first part 111 (module 111) and a second part 112 (module 112), and a surface 1100 to remove dust or impurities by way of cleaning actions such as, but not limited to, wiping, sweeping, vacuuming, spreading fluid, or any combination thereof. A
15 cleaning module 600 of the apparatus 1000 may clean the second part 112 simultaneously when the first part 111 is operated to clean the surface 1100. The cleaning module 600 of the apparatus 1000 may clean the first part 111 simultaneously when the second part 112 is operated to clean the surface 1100.

[0028] As shown in figure 1 (figure 1A and 1B), the surface 1100 may be a
20 surface on which the apparatus 1000 is deployed on and may include, but not limited to, a surface of a floor. It is to be appreciated that the dust or impurities on the surface 1100 and/or dust or impurities attached to the module 110 may include, but not limited to, hair, fluff, dandruff, and liquid. The deployment of the apparatus 1000 may include motion and movement of the apparatus 1000.

25 [0029] The apparatus 1000 may further comprise a first height adjustment member 211 and a second height adjustment member 212. The apparatus 1000 may further comprise a body 10, at least one tank (not shown), a cleaning module 600, an actuator 800, a motor 850, a wheel 901 and a wheel 902.

[0030] Hereinafter, the first part 111 and the second part 112 may be collectively referred to as a module 110. Hereinafter, the first height adjustment member 211 and the second height adjustment member 212 may be collectively referred to as a height adjustment member 210. Hereinafter, the wheel 901 and the wheel 902 may be collectively referred to as a wheel 900. Hereinafter, a traveling direction of the apparatus 1000 may be referred to as a direction X1 or a first direction. Hereinafter, an opposite direction of the direction X1 may be referred to as a direction X2. Hereinafter, a depth direction of figure 1 may be referred to as a direction Y1 and an opposite direction of the direction Y1 may be referred to as a direction Y2. The directions Y1 and Y2 may be orthogonal in relation to the directions X1 and X2. Each of the directions X1 (X2) and Y1 (Y2) may be pre-determined, or may be determined by a controller 150 (figure 11). The apparatus 1000 may move along the direction X1 shown by an arrow in figure 1.

[0031] The module 110

[0032] As shown in figures 2 (figure 2A, 2B, and 2C) and 3 (figure 3A and 3B), each of the first part 111 and the second part 112 may be a planar member and may be used to clean the surface 1100. Each of the first part 111 and the second part 112 may comprise a head and a fabric detachably secured to the head. The fabric may include, but not limited to, a non-woven fabric to constitute, for example, a mop or a sponge. It is to be appreciated the apparatus 1000 may comprise one or more additional module(s) to clean the surface 1100 other than the module 110. Figure 2A and 2B may indicate that the first part 111 is cleaned simultaneously when the second part 112 is operated to clean the surface 1100. Figure 2C may indicate that the second part 112 moves up to a default state after the second part 112 is operated to clean the surface 1100.

[0033] As shown in figure 3, the first part 111 may include a first outer surface 111A and a second outer surface 111B disposed at an opposite side of the first outer surface 111A. As shown in figure 4 (figure 4A and figure 4B), the second part 112 may have a first outer surface 112A and a second outer surface 112B disposed an opposite side of the first outer surface 112A. When the apparatus 1000 clean the surface 1100, at least one of the second outer surface 111B and the

second outer surface 112B may face the surface 1100 or may be in contact with the surface 1100.

[0034] As shown in figure 4 and figure 5, the second part 112 may comprise an engaging means 113 comprising a protruding part 113a and may be configured to be engaged with an engaging means 213 comprising an opening 213a. Hereinafter, each end of the second part 112 in the direction Y1 (Y2) may be referred to as a left end 112L and a right end 112R shown in figure 4A.

[0035] Although an example of a configuration of the second part 112 has been described as above with reference to figure 4, the first part 111 may be configured in a similar manner to the second part 112. For example, although not shown in figure 4, the first part 111 may comprise an engaging means (not shown) comprising a protruding part (not shown) and may be configured to be engaged with an engaging means (not shown) of the second height adjustment member 212, wherein the second height adjustment member 212 comprises an opening (not shown).

[0036] It is to be appreciated that 'clean the surface 1100' or 'cleaning the surface 1100' may be understood to mean, for example, at least one element of the first part 111 and the second part 112 is in contact with the surface 1100 while apparatus 1000 travels at a determined direction such as the direction X1. 'clean the surface 1100' or 'cleaning the surface 1100' may be understood to mean, for example, at least one of the first part 111 and the second part 112 wipes or mops the surface 1100 along the direction X1.

[0037] Height adjustment member 210

[0038] As shown in figures 4, 5 and 6, the second height adjustment member 212 may have an engaging means 213 arranged to be engaged with an engaging means 113. A height of the second height adjustment member 212 may be adjusted progressively under the control of the controller 150. The engaging means 213 may comprise an opening 213a. In the case where the engaging means 213 moves so that the protruding part 113a is inserted to the opening 213a, the second part 112 may be fastened to the second height adjustment member 212. It is to be

appreciated that a protruding direction of the protruding part 113a may be perpendicular in relation to a traveling direction of the apparatus 1000.

[0039] Although an example of a configuration of the second height adjustment member 212 has been described as above with reference to figure 4, the first height adjustment member 211 may be configured in a similar manner to the second height adjustment member 212. For example, although not shown in figure 4, the first height adjustment member 211 is configured to be engaged with an engaging means (not shown) within the first part 111.

[0040] It is to be appreciated that the engaging means 113 may have an opening part instead of the protruding part 113a and the engaging means 213 may have the protruding part instead of the opening 213a. In this case, the protruding part of the engaging means 213 may be inserted into the opening part of the engaging means 113.

[0041] Cleaning module 600

[0042] As shown in figure 7 (figure 7A, 7B, and 7C), the cleaning module 600 may include a tray 650, a brush 660, a first pump nozzle 671, a second pump nozzle 672, and a third pump nozzle 673, a first squeezing part 681, a second squeezing part 682, a first tank, and a second tank. The cleaning module 600 may be used to clean the module 110. In particular, the cleaning module 600 may be used to (i) wet the module 110, (ii) clean the module 110 using the brush 660 and/or (iii) squeeze the module 110 to leave it damp.. Hereinafter, the first pump nozzle 671, the second pump nozzle 672, and the third pump nozzle 673 may be referred to as a pump nozzle 670. Hereinafter, the cleaning module 600 may be referred to as a module 600.

[0043] The cleaning module 600 or at least part to constitute the cleaning module 600 may move one side to the other side along a lateral direction of the module 110, and vice versa, under the control of the actuator 800. The lateral direction may be the direction Y1 and Y2. The cleaning module 600 or at least part to constitute the cleaning module 600 may rotate at 360 degree clockwise or counter-clockwise in a horizontal direction of the apparatus 1000, under the control of the motor 850. It is to be appreciated that the number of reciprocating motions is

not limited to a particular number and may be determined by the degree of cleanness of the module 110.

[0044] The tray 650 may be configured to be curved downwardly to collect dust or impurities or water including dust or impurities removed from the module 110.

5 The tray 650 may move one side to the other side along a lateral direction of the module 110, and vice versa, under the control of the actuator 800. The lateral direction may be the direction Y1 and Y2.

[0045] The brush 660 may be used to scrub an outer surface of the module 110 under the control of the motor 700. The brush 660 may be disposed above the tray
10 650 during a cleaning process for the module 100. A position of the brush 660 may be changed in accordance with a position of the tray 650. For example, in the case where the tray 650 is disposed below the module 110, the brush 660 may be disposed between the module 110 and the tray 650 so that dust or impurities removed from the module 110 can be collected by the tray 650.

15 **[0046]** The first pump nozzle 671 and a second pump nozzle 672 may be used to direct liquid in a first tank (not shown) toward the module 110. The first pump nozzle 671 is configured to rinse the module 110 and the second pump nozzle 672 is configured to wet the module 110 before the brush 660 scrubs the module 110. The liquid from a first tank may include water or may include a mixture of water and
20 detergent. As such, the apparatus 1000 may facilitate removing dust or impurities on the surface 1100 using the liquid. The third pump nozzle 673 may be used to direct dirty liquid toward a second tank (not shown), wherein the dirty liquid may be rebounded from an outer surface of the module 110. The first squeezing part 681 is configured to act as a squeezing mechanism that digs into the module 110 and
25 leaves the pad damp. The second squeezing part 682 is configured to act as a squeezing mechanism to squeeze away the dirty water.

[0047] The first tank may contain liquid such as water to be directed to the first pump nozzle 671 and/or the second pump nozzle 672 in order to remove dust or impurities attached to an outer surface of the module 110. The second tank may
30 contain liquid such as water rebounded from the module 110.

[0048] Motor 700

[0049] Referring back to figure 1, the motor 700 may be configured to drive the brush 660 and to adjust rotation speed of the brush 660.

[0050] Horizontal actuator 800

5 [0051] As shown in figure 1, the actuator 800 may be used to move and the cleaning module 600 in a determined direction such as a horizontal direction including the directions Y1 and Y2. As such, the actuator 800 may be activated in the case where the cleaning module 600 commences cleaning the module 110. A range of motion of the actuator 800 may be determined based on a length of the module 110.

10 [0052] Motor 850

[0053] As shown in figure 1, the motor 850 may be provided in the apparatus 1000 and may be used to rotate the cleaning module 600 in a determined direction such as a horizontal direction. The cleaning module 600 may be rotated 360 degree in a clockwise or a counter-clockwise.

15 [0054] Wheel 900

[0055] The wheel 901 and the wheel 902 may be used to move the apparatus 1000 along the direction X1 or other direction. The wheel 901 may be shaped and dimensioned to be different from the wheel 902. It is to be appreciated that the size and/or the dimension of the wheels 901, 902 are not limited to a particular size
20 and/or the dimension.

[0056] An exemplary movement of the apparatus 1000

[0057] An exemplary movement of the apparatus 1000 will be described with reference to figure 9 and figure 10 (figure 10A, figure 10B, figure 10C, figure 10D, and figure 10E). S100 to S320 in figure 9 may be performed by the apparatus
25 1000. S110 to S190, S310, and S320 may be related to processes to clean the surface 1100 by the first part 111 and to clean the second part 112 by the cleaning module 600. S210 to S290 may be related to processes to clean the surface 1100 by the second part 112 and to clean the first part 111 by the cleaning module 600.

It is to be appreciated that in figure 9 the first part 111 and the second part 112 are respectively referred to as part 111 and part 112.

5 **[0058]** At S100, the apparatus 1000 may determine whether a button (not shown) to start a process to clean the module 110 and the surface 1100 is turned on. At S100, the first part 111, the second part 112 and the tray 650 may be positioned at the corresponding default state as shown in figure 10A.

10 **[0059]** Hereinafter, a default state of the first part 111 may be referred to a default state 111S. Hereinafter, a default state of the second part 112 may be referred to as a default state 112S. Hereinafter, a default state of the tray 650 may be referred to as a default state 600S. At the default states 111S, 112S, and 600S, each of the first part 111, the second part 112, and the tray 650 is disposed at a height Z0.

15 **[0060]** The first part 111 at the default state 111S may be spaced a determined distance away from the surface 1100. The second part 112 at the default state 112S may be spaced a determined distance away from the surface 1100. The first part 111 may be disposed along the direction X1 in relation to the second part 112. The tray 650 at the default state 600S may be spaced a determined distance away from the surface 1100.

20 **[0061]** The first part 111 at the default state 111S and the second part 112 at the default state 112S may be positioned at a height Z0 as shown in figure 10A. The cleaning module 600 at the default state 600S may be positioned at a height Z1 as shown in figure 10A.

25 **[0062]** The cleaning module 600 at the default state 600S may be at a position rotated 90 degrees in relation to the first part 111 in a one of clockwise and a counter-clockwise and may be at a position rotated 90 degrees in relation to the second part 112 in the other one of a clockwise and a counter-clockwise. The rotation angle of the cleaning module 600 is not limited to 90 degrees.

[0063] If yes at S100 in figure 9, the controller 150 may control the first height adjustment member 211 so that the first part 111 is lowered to the height Z2 at

S110. In a state where the first part 111 is at the height Z2, the first part 111, the second part 112, and the tray 650 may be located as shown in figure 10B.

[0064] At S120, the controller 150 may control the pump nozzle 670 so that the pump nozzle 670 is turned on. At S130, the apparatus 1000 starts processes to
5 clean the second part 112.

[0065] At S140, the controller 150 may control the second part 112 so that the second part 112 is lowered to the height Z1. Further, the controller 150 may control the cleaning module 600 so that cleaning module 600 is positioned under the second part 112. In a state where the first part 111 is lowered to the height Z1 and
10 the cleaning module 600 is positioned under the second part 112, the first part 111, the second part 112, and the cleaning module 600 may be located as shown in figure 10C.

[0066] Although not shown in figure 10, the brush 660 may be rotated in accordance with rotation of the tray 650. For example, in the case where the tray
15 650 is rotated at a determined degree so that the tray 650 is positioned under the second part 112, the brush 660 is rotated at the determined degree. As such, the dust or impurities removed from the second part 112 by using the brush 660 can be collected in the tray 650 as the brush 660 is positioned between the second part 112 and the tray 650.

[0067] At S150, the controller 150 may control the cleaning module 600 so that
20 the cleaning module 600 is turned on. At S160, the controller 150 may control the cleaning module 600 to clean the second part 112. At S170, the controller 150 may control the cleaning module 600 so that the cleaning module 600 is turned off. At S180, the motor 850 may rotate the cleaning module 600 so that the cleaning
25 module 600 returns to the default state 600S.

[0068] At S190, the controller 150 may control the second height adjustment member 212 so that the second part 112 moves to the default state 112S. It is appreciated that in the case where the second part 112 cleans the surface 1100 upon being cleaned, the process of S190 can be omitted. That is, the second part
30 112 may move down to the height Z2 after being cleaned, instead of returning back to the height Z0 (i.e. the default state 112S).

[0069] At S210, the controller 150 may control the second height adjustment member 212 so that the second part 112 is lowered to the height Z2. In a state where the second part 112 is lowered to the height Z2, the first part 111, the second part 112, and the tray 650 may be located as shown in figure 10D.

5 [0070] At S220, the controller 150 may control the first height adjustment member 211 so that the first part 111 moves to the default state 111S. At S230, the apparatus 1000 starts processes to clean the first part 111. After the second part 112 commences cleaning the surface 1100, the first part 111 moves to the default state 111S. As such, the procedures of S210 and S220 help to ensure that the
10 apparatus 1000 does not leave dust or impurities during a transition from a step to clean the surface 1100 by the first part 111 to a step to clean the surface 1100 by the second part 112.

[0071] At S240, the controller 150 may control the first part 111 so that the first part 111 is lowered to the height Z1. Further, the controller 150 may control the
15 cleaning module 600 so that the cleaning module 600 is positioned under the first part 111. In a state where the second part 112 is lowered to the height Z2 and the cleaning module 600 so that the cleaning module 600 is positioned under the second part 112, the first part 111, the first part 111, and the cleaning module 600 may be located as shown in figure 10E.

20 [0072] At S250, the controller 150 may control the cleaning module 600 so that the cleaning module 600 is activated. At S260, the controller 150 may control the cleaning module 600 so that the first part 111 is cleaned by the cleaning module 600. At S270, the controller 150 may control the cleaning module 600 so that the cleaning module 600 is deactivated. At S280, the motor 850 may rotate the
25 cleaning module 600 so that the cleaning module 600 returns to the default state 600S.

[0073] At S290, the controller 150 may control the first height adjustment member 211 so that the first part 111 may move to the default state 111S. It is appreciated that in the case where the first part 111 cleans the surface 1100 upon
30 being cleaned, the process of S290 can be omitted. That is, the first part 111 may

move down to the height Z2 after being cleaned, instead of returning back to the height Z0 (i.e. the default state 111S).

5 **[0074]** At S310, the controller 150 may control the first height adjustment member 211 so that the first part 111 is lowered to the height Z2. At S320, the controller 150 may control the second height adjustment member 212 so that the second part 112 moves to the default state 112S. In a state where the second part 112 moves to the default state 112S, the first part 111, the second part 112, and the cleaning module 600 may be located as shown in figure 10B.

10 **[0075]** As such, the cleaning module 600 is configured to clean the second part 112 simultaneously when the first part 111 is operated to clean the surface 1100. In particular, wherein the first part 111 or second part 112 is operated to clean the surface 1100 via a movement of the cleaning apparatus 600 along a first direction such that the first part 111 moves while in contact with the surface 1100, the movement of the first part 111 causes the cleaning module 600 to clean the second part 112.

20 **[0076]** It is to be appreciated that the controller 150 may determine a timing to start the process of S220 based on at least one factor such as amount of the dust or impurities attached to the first part 111. In this regard, after the process of S210, the controller 150 may determine to perform the process of S220 in the case where the amount of the dust or impurities attached to the first part 111 exceeds a determined amount. In contrast, after the process of S210, the controller 150 may determine to continue cleaning the surface 1100 by the first part 111 at a determined period instead of performing the process of S220 in the case where the amount of the dust or impurities attached to the first part 111 does not exceed the determined amount. The dust or impurities attached to the first part 111 may be detected by a second detection sensor 40 (figure 11).

30 **[0077]** It is to be appreciated that the controller 150 may determine a timing to start the process of S320 based on at least one factor such as amount of the dust or impurities attached to the second part 112. In this regard, after the process of S310, the controller 150 may determine to perform the process of S320 in the case where the amount of the dust or impurities attached to the second part 112

exceeds a determined amount. In contrast, after the process of S310, the controller 150 may determine to continue cleaning the surface 1100 by the second part 112 at a determined period instead of performing the process of S320 in the case where the amount of the dust or impurities attached to the second part 112 does not exceed the determined amount. The dust or impurities attached to the second part 112 may be detected by a second detection sensor 40 (figure 11). It is to be appreciated that the S180 and S190 may be interchangeable and the S280 and S290 may be interchangeable. It is to be appreciated that the controller 150 may control movements of the module 110 to prevent the module 110 from colliding with the cleaning module 600.

[0078] Configuration of the apparatus 1000

[0079] As shown in figure 11, the apparatus 1000 may further comprise an input module 20, a first detection sensor 30, a second detection sensor 40, and a switch 50. Each signal provided from the input module 20, the first detection sensor 30, the second detection sensor 40, and the switch 50 may be inputted to the controller 150.

[0080] The input module 20 may be used to input an instruction from a user and may be configured to be a mouse, a keyboard, voice recognition means or the like. The input module may be disposed in the apparatus 1000 or may be disposed separately from the apparatus 1000. In the case where the input module is disposed separately from the apparatus 1000, the input module 20 may be mounted on a device. The device may be a computing device, such as, but not limited to, a personal computer, a mobile phone, a tablet, or the like.

[0081] The first detection sensor 30 may be used to detect dust or impurities on the surface 1100. The controller 150 may determine a traveling direction of the apparatus 1000 based on a detection result of the first detection sensor 30. The controller 150 may determine whether or not the module 110 moves down to the height Z2 to clean the surface 1100 based on the first detection sensor 30. The second detection sensor 40 may be used to detect dust or impurities on the module 110. Each of the first detection sensor 30 and the second detection sensor 40 may be, for example, an optical sensor or other sensor used to detect object(s). The

switch 50 may be used to start an operation of the apparatus 1000. The apparatus 1000 may further comprise and a limit switch (not shown).

[0082] The controller 150 may control the height adjustment member 210, the cleaning module 600, the motor 700, the actuator 800, and the motor 850, based on the data provided from input module 20, the first detection sensor 30, the second detection sensor 40, and the switch 50.

[0083] An example of data communication between a cleaning apparatus such as the apparatus 1000 and a server such as a cloud server 1800 will be described as follows with reference to figure 19 to figure 25. It is to be appreciated that at least one part of the apparatus 1000 as stated above may be included in an apparatus 2000 or may replace at least part of the apparatus 2000.

[0084] The apparatus 2000 may include a power supply module 1900, a base module 2001, a scrub module 2100, a mopping module 2200, and a vacuum module 2300, and may be used to clean the surface 1100, by way of example, scrubbing, mopping, vacuuming, window cleaning, table cleaning, garbage collecting, or arrangement of furniture for facilitating cleaning.

[0085] Although an example of a cleaning surface, by way of example, scrubbing, mopping, vacuuming, window cleaning, table cleaning, garbage collecting, or arrangement of furniture for facilitating cleaning has been described, cleaning by a unit 300 with a tool to remove or wipe liquid off a surface, such as a squeegee, will be described with reference to figure 12 to figure 18.

[0086] The unit 300

[0087] Figure 12 illustrates an example of a unit 300 according to some embodiments of the present disclosure. As shown in figure 12 (figure 12A and figure 12B, the unit 300 may comprise a plurality of guiding units 341 and a cartridge (squeegee) 360. The unit 300 may move in accordance with a direction A1 as shown in figure 12 B. The plurality of guiding units 341 may be disposed around the cartridge 360 with a predefined shape (e.g.arc- shaped) to intake liquid therein. Movement of the unit 300 may be guided by a set of ball bearings. Such movement may include sliding or swinging. Fixing the plurality of guiding units 341

to the cartridge 360 and/or removing the plurality of guiding units 341 from the cartridge 360 can be performed by sliding, without disturbing an outer skin 360A of the cartridge 360. Example of attaching each of the plurality of guiding units 341 to the cartridge 360 will be described with reference to figure 13 (figure 13A to figure 13D). The unit 300 may further comprise a linear guiding shaft 342, a spherical ball bearing 343 with a linear guide, a motor (stepper motor) 344 with lead-screw to perform a vertical up-down mechanism (e.g. to move the cartridge 360 up and down), a rotary latch 345, a lead screw nut 346, a spring post 347, a spring (a hook spring) 348, and a hose 350 which may be attached to the connecting part 333, a spring 351. It is to be appreciated that an initial starting position of the cartridge 360, which may also be referred to as a 'home' position, may be calibrated by a mechanical switch (not shown) at a predefined height.

[0088] Cleaning of uneven surface(s) may be handled by a suspension mechanism. A pre-determined angle of tilt (e.g. 45 degree) tilt of the unit 300 will allow the unit 300 to absorb water and dries a surface. During a movement of the unit 300, when the cleaning apparatus in the form of a robot turns towards a left or right direction, the unit 300 may swivel out to collect/absorb liquid such as water around corners. When the unit 300 swivel out, a plurality of actions may be concurrently performed. The concurrent actions can include the extension of springs and guiding of bearings 325. When the locomotion of the unit 300 takes a straight path after unit 300 turns left or turns right, the unit 300 will swivel back to its home position. The above mentioned sequence can be performed repeatedly until the unit 300 complete its whole cleaning path.

[0089] The up-down mechanism may be initiated after the unit 300 receives the command from a central low level controller (not shown), the motor 344 may bring down an entire mechanism to a desired position. When the unit 300 reaches its end destination, the whole mechanism of the unit 300 may be brought back to the home position by triggering the motor 344. The home position is calibrated using a mechanical limit switch at a predefined height. The movement when the squeegee mechanism of the unit 300 is off from the ground the hook springs 348a and 348b pull back the squeegee to its original position.

[0090] Figure 13 illustrates an example of a plurality of guiding units 341 and a cartridge 360 according to some embodiments of the present disclosure. Figure 13A indicates a first state where the plurality of guiding units 341 are disposed away from the assembly 349. Positions of the plurality of guiding units 341 may be changed in accordance with figure 13B, figure 13C, and figure 13(d) in this order. Thus, the plurality of guiding units 341 may be attached to the assembly 349 shown in figure 13(d). The unit 300 may be secured with a rotary latch 345 (figure 16B).

[0091] Figure 14 illustrates an example of a guiding unit 341 according to some embodiments of the present disclosure. As shown in figure 14, the guiding unit 341 may comprise at least one bearing 325, a bearing holder 326, a spring holder 327, an adhesion means 328, and an adhesion means 329. The function of the bearing 325 may help the unit 300 to slide in and out by reducing the friction. This in turn, may restrict the guiding unit 340 to swing only within a predefined arc. The bearing holder 326 may have a member (not shown) such as a rubber member. The element may be disposed on an outer surface of the bearing holder 326, the outer surface facing a surface such as a floor during use of the unit 300. The spring holder 327 may be disposed on the at least one bearing 325 and the at least one bearing holder 326 and may cover the at least one bearing 325. The adhesion means 328 and the adhesion means 329 may be, for example, tribo tape. Each of the surface of the adhesion means 328, 329 catered has very less frictional coefficient, enabling the unit 300 to swivel in and out with reduced friction furthermore. The considerable reduction in the friction during the swivel in and out increases life expectancy and reduces the worn out of the unit.

[0092] Figure 15 illustrates an example of a cartridge 360 according to some embodiments of the present disclosure. The cartridge 360 may include at least one element included in the unit 300. As shown in figure 15, the cartridge 360 may have a fastener 331, a holder 332, a connecting part 333, the body 311, the first blade 312, the second blades 313, a wheel 337, and at least one rubber (not shown). The fastener 331 may be used to attach the connecting part 333 to the holder 332. The holder 332 may be disposed on the assembly 349 to cover the assembly 349.

[0093] Figure 16 (figure 16A and figure 16B) illustrates an example of an assembly 349 according to some embodiments of the present disclosure. The

assembly 349 may include at least one element included in the cartridge 360. As shown in figure 16A, the assembly 349 may comprise a body 311, a first blade 312, and a second blade 313, and the respective blades 312, 313 may comprises a curved surface. The shape of the assembly 349 may be an arcuate. The assembly
5 349 may have two different blades front and back (e.g. the first blade 312 and the second blade 313) to absorb and wipe a pool of liquid such as water from a surface while cleaning a surface such as the surface 1100. The first blade 312 may have at least one opening 312a, wherein each of the at least one opening 312a may be used for insertion of the protruding member 311a. During use of the assembly 349,
10 the first blade 312 may be disposed in a traveling direction of the assembly 349 in relation the body 311. The first blade 312 may have at least one perforation to allow liquid such as the water to be sucked into a wastewater tank disposed in the body 311 (not shown). The wastewater tank may have a space (a first space) to store therein liquid such as water collected from a surface. The second blade 313 may
15 have at least one opening 313b, wherein each of the at least one opening 313b may be used for insertion of the protruding member 311b. During use of the assembly 349, the second blade 313 may be disposed in an opposite direction of a traveling direction of the assembly 349 in relation the body 311. The second blade 313 may help to keep a surface such as the surface 1100 dry. When the unit 300
20 starts its locomotion, the first blade 312 and the second blade 313 may be automatically or manually tilted to the determined degree (e.g. 45 degree) angle. In the case the first blade 312 and the second blade 313 are attached to the body 311, the first blade 312 and the second blade 313 are fastened to the body 311 as shown in figure 16B.

25 **[0094]** Figure 17 illustrates an example of a unit 300 according to some embodiments of the present disclosure. In the case where the unit 300 moves forward, the unit 300 may be configured as shown in figure 17A. In the case where the unit 300 as shown in figure 17A turns right, this movement of the unit 300 may cause the spring 348a displaced at a first determined degree as shown in figure 17
30 B. In the case where the squeegee as shown in figure 17A takes left turn, this movement of the unit 300 may cause the spring 348b displaced at a second determined degree as shown in figure 17 C. It is to be appreciated that in the case

where the unit 300 as shown in figure 17B or figure 17C changes the state shown in figure 17A,

[0095] Figure 18 illustrates an example of a movement of a unit 300 according to some embodiments of the present disclosure. A plurality of numbers '1' to '6' shown in figure 18 may respectively correspond to steps S1 to S6 shown in figure 18. Steps S1 to S6 may indicate different positions of the unit 300. In the figure 18, it is assumed that the unit 300 moves from a position corresponding to the step S1 toward a position corresponding to the step S6. At the step S1 and S2, the unit 300 may move straight when the unit 300 follows a straight path, and subsequently the unit 300 may swing out when the unit 300 turns right at the step S3. During a transition from step S2 to step S3, the spring 348a may be displaced at the first determined degree as shown in figure 17B. After the unit 300 turns right at the step S3 and the step S4, the unit 300 may retract back to its home position when the unit 300 follows a straight path. During a transition from step S4 to step S5, the spring 348b may be displaced at the second determined degree as shown in figure 17A. It is to be appreciated that an example of moving forward and turning right for the unit 300 has been described with reference to figure 18, the unit 300 may turn left after step S1, S2, S5, or S6 so that the spring 348b is displaced shown in figure 17C.

[0096] An example of communication via a cloud server 1800

[0097] As shown in figure 19, a device 1500 may be connected to a cloud server 1800 and may comprise at least one application. The device 1500 may be mounted on the apparatus 1000 or may be disposed separately from the apparatus 1000. The device 1500 may be a mobile phone or a personal computer. The at least one application may include, but not limited to, a web interface 1510 such as a web browser and/or a mobile app 1520.

[0098] It is to be appreciated that the number of the device 1500 is not limited to a particular number shown in figure 19. That is, a plurality of the device 1500 may be provided and different data from the plurality of device 1500 may be transmitted to the cloud server 1800.

[0099] A user, by operating the device 1500, can transmit data (first data) with regard to at least one state (internal state) of the apparatus 1000, to the cloud server 1800. The at least one state may include a location of the apparatus 1000, a current state of the apparatus 1000, and current consumption status, battery management data, hours of operation, error status, characteristics of working environment and fault-diagnostic information. The cloud server 1800 generates individual and machine specific digital personality clusters, based on at least one state from the device 1500.

[00100] The location of the apparatus 1000 may include, but not limited to, three-dimensional coordinates, a country where the apparatus 1000 is located, and a city where the apparatus 1000 is located. The current state of operation may include at least one state of the apparatus 1000 as stated above. In particular, the current state of operation may include at least one state shown in figure 9 and figure 10.

[00101] It is to be appreciated that data with regard to the apparatus 1000 can be transmitted to the cloud server 1800 by performing an identification, an authentication, an encryption, and decryption. In particular, in the case where data with regard to the apparatus 1000 is transmitted from the device 1500, authentication may be performed. During the authentication, the apparatus 1000 may generate a signal that is to be sent to the cloud server 1800 for an establishment of a full duplex communication. The signal is encrypted through a key generation processes and sent to a receiver end such as the base module 2001. Then at the receiver end, decryption of the signal is done and the two-way handshake is performed. On the event of successful two-way handshake process, the full duplex communication between the apparatus 1000 and cloud server 1800 is established.

[00102] In the case where the user chooses the state of the apparatus 1000, the data of the internal state may be transmitted to the cloud server 1800. The data to be transmitted may be selected by a user. It is to be appreciated that the device 1500 may be mounted on the apparatus 2000.

[00103] As shown in figure 19, the power supply module 1900 may comprise a fuse boards 1910, a voltage regulators 1920, and a power supply module 1930.

The power supply module 1900 may be used to supply the base module 2001, the scrub module 2100, the mopping module 2200, and the vacuum module 2300 with power.

[00104] The base module 2001 may be used to control the scrub module 2100, the mopping module 2200, and the vacuum module 2300 based on the data provided from the web interface 1510 and/or the mobile app 1520. The base module 2001 may be activated once power is provided from a power supply module 1900.

[00105] It is to be appreciated that solid lines shown in figure 19 and figures 14 to 16 may indicate a flow of a signal and dotted lines shown in figure 19 and figures 14 to 16 may indicate a flow of power from a power supply 2090.

[00106] Figure 19 further shows a mapping module 3000 that is in communication with the device 5000. The apparatus 1000 is designed to operate autonomously only in a pre-mapped area for safety reasons. Each location where the apparatus 1000 will be operating must therefore be initially mapped before the operation of the apparatus 1000. A mapping robot 3100, which may be remote controlled, may be initially driven around the location (e.g. a shopping mall or an office area) by a trained professional to thereby perform the mapping. The mapping robot 3100 can be driven slowly though all of the areas within the location that will be cleaned by the apparatus 1000. The person operating the mapping robot 3100 will in particular ensure that the map being created will cover most or all of the features of the location being mapped including, but not limited to, walls, pillars, furniture, stairs, doorways and so on. A resultant raw map can then be created which can be reviewed by the person controlling the mapping robot. That raw map can for example be displayed on a laptop placed on the mapping robot 3100. The person can then identify specific zones within the mapped area, such as the cleaning zones, danger zones, restricted zones and so on. The raw map generated by the mapping robot 3100 can then be converted into a post-processed map using a mapping editor 3200. That mapping editor 3200 allows the raw map to be annotated with the different zones within the location that has been mapped. The mapping editor can also allow for different cleaning behaviours in each specific zone to be defined. For example, in any zone marked as a danger zone, the speed

of the cleaning behaviour of the apparatus 1000 may be reduced when compared with the speed of the cleaning behaviour of the apparatus 1000 in zones marked as being cleaning zones.

5 **[00107]** The fully processed map can then be uploaded as a map file into the cloud server 1800 using the web interface 1510 of the device 1500. The map of a certain location is therefore stored in the cloud and can be tagged to a specific cleaning site or a contractor/building. The map can then be universally used by any apparatus 1000 having access to the map data. This feature of any apparatus 1000 being able to use the same map contributes towards the modular architecture. The user can for example use the web interface 1510 to tag each map to certain distributors, worksites, floors or sections. Once this information is logged on the web interface 1510, any authorized app user is able to get access to the control of an apparatus 1000 for the given map. The user access to specific apparatus 1000 can be controlled using the web interface 1510 by a user with administrative rights. 10 This requires the user to log-on to the mobile app 1520 using a username and password. This authenticates whether the user is authorized to use the specific apparatus 1000 at the particular jobsite/location. If authorization is successful, the user will be able to select the maps within the app 1520 and proceed with the autonomous cleaning at the jobsite/location.

20 **[00108]** Details configuration of the cloud server 1800 will be described as follows with reference to figure 20. Details configuration of the base module 2001 will be described as follows with reference to figure 21. The details configuration of the scrub module 2100 will be described as follows with reference to figure 22. The details configuration of the mopping module 2200 will be described as follows with reference to figure 23. The details configuration of the vacuum module 2300 will be described as follows with reference to figure 24. 25

[00109] Cloud server 1800

30 **[00110]** As shown in figure 20, the cloud server 1800 (backend server) may include a controller 1810, a database 1820, and a personality generator 1830. Map data 1840 can also be uploaded to and stored within the database 1820. The controller 1810 may transmit, to the personality generator 1830, data transmitted

from the device 1500, and data from the database 1820. It is to be appreciated that the controller 1810 may receive an apparatus such as at least one apparatus 1600. The at least one apparatus 1600 may be used, for a designated cleaning task the designated cleaning task may include at least one of scrubbing, mopping, vacuuming, window cleaning, table cleaning, garbage collecting, and arrangement of furniture for facilitating cleaning. Additionally or alternatively, the at least one apparatus 1600 may be used to interact /communicate with a user. As such, the personality generator 1830 may determine personality for the apparatus 2000 based on a plurality of inputs provided from a plurality of apparatus (i.e. the apparatus 1000 and the at least one apparatus 1600). The at least one apparatus 1600 may comprise at least one of a mop robot (not shown), a vacuum robot (not shown), a window cleaning robot (not shown), a garbage collecting robot (not shown), a scrubbing robot (not shown) and a cleaning assistant robot. The apparatus 1000 may be also used to interact /communicate with a user. When the designated cleaning task is relatively complex (e.g. to clean an entire office area), the different types of apparatus 1600 used in the cooperative cleaning system may work together to provide a holistic and more efficient machine cleaning solution. The cooperative cleaning system of the present disclosure is capable of a higher level of automation, and requirement of human involvement may be reduced.

[00111] The database 1820 may include dataset. Detailed dataset of the database 1820 will be described as follows with reference to figure 25. The personality generator 1830 may determine a personality (a control command) to be installed on the base module 2001 based on the data provided from the controller 1810. The cloud server 1800 may subsequently transmit data on the personality to the base module 2001.

[00112] The personality generator 1830 may be used to generate personality to be installed in the cloud server 1800. The personality generator 1830 may determine personality of the apparatus 1000 based on the state of the apparatus 1000, wherein the personality may include at least one voice type, at least one accent, and/or at least one language, and wherein the state may comprise location of the apparatus 1000, current state of operation of the apparatus 1000, and current consumption. The data generated in the personality generator 1830 may be

referred to as second data and may include at least one data selected from the database 1820 based on the first data. The cloud server 1800 may transmit the second data to the base module 2001 based on the first data. The determined data may include a movement state, and change in speed of a movement. The cloud server 1800 may be configured to be a remote server.

[00113] As such, the apparatus 2000 may change at least one state of the at least one part of the apparatus 2000. It is to be appreciated that the data generated in the personality generator 1830 can be transmitted to an apparatus other than the apparatus 2000, wherein the apparatus other than the apparatus 2000 may be the apparatus 1000 or the apparatus 1600.

[00114] Base module 2001

[00115] As shown in figure 21, the base module 2001 may comprise a sensor 2011, a switch 2012, an emergency system 2020, a sensor 2030, a sensor data processing 2040, a controller 2050, a traction controller 2060, a traction motor 2070, a personality controller 2080, a driver module 2091, a display module 2092, a speaker 2093.

[00116] The sensor 2011 may be a bumper sensor configured to detect that the base module 2001 is in contact with an object such as a wall, a chair, a sofa or the like. The switch 2012 may be an emergency switch configured to output an alert upon being pressed. The alert may include, but not limited to, message displayed on a display (not shown), voice, or a Light Emitting Diode (LED). The emergency system 2020 may receive the data from the sensor 2011 and the switch 2012 and transmit data to the sensor data processing 2040.

[00117] The perception sensor 2030 may be at least one of two dimensional distance measurement, three dimensional distance measurement, infrared distance sensor, ultra sound distance & obstacle sensor, and cliff detection sensor.

[00118] The sensor data processing 2040 may receive data from the perception sensor 2030 and the emergency system 2020, and transmit data to the controller 2050, based on data provided from the perception sensor 2030 and the emergency system 2020.

[00119] The controller 2050 may transmit data to the traction controller 2060 and the personality controller 2080 based on data transmitted from the cloud server 1800 and/or the sensor data processing 2040. The controller 2050 may control the scrub module 2100, the mopping module 2200, and the vacuum module 2300.

5 [00120] The traction controller 2060 may control the traction motor 2070 based on data provided from the controller 2050. The personality controller 2080 may transmit data to the driver module 2091, the display module 2092, and the speaker 2093 based on the data provided from the controller 2050 so that the base module 2001 can express the personality via, voice commands, body LED, eye expression,
10 etc.

[00121] The driver module 2091 may be controlled by the personality controller 2080 so that at least one of parts of the apparatus 1000 can be moved. The at least one of parts of the apparatus 1000 may include, but not limited to, a head, a hand, and a leg of the apparatus 1000. An exemplary movement of the apparatus 1000
15 may include, but not limited to, left turn and right turn, in relation to a traveling direction of the apparatus 1000. An example of the movement of the apparatus 1000 may include, but not limited to, stop and slow down of current speed of a movement. The display module 2092 may include, but not limited to, a LED, a display configured to display at least one character and/or at least one image. The
20 speaker 2093 may include a speaker to output voice commands from the base module 2001.

[00122] The sensor 2030, the traction motor 2070, the driver module 2091, the display module 2092, and the speaker 2093 may drive once the power from the power supply module 1900 is supplied. It is to be appreciated that the base module
25 2001, the scrub module 2100, the mopping module 2200, and the vacuum module 2300 may be included in the apparatus 1000.

The scrub module 2100

[00123] As shown in figure 22, the scrub module 2100 may be used to scrub an object such as the module 110, the surface 1100 or other object, and may comprise
30 a float switch 2110, a float switch 2120, a level sensor 2130, a tank controller 2140,

a controller 2150, a pump 2160, an actuator 2170, a brush 2180, and a vacuum motor 2190.

5 **[00124]** Each of the float switch 2110, the float switch 2120, and the level sensor 2130 may be used to detect a level of liquid such as water in the tank. The tank controller 2140 may determine a current level of the tank based on at least one of the float switch 2110, the float switch 2120, and level sensor 2130. The tank controller 2140 may determine amount of liquid to be added to the tank based on current level of the tank. The tank controller 2140 may transmit data to the controller 2150 based on the data provided from the tank controller 2140. The data
10 provided from the tank controller 2140 may include, but not limited to, amount of liquid to be added, and current level of liquid in the tank.

[00125] It is to be appreciated that the tank controller 2140 may be provided in at least one of the float switch 2110, the float switch 2120, and level sensor 2130 so that the at least one of the float switch 2110, the float switch 2120, and level sensor
15 2130 can control a level of the tank directly and transmit the data to the controller 2150 directly.

[00126] The controller 2150 may control the pump 2160, the actuator 2370, the brush 2180, and the vacuum motor 2380 based on data provided from the base module 2001 and the tank controller 2140.

20 Mopping module 2200

[00127] As shown in figure 23, the mopping module 2200 may be used to mop an object such as the module 110, the surface 1100 or other object, and may comprise a float switch 2210, a float switch 2220, a level sensor 2230, a tank controller 2240, a controller 2250, a pump 2260, an actuator 2270, and a mop
25 2280.

[00128] It is appreciated that the float switch 2210, the float switch 2220, the level sensor 2230, and the tank controller 2240 shown in figure 23 may be same as the float switch 2110, the float switch 2120, the level sensor 2130, and the tank controller 2140 shown in figure 22.

[00129] The controller 2250 may control the pump 2260, the actuator 2270, and the brush 2180 based on data provided from the base module 2001 and the tank controller 2240. The mop 2280 may be controlled so that the apparatus 1000 wipes the surface 1100 and/or wipes the module 110.

5 Vacuum module 2300

[00130] As shown in figure 24, the vacuum module 2300 may be used to vacuum dust or impurities on the module 110 or to vacuum dust or impurities on the surface 1100 or at least one object, and may comprise a controller 2350, a brush motor 2360, an actuator 2370, and a vacuum motor 2380.

10 **[00131]** The controller 2350 may control the brush motor 2360, the actuator 2370, and the vacuum motor 2380 based on data provided from the base module 2001. The vacuum motor 2380 may be controlled so that the apparatus 1000 vacuum dust or impurities on the surface 1100 and/or vacuum dust or impurities on the module 110.

15 Database 1820

[00132] As shown in figure 25, the database 1820 may include dataset including (1) Personality data, (2) User Defined Personality data, (3) Personification data, (4) Geographical Personality data, (5) Seasonal Greetings data, and (6) State Expressive Personality data.

20 **[00133]** (1) The personality data may include emotion variable data, personification variable data, seasonal variable data, and geographical variable data. The personality data may be connected to global robot ID data. The global robot ID data may include information on name data, Personality ID data, Family data, Model data, and Version data. The emotion variable data may include at least
25 one emotion such as direct laughing, crying, cheering, screaming, and/or singing.

[00134] (2) User defined Personality data may include at least one message and at least one greeting pattern. This allows a user to define the at least one message spoken by the apparatus 1000. Thereby, the user may have the flexibility of defining the behavior of the apparatus 1000 even for announcements or other

specific events. For example, the apparatus 1000 which downloaded the data can be customized to announce special offers and services in a shopping center.

[00135] (3) Personification data: The data may include at least specific personality node, wherein each of the specific personality node is coined based on a characterizable feature. As such, each of personality modules may have a character. This in turn enables the user to have a variety of options while choosing a specific personality module for the apparatus 1000. The characterization of the modules is devised using a voice tone, eye expressions, a body color and a gender. For example, in an environment that is kids/children centric, the personality module can be chosen to be a cartoon character.

[00136] (4) Geographical Personality data: The data may include, but not limited to, a way of greeting, expression, interaction and social behavior for each region. The apparatus 1000 which downloaded the data may behave in accordance with a region where the apparatus 1000 is located. For example, the apparatus 1000 located in a particular country such as Singapore, the apparatus 1000 may have common features and have personality modules in accordance with the particular country.

[00137] (5) Seasonal greetings data: The data may include information with regard to a behavior such as singing and sharing some short information in accordance with at least one festival and at least one highlighting event of a particular season, regarding the event/festival. For example, during December, the apparatus 1000 which downloaded the data may autonomously wish or greet people and sing at least one Christmas song.

[00138] (6) State expressive personality data: The data may include a state of action via voice overs and body indicators. This is mainly to indicate the actions that are being performed by the apparatus 1000 in a human centric environment. This in turn allows the apparatus 1000 to work in harmony in the real time dynamic environment.

[00139] Apparatus (the apparatus 1000 and the at least one apparatus 1600) and the corresponding users' activities may be constantly recorded and uploaded to the cloud server to allow further processing. User historical information such as

performance of each cleaning operation, emergency record and cleaner operation command can be tracked. The database 1820 may include a dynamic database (not shown), a core database (not shown), and a file storage server (not shown). The core database may be configured to retrieve and process user historical information, and the file storage sever may be used to store system-related information including the user historical information. In this manner, the user historical information can be traced via a unique user ID. This provides the advantages of cultivating sense of accountability and responsibility in users (who may be cleaners performing a cleaning task) on how they should interact with robots they are assigned to.

Advantageous effect

[00140] According to the present disclosure, while the apparatus 1000 moves along the direction X1, one of the first part 111 and the second part 112 is in contact with the surface 1100 and the cleaning module 600 cleans the other of the first part 111 and the second part 112. As such, the apparatus 1000 can clean the surface 1100 and clean one of the first part 111 and the second part 112 simultaneously.

[00141] According to the present disclosure, the controller 150 may control the first height adjustment member 211 and the second height adjustment member 212 so that the first height adjustment member 211 and the second height adjustment member 212 are positioned at a different heights.

[00142] According to the present disclosure, while the apparatus 1000 moves along the first direction, the cleaning module 600 can clean the module 110. As such, there is no need to clean the module 110 manually, thus can prevent at least part of a body of the user from being dirty because of dust or impurities attached to the module 110.

[00143] According to the present disclosure, the first part 111 and the second part 112 are removable from the apparatus 1000. As such, the apparatus 1000 can be stored in a smaller space after use.

[00144] According to the present disclosure, in the case where the cleaning module 600 cleans the second part 112 and thereafter the second part 112 commences cleaning the surface 1100, the first part 111 moves to the default state 111S after the second part 112 is lowered to the height Z2. As such, the
5 procedures of S210 and S220 help to ensure that the apparatus 1000 does not leave dust or impurities during a transition from a step to clean the surface 1100 by the first part 111 to a step to clean the surface 1100 by the second part 112.

[00145] According to the present disclosure, the actuator 800 can move the cleaning module 600 toward along the directions Y1, and Y2. As such, the cleaning
10 module 600 can clean the second part 112 throughout a longitudinal direction of the second part 112. In particular, the cleaning module 600 can clean the second part 112 in the range of the left end 112L to the right end 112R.

[00146] According to the present disclosure, the personality generator 2900 may determine personality of the apparatus 1000 based on a state of the apparatus
15 1000, wherein the state may comprise location of the apparatus 1000, current state of operation of the apparatus 1000, and current consumption.

[00147] According to the present disclosure, the data stored in the cloud server 1800 may update based on data provided from at least one apparatus. As such, an apparatus other than the at least one apparatus can download updated personality
20 from the cloud server 1800 and change a personality thereof based on the downloaded updated personality.

[00148] According to the present disclosure, the at least one rubber is mounted to the cartridge 360 without any fasteners, the complexity involved in the replacement of squeegee blades in comparison with other machines may be
25 reduced.

[00149] According to the present disclosure, the first blade 312 and the second blade 313 may be attached to the body 311 using a tab (e.g. the protruding member 311a and the protruding member 311b) and a slot (e.g. the at least one opening 312a and the at least one opening 313b) without using any fasteners. This
30 allows the user to change the protruding member 311a and the protruding member 311b easily without any extra effort.

[00150] According to the present disclosure, the first blade 312 and the second blade 313 are suspended under a compressed spring (the springs 348a and 348b). This in turn allows the unit 300 to be in constant contact with a surface. Hence the cleaning performance can be facilitated.

5 [00151] According to the present disclosure, the squeegee mechanism is connected to the motor 344 where it is being coupled with self-lubricating lead screw and nut to engage and retract the whole swivelling squeegee assembly. This allows the user to move the entire squeegee mechanism precisely to the desired location to get the positive cleaning result.

10 [00152] According to the present disclosure, the spherical ball bearing 343 is with linear guide. This can facilitate self-adjustments, provided any misalignments.

Possible variants

[00153] The present disclosure can be applied for cleaning or other purpose such as entertainment, social companionship, education and training, and customer
15 service applications.

[00154] It is to be appreciated that the present disclosure may be applied to online gaming, swarm robotics, or the like.

[00155] It is to be appreciated that at least one of the present disclosure (e.g. the controller 150, the controller 1810, the controller 2050, the traction controller 2060,
20 personality controller 2080, the tank controller 2140, the controller 2150, the tank controller 2240, the controller 2250, and/or the controller 2350) is configured with a hardware by way of example, but the disclosure may also be provided by software in concert with hardware.

[00156] In addition, the functional blocks (not shown) used for the hardware are
25 typically implemented as LSI devices, which are integrated circuits. The functional blocks may be formed as individual chips, or a part or all of the functional blocks may be integrated into a single chip.

[00157] It is to be appreciated by the person skilled in the art that variations and combinations of features described above, not being alternatives or substitutes,

may be combined to form yet further embodiments falling within the intended scope of the disclosure.

[00158] Notes

5 **[00159]** According to one aspect of the disclosure, a cleaning apparatus comprises at least one module configured to clean a surface, one of the at least one module comprising a first part and a second part and comprises a cleaning module configured to clean the second part simultaneously when the first part is operated to clean the surface.

10 **[00160]** In some embodiments, the cleaning apparatus comprises a plurality of height adjustment members comprising a first height adjustment member and a second height adjustment member, each of the plurality of height adjustment members configured to adjust height of corresponding part of the member; and a controller configured to control at least one of the plurality of height adjustment members, wherein the controller is configured to control the first height adjustment member to adjust height of the first part, and wherein controller is configured to control the second height adjustment member to adjust height of the second part.

20 **[00161]** In some embodiments, each of the plurality of height adjustment members is configured to adjust height of corresponding module of the plurality of modules in the range of a first height to a second height, wherein the first height is height of the surface and the second height is height above height of the cleaning module.

25 **[00162]** In some embodiments, one of the first part and the second part is disposed along the first direction in relation to the cleaning module, and wherein the other of the first part and the second part in a direction opposite to the first direction in relation to the cleaning module.

[00163] In some embodiments, the second part is in contact with the surface after the cleaning module cleans the second part, and wherein the first part moves to a determined height above the first height after the second part is in contact with the surface.

[00164] In some embodiments, the cleaning apparatus further comprises a tray for collecting dust or impurities, wherein the tray is disposed below the cleaning module while the cleaning module cleans the second part.

5 [00165] In some embodiments, the cleaning module comprises at least one brush configured to scrub the second part, wherein the controller is configured to determine rotation speed of the at least one brush.

[00166] In some embodiments, the cleaning module comprises at least one tank configured to contain liquid.

10 [00167] In some embodiments, the cleaning module comprises at least one pump nozzle configured to direct liquid from the tank of the at least one tank toward the second part, wherein the controller is configured to determine an amount of the liquid.

[00168] In some embodiments, the liquid includes water or includes a mixture of water and detergent.

15 [00169] In some embodiments, at least one of the first part and the second part comprises a head and a fabric detachably secured to the head, and wherein while the apparatus moves along the first direction, the fabric is in contact with the surface and the cleaning module cleans the second part.

20 [00170] In some embodiments, one of the first part and the second part is configured to have a first engaging means and the other of the first part and the second part is configured to have a second engaging means.

[00171] In some embodiments the first engaging means is an opening and the second engaging means is a protruding member to be inserted to the opening.

25 [00172] In some embodiments, a protruding direction of the protruding member is an orthogonal to the first direction.

[00173] In some embodiments, a cleaning apparatus comprising a plurality of modules comprising a first part and a second part, the plurality of modules configured to clean a surface on which the apparatus moves and comprising a

cleaning module configured to clean at least one of the plurality of modules, wherein while the apparatus moves along a first direction, the first part is in contact with the surface and the cleaning module cleans the second part.

[00174] In some embodiments, a system comprising an apparatus configured to transmit data on at least one state of the apparatus and comprising a server configured to store database on at least one control command for the apparatus, wherein the server is configured to receive the data from the apparatus and to transmit, based on the stored database and the received data from the apparatus, data on one or more control command of the at least one control command, and wherein the apparatus is configured to receive the data transmitted from the server and to change at least one state of at least one part of the apparatus based on the received data from the server.

[00175] In some embodiments, a system comprising a cleaning apparatus configured to transmit data on condition of the apparatus and comprising at least one cleaning module and comprising a server configured to store database on at least one control command for the apparatus, wherein the server is configured to receive the data from the apparatus and to transmit, based on the stored database and the received data from the apparatus, data on one or more control command of the at least one control command, and wherein the apparatus is configured to receive the data transmitted from the server and to control at least one part of the at least one cleaning module based on the received data from the server.

[00176] As would be understood by a person skilled in the art, each embodiment, may be used in combination with other embodiment or several embodiments.

Reference numerals

- 10 : body
- 20 : input module
- 30 : first detect sensor
- 40 : second detect sensor
- 50 : switch
- 110 : module
- 111 : first part

111A, 112A : first surface
 111B, 112B : second surface
 111S, 112S, 600S : default state
 112 : second part
 5 112L : left end
 112R : right end
 113 : engaging means
 113a : protruding part
 150 : controller
 10 210 : height adjustment member
 211 : first height adjustment member
 212 : second height adjustment member
 213 : engaging means
 213a : opening
 15 300 : unit
 311 : body
 311a, 311b : first protruding member
 312 : front blade
 312a, 313b : opening
 20 313 : second blade
 325 : bearing
 326 : bearing holder
 327 : spring holder
 328, 329 : adhesion means
 25 331 : fastener
 332 : squeegee holder
 333 : connecting part (squeegee trap)
 337 : wheel
 341 : guiding unit (second member)
 30 342 : linear Guiding Shaft
 343 : ball bearing
 344 : motor (permanent magnet motor)
 345 : rotary latch
 346 : lead screw nut
 35 347 : hook spring post
 348a, 348b : spring
 349 : assembly
 350 : hose
 351 : spring
 40 360 : cartridge (first member)
 360A : outer skin
 600 : module (cleaning module)
 650 : tray

660 : brush
670 : pump nozzle
671 : first pump nozzle
672 : second pump nozzle
5 673 : third pump nozzle
681 : first squeezing part
682 : second squeezing part
700 : motor
711 : pump nozzle
10 800 : actuator
850 : motor
901, 902 : wheel
1000 : apparatus
1100 : surface
15 1500 : device
1510 : web interface
1520 : mobile app
1600 : apparatus
1800 : cloud server
20 1810 : controller
1820 : database
1830 : personality generator
1840 : maps
1900 : power supply module
25 1910 : fuse boards
1920 : voltage regulators
1930 : power supply
2000 : apparatus
2001 : base module
30 2011 : sensor
2012 : switch
2020 : emergency system
2030 : sensor
2040 : sensor data processing
35 2050 : controller
2060 : traction controller
2070 : traction motor
2080 : personality controller
2090 : power supply module
40 2091 : driver module
2092 : display module
2093 : speaker
2100 : scrub module

2110 : float switch
 2120 : float switch
 2130 : level sensor
 2140 : tank controller
 5 2150 : controller
 2160 : pump
 2170 : actuator
 2180 : brush
 2190 : vacuum motor
 10 2200 : mopping module
 2210 : float switch
 2220 : float switch
 2230 : level sensor
 2240 : tank controller
 15 2250 : controller
 2260 : pump
 2270 : actuator
 2280 : mop
 2300 : vacuum module
 20 2350 : controller
 2360 : brush motor
 2370 : actuator
 2380 : vacuum motor
 2900 : personality generator
 25 3000 : mapping module
 3100 : mapping robot
 3200 : map editor
 X1, X2, Y1, Y2 : direction
 Z0, Z1, Z2 : height
 30

CLAIMS

1. A system for controlling a cleaning apparatus, the system comprising:

a transmitter configured to transmit a first data to a server, the server arranged in data communication with a database, the server having a personality generator for determining a personality for the cleaning apparatus;

a receiver configured to receive a second data from the server, the second data for interacting with a user or for effecting a cleaning operation and personality of the cleaning apparatus, the second data determined based on the first data and the database; and

a controller configured to control at least one part of the cleaning apparatus to change at least one state of the at least one part of the cleaning apparatus, based on the received second data;

wherein the database includes at least one of personality data, user defined personality data, personification data, geographical personality data, seasonal greetings data, and state expressive personality data, and wherein the second data includes at least one data selected from the database based on the first data.

2. The system according to claim 1, wherein the at least one state of the at least one part of the cleaning apparatus includes a movement state, change in speed of a movement.

3. The system according to claim 1 or 2, wherein the controller is configured to control the at least one part to perform one or more of the following cleaning actions: sweeping, vacuuming, scrubbing, mopping, window cleaning, table cleaning garbage collecting, arrangement of furniture for facilitating cleaning.

4. The system according to any one of the preceding claims, wherein the first data includes a current movement state of the apparatus, geographic information of the apparatus, battery management information of the apparatus, hours of operation of the apparatus, error status of the apparatus.

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5. The system according to any one of the preceding claims, comprising:

the cleaning apparatus being arranged in data communication with the server, wherein the server is a remote server.

10 6. The system according to any one of the preceding claims, wherein the database includes map data of one or more locations for controlling the movement of the cleaning apparatus within said location(s).

15 7. The system of claim 6 wherein the map data further includes preset zones dictating the operation of the cleaning apparatus within the location(s).

8. The system of claim 6 or 7, wherein the map data can be access by one or more said cleaning apparatus.

20 9. The system of any one of the preceding claims, wherein the personality data includes emotion variable data, personification variable data, seasonal variable data and geographical variable data.

25 10. The system of any one of the preceding claims, wherein the user defined personality data includes at least one of a message and greeting pattern.

11. The system of any one of the preceding claims, wherein the personification data includes at least one specific personality node, wherein the specific personality mode is based on a characterizable feature.

5 12. The system of claim 11, wherein the characterizable feature includes at least one of a voice tone, eye expression, body color or gender.

13. The system of any one of the preceding claims, wherein the geographical personality data includes at least one of a way of greeting, expression, interaction
10 and social behavior based on region.

14. The system of any one of the preceding claims, wherein the seasonal greetings data includes information with regard to a behavior including at least one of singing and sharing information in accordance with a seasonal event.

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15. The system of any one of the preceding claims, wherein the state expressive personality data includes a state of action via at least one of voice overs and body indicators.