

SQUEEGEE UNIT FOR A CLEANING APPARATUS

FIELD OF THE INVENTION

5 **[0001]** The present disclosure generally relates to a cleaning apparatus and In particular to a squeegee unit for such an apparatus.

BACKGROUND ART

10 **[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 knowledge of the person skilled in the art in any jurisdiction as at the priority date of the disclosure.

15 **[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, 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.

20 **[0004]** Some cleaning apparatus also comprise a squeegee assembly for capturing dirty water left on the floor surface following the cleaning process by the mop. Such squeegee assemblies are mounted to the rear of the cleaning apparatus and rotate around a pivot point when capturing the dirty water. The problem associated with this rear mounting of the squeegee assembly is that the wheels of the cleaning apparatus can get wet during the cleaning process reducing the traction of those wheels.

25 **[0005]** Furthermore, as conventional squeegee assemblies are designed to pivot around a single point this can require the squeegee assembly to be relatively long to work properly. This can result in the squeegee assembly extending beyond the

outer boundary of the cleaning apparatus to which the squeegee apparatus has been installed. In a manually operated cleaning apparatus, the operator can ensure that the squeegee assembly, when protruding from the cleaning apparatus, will not collide with or become caught on obstacle such as furniture legs, low kerbs and so on. However, such a squeegee assembly cannot be safely used on an autonomous cleaning apparatus.

SUMMARY

[0006] The present disclosure seeks to address and/or ameliorate one or more of the problems in the prior art by providing a squeegee unit for a cleaning apparatus.

10 **[0007]** 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'.

[0008] 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.

[0009] According to one aspect of the present disclosure, there is provided a squeegee unit for a cleaning apparatus comprising: a squeegee cartridge supporting one or more squeegee blades; and support means for supporting the squeegee cartridge for movement along a pre-defined arcuate path over a floor surface.

[0010] In some embodiments, the support means may support the squeegee cartridge for a left or right swinging motion when the cleaning apparatus is turning.

25 **[0011]** In some embodiments, the support means may comprise one or more guide units having at least one roller bearing for guiding the squeegee cartridge along the arcuate path.

[0012] In some embodiments, the or each guide unit may further include one or more low friction surfaces to facilitate sliding of the squeegee cartridge.

[0013] In some embodiments, the squeegee unit may further comprise a suspension system for supporting the squeegee cartridge.

[0014] In some embodiments, the suspension system may comprise a spring arrangement engaging the or each guide unit.

5 **[0015]** In some embodiments, the suspension system may further comprise elevation means for raising and lowering the squeegee cartridge away from or towards the floor surface during operation of the cleaning apparatus

[0016] In some embodiments, the suspension system may maintain the one or more squeegee blades at an angle of about 45 degrees relative to the floor surface
10 during operation thereof.

[0017] In some embodiments, the one or more squeegee blades may be supported on the squeegee cartridge to form an arcuate shape.

[0018] In some embodiments, the one or more squeegee blades may be releasably secured to the squeegee cartridge.

15 **[0019]** In some embodiments, the one or squeegee blades may be releasably attached to the squeegee cartridge using a tab and cooperating slot arrangement.

[0020] In some embodiments, the or each squeegee blade may be formed from rubber.

[0021] In some embodiments, the squeegee cartridge may comprise a
20 wastewater tank for receiving water collected by the one or more squeegee blades.

[0022] In some embodiments, the one or more squeegee blades may comprise one or more perforations to allow the water to be sucked into the wastewater tank.

[0023] According to another aspect of the present invention, there is provided a cleaning apparatus comprising a squeegee unit as described above.

25 **[0024]** Other aspects and features will become apparent to those of ordinary skill in the art upon review of the following description of specific embodiments in conjunction with the accompanying figures.

BRIEF DESCRIPTION OF THE DRAWINGS

[0025] Various embodiments are described, by way of example only, with reference to the accompanying drawings, in which:

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

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
10 embodiments of the present disclosure.

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

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

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

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
20 disclosure.

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

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

- 25 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 squeegee unit 300 according to some embodiments of the present disclosure.

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

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

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

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

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

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

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

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

- 20 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.

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

- 25 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.

DETAILED DESCRIPTION

[0026] The present disclosure may be suited for a cleaning apparatus, a system.

5 **[0027]** 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.

[0028] Apparatus 1000

[0029] As shown in figures 1 to 6, the apparatus 1000 may comprise a first part
10 111 (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 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
15 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.

[0030] As shown in figure 1 (figure 1A and 1B), the surface 1100 may be a 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
20 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.

[0031] The apparatus 1000 may further comprise a first height adjustment member 211 and a second height adjustment member 212. The apparatus 1000
25 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.

[0032] 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.

5 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

10 the direction X1 shown by an arrow in figure 1.

[0033] The module 110

[0034] 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

15 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

20 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.

[0035] 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

25 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

30 the surface 1100.

5 [0036] 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.

10 [0037] 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).

15 [0038] 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
20 the surface 1100 along the direction X1.

[0039] Height adjustment member 210

25 [0040] 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
30 perpendicular in relation to a traveling direction of the apparatus 1000.

5 [0041] 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.

10 [0042] 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.

[0043] Cleaning module 600

15 [0044] 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.

25 [0045] 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.

5 **[0046]** 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. 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.

10 **[0047]** 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 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
10 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 **[0048]** 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 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
20 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 leaves the pad damp. The second squeezing part 682 is configured to act as a squeezing mechanism to squeeze away the dirty water.

25 **[0049]** 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 contain liquid such as water rebounded from the module 110.

[0050] Motor 700

30 **[0051]** 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.

[0052] Horizontal actuator 800

[0053] 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
5 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.

[0054] Motor 850

[0055] As shown in figure 1, the motor 850 may be provided in the apparatus
10 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.

[0056] Wheel 900

[0057] The wheel 901 and the wheel 902 may be used to move the apparatus
15 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 and/or the dimension.

[0058] An exemplary movement of the apparatus 1000

[0059] An exemplary movement of the apparatus 1000 will be described with
20 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 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
25 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.

[0060] 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.

5 **[0061]** 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
10 height Z0.

[0062] 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.
15 The tray 650 at the default state 600S may be spaced a determined distance away from the surface 1100.

[0063] 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
20 Z1 as shown in figure 10A.

[0064] 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
25 rotation angle of the cleaning module 600 is not limited to 90 degrees.

[0065] 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.

[0066] 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 clean the second part 112.

5 **[0067]** 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 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
10 figure 10C.

[0068] 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 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
15 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.

[0069] At S150, the controller 150 may control the cleaning module 600 so that the cleaning module 600 is turned on. At S160, the controller 150 may control the
20 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 module 600 returns to the default state 600S.

[0070] 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
25 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 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).

30 **[0071]** 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.

[0072] 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 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.

[0073] 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 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.

[0074] 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 cleaning module 600 so that the cleaning module 600 returns to the default state 600S.

[0075] 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 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 **[0076]** 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 **[0077]** 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.

15 **[0078]** 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).

25 **[0079]** 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.

[0080] Configuration of the apparatus 1000

[0081] 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.

[0082] 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.

[0083] 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).

[0084] 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.

5 **[0085]** 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.

10 **[0086]** 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.

15 **[0087]** 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 squeegee 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.

20 **[0088]** The squeegee unit 300

[0089] Figure 12 illustrates an example of a squeegee unit 300 for capturing dirty water left by the cleaning module 110 on the floor surface according to some embodiments of the present disclosure. The squeegee unit 300 may be located between the wheels 902 and the cleaning module 110 of the cleaning apparatus
25 1000 to thereby minimize the wheels 902 getting wet which can reduce the traction of those wheels. The squeegee unit 300 may be made of a number of subassemblies as will be subsequently described. This allows the squeegee unit 300 to operate within the constrained space between the wheels 902 and cleaning module 110. As shown in figure 12 (figure 12A and figure 12B, the squeegee unit
30 300 may comprise a plurality of guiding units 341 and a cartridge (squeegee) 360. The squeegee 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. Sliding movement of the squeegee cartridge 360 along a pre-defined arcuate path may be guided by a set of ball bearings provided within each guiding units 341. Such movement may include sliding or swinging along the pre-defined arcuate path. 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 squeegee unit 300 may further comprise one or more linear guiding shafts 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 motor support bracket 340, a rotary latch 345, a lead screw nut 346, a spring post 347, a spring (a hook spring) 348a and b, 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.

[0090] 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 squeegee cartridge 360 will allow the squeegee unit 300 to absorb water and dries a surface. During a movement of the squeegee unit 300, when the cleaning apparatus in the form of a robot turns towards a left or right direction, the squeegee cartridge 360 may swivel out along the pre-defined arcuate path to collect/absorb liquid such as water around corners. When the squeegee cartridge 360 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 squeegee unit 300 takes a straight path after squeegee unit 300 turns left or turns right, the squeegee cartridge 360 will swivel back to its home position. The above-mentioned sequence can be performed repeatedly until the squeegee unit 300 complete its whole cleaning path.

[0091] The up-down mechanism may be initiated after the squeegee 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 squeegee cartridge 360 reaches its end destination, the whole mechanism of the squeegee cartridge 360 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 squeegee cartridge 360 is off from the ground the hook springs 348a and 348b pull back the squeegee to its original position.

[0092] 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 squeegee cartridge 360 may be secured with a rotary latch 345 (figure 12A).

[0093] 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 squeegee cartridge 360 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 squeegee 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 surfaces of the adhesion means 328, 329 has a very low frictional coefficient, enabling the squeegee cartridge 360 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.

[0094] 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 squeegee 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. The first and second squeegee blades 312,313 may be made of rubber, although the use of alternative resilient materials is also envisaged.

[0095] 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 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, 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 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 squeegee

unit 300 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.

[0096] During movement of the cleaning apparatus 1000, the squeegee unit 300 may be automatically tilted such that the blades 312, 313 are tilted to a 45-degree angle relative to the floor surface. This 45-degree tilt will allow the squeegee unit 300 to suck up any pools of water located on the floor surface as well as facilitating drying of the floor. Conventional squeegees will by comparison need to be manually adjusted if they are to achieve a similar tilt angle.

[0097] Figure 17 illustrates an example of a squeegee unit 300 according to some embodiments of the present disclosure. In the case where the squeegee unit 300 moves forward, the squeegee unit 300 may be configured as shown in figure 17A. In the case where the squeegee unit 300 as shown in figure 17A turns right, this movement of the squeegee unit 300 may cause the spring 348a displaced at a first determined degree as shown in figure 17 B. In the case where the squeegee as shown in figure 17A takes left turn, this movement of the squeegee 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 squeegee unit 300 as shown in figure 17B or figure 17C changes the state shown in figure 17A.

[0098] Figure 18 illustrates an example of a movement of a squeegee 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 squeegee unit 300. In the figure 18, it is assumed that the squeegee 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 squeegee unit 300 may move straight when the squeegee unit 300 follows a straight path, and subsequently the squeegee cartridge 360 may swing out in a pre-defined arcuate path when the squeegee 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 squeegee

unit 300 turns right at the step S3 and the step S4, the squeegee cartridge 360 may retract back to its home position when the squeegee 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
5 that an example of moving forward and turning right for the squeegee unit 300 has been described with reference to figure 18, the squeegee unit 300 may turn left after step S1, S2, S5, or S6 so that the spring 348b is displaced shown in figure 17C

[0099] The squeegee unit 300 according to the present disclosure has a number
10 of advantages when compared with conventional squeegee assemblies:

[00100] a) The unit 300 can be installed between the cleaning module 110 and wheels of the cleaning apparatus 1000 so that wetting of the wheels 902 is minimized;

[00101] b) The unit 300 can remain within the outer boundary of
15 the cleaning apparatus 1000 as it moves straight, and may only slide out of the outer boundary when the cleaning apparatus turns left or right;

[00102] c) The squeegee cartridge 360 of the unit 300 may slide along a pre-defined arcuate path during a turn of the cleaning apparatus 1000. This allows the turning behavior of the squeegee cartridge 360 to be predicted by
20 knowing the turning speed and radius of the cleaning apparatus 1000;

[00103] d) The sliding motion of the squeegee cartridge 360 may be guided by two sets of ball bearings. The two sets of bearing help to handle the axial and thrust loads when the squeegee cartridge 360 is pressed against the floor surface. Current squeegee mechanisms are pressed against the floor at the centre
25 and causes water leaks at the sides. The squeegee cartridge 360 according to the present disclosure may have three points of contact: on the left, right and centre. This ensures even force distribution against the floor surface and thus no occurrence of water leaks.

[00104] e) Conventional squeegee assemblies are mounted using Thumb
30 screws. Taking them out for maintenance can be difficult once the dirty water dries

up and leaves sediments at the screw thread. In the unit 300 according to the present disclosure, fixing and removing the squeegee cartridge 360 can be performed easily by sliding the cartridge in, without disturbing the outer skin of the cleaning apparatus 1000. The squeegee cartridge 360 may be fixed by two simple steps;

- i) The entire squeegee cartridge 360 slides out following the guide units 341.
- ii) Then, the squeegee cartridge 360 is then secured with the rotary latch 345.

[00105] f) Conventional cleaning machines use multiple connectors and fasteners to keep the squeegee rubber blades in place. Whereas, in the unit 300, squeegee blades 312,313 can be mounted on the cartridge 360 to facilitate the easy replacement of the squeegee blades. Since, squeegee blades are mounted to the cartridge 360 without any fasteners, the complexity involved in the replacement of squeegee blades in comparison with other machines will be drastically reduced.

[00106] g) The whole squeegee cartridge 360 may be suspended under compressed springs 351. This in turn allows the squeegee cartridge 360 to be in constant contact with the floor surface, Hence the cleaning performance may be maximized.

[00107] h) The squeegee cartridge 360 can be lowered and retracted by the means of a DC motor 344 coupled with a leadscrew. When the motor is rotated, the leadscrew nut moves up/down along the leadscrew resulting in the squeegee cartridge 360 moving vertically.

[00108] An example of communication via a cloud server 1800

[00109] 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.

5 **[00110]** 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.

10 **[00111]** 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.

15 **[00112]** 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.

20 **[00113]** 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
25 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,
30 the full duplex communication between the apparatus 1000 and cloud server 1800 is established.

[00114] 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.

5 **[00115]** As shown in figure 12, 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.

10 **[00116]** 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.

15 **[00117]** 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.

[00118] Details configuration of the cloud server 1800 will be described as follows with reference to figure 20. Details configuration of the base module 2001
20 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 **[00119]** Cloud server 1800

[00120] As shown in figure 20, the cloud server 1800 (backend server) may include a controller 1810, a database 1820, and a personality generator 1830. 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
30 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
5 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
10 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
15 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.

[00121] The database 1820 may include dataset. Detailed dataset of the database 1820 will be described as follows with reference to figure 25. The
20 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.

[00122] The personality generator 1830 may be used to generate personality to
25 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
30 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.

- 5 **[00123]** 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.

[00124] Base module 2001

- 10 **[00125]** 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.

- 15 **[00126]** 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
20 system 2020 may receive the data from the sensor 2011 and the switch 2012 and transmit data to the sensor data processing 2040.

[00127] 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.

- 25 **[00128]** 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.

[00129] 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 **[00130]** 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.

[00131] 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.

[00132] 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

[00133] 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 **[00134]** 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.

[00135] 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.

[00136] 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

[00137] 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.

[00138] 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.

[00139] 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

[00140] 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 **[00141]** 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

[00142] 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 **[00143]** (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.

[00144] (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.

[00145] (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.

[00146] (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.

[00147] (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.

[00148] (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.

[00149] 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
5 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
10 robots they are assigned to.

Advantageous effect

[00150] 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
15 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.

[00151] According to the present disclosure, the controller 150 may control the first height adjustment member 211 and the second height adjustment member 212
20 so that the first height adjustment member 211 and the second height adjustment member 212 are positioned at a different heights.

[00152] 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
25 part of a body of the user from being dirty because of dust or impurities attached to the module 110.

[00153] 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.

5 [00154] 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 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.

10 [00155] 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 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.

15 [00156] According to the present disclosure, the personality generator 2900 may determine personality of the apparatus 1000 based on a state of the apparatus 1000, wherein the state may comprise location of the apparatus 1000, current state of operation of the apparatus 1000, and current consumption.

20 [00157] 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 from the cloud server 1800 and change a personality thereof based on the downloaded updated personality.

25 [00158] 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 reduced.

30 [00159] 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 allows the user to change the protruding member 311a and the protruding member 311b easily without any extra effort.

[00160] According to the present disclosure, the first blade 312 and the second blade 313 are suspended under a compressed spring (the springs 351). This in turn allows the squeegee unit 300 to be in constant contact with a surface. Hence the cleaning performance can be facilitated.

5 **[00161]** 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 **[00162]** According to the present disclosure, the spherical ball bearing 343 is with linear guide. This can facilitate self-adjustments, provided any misalignments.

Possible variants

[00163] The present disclosure can be applied for cleaning or other purpose such as entertainment, social companionship, education and training, and customer
15 service applications.

[00164] It is to be appreciated that the present disclosure may be applied to online gaming, swarm robotics, or the like.

[00165] 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.

[00166] 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.

[00167] 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.

Reference numerals

- 5 10 : body
- 20 : input module
- 30 : first detect sensor
- 40 : second detect sensor
- 50 : switch
- 10 110 : module
- 111 : first part
- 111A, 112A : first surface
- 111B, 112B : second surface
- 111S, 112S, 600S : default state
- 15 112 : second part
- 112L : left end
- 112R : right end
- 113 : engaging means
- 113a : protruding part
- 20 150 : controller
- 210 : height adjustment member
- 211 : first height adjustment member
- 212 : second height adjustment member
- 213 : engaging means
- 25 213a : opening
- 300 : unit
- 311 : body
- 311a, 311b : first protruding member
- 312 : front blade
- 30 312a, 313b : opening
- 313 : second blade
- 325 : bearing
- 326 : bearing holder
- 327 : spring holder
- 35 328, 329 : adhesion means
- 331 : fastener
- 332 : squeegee holder
- 333 : connecting part (squeegee trap)
- 337 : wheel
- 40 340 : motor support bracket
- 341 : guiding unit (second member)

	342	: linear Guiding Shaft
	343	: ball bearing
	344	: motor (permanent magnet motor)
	345	: rotary latch
5	346	: lead screw nut
	347	: hook spring post
	348a, 348b	: spring
	349	: assembly
	350	: hose
10	351	: spring
	360	: cartridge (first member)
	360A	: outer skin
	600	: module (cleaning module)
	650	: tray
15	660	: brush
	670	: pump nozzle
	671	: first pump nozzle
	672	: second pump nozzle
	673	: third pump nozzle
20	681	: first squeezing part
	682	: second squeezing part
	700	: motor
	711	: pump nozzle
	800	: actuator
25	850	: motor
	901, 902	: wheel
	1000	: apparatus
	1100	: surface
	1500	: device
30	1510	: web interface
	1520	: mobile app
	1600	: apparatus
	1800	: cloud server
	1810	: controller
35	1820	: database
	1830	: personality generator
	1900	: power supply module
	1910	: fuse boards
	1920	: voltage regulators
40	1930	: power supply
	2000	: apparatus
	2001	: base module
	2011	: sensor

2012 : switch
 2020 : emergency system
 2030 : sensor
 2040 : sensor data processing
 5 2050 : controller
 2060 : traction controller
 2070 : traction motor
 2080 : personality controller
 2090 : power supply module
 10 2091 : driver module
 2092 : display module
 2093 : speaker
 2100 : scrub module
 2110 : float switch
 15 2120 : float switch
 2130 : level sensor
 2140 : tank controller
 2150 : controller
 2160 : pump
 20 2170 : actuator
 2180 : brush
 2190 : vacuum motor
 2200 : mopping module
 2210 : float switch
 25 2220 : float switch
 2230 : level sensor
 2240 : tank controller
 2250 : controller
 2260 : pump
 30 2270 : actuator
 2280 : mop
 2300 : vacuum module
 2350 : controller
 2360 : brush motor
 35 2370 : actuator
 2380 : vacuum motor
 2900 : personality generator
 X1, X2, Y1, Y2 : direction
 Z0, Z1, Z2 : height
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CLAIMS

1. A squeegee unit for an autonomous cleaning apparatus comprising a cleaning module and support wheels, the squeegee unit comprising:

a squeegee cartridge supporting one or more squeegee blades; and

5 support means for supporting the squeegee cartridge for movement along a pre-defined arcuate path over a floor surface for supporting the squeegee cartridge between the cleaning module and the support wheels of the cleaning apparatus, and for supporting the squeegee cartridge for a left or right swinging motion when the cleaning apparatus is turning;

10 wherein the support means comprises a plurality of guide units, each guide unit having at least one roller bearing for guiding the squeegee cartridge along the arcuate path.
2. A squeegee unit according to claim 1, wherein each of the plurality of guide units further includes one or more low friction surfaces to facilitate sliding of
15 the squeegee cartridge.
3. A squeegee unit according to claim 1 or 2, further comprising a suspension system for supporting the squeegee cartridge.
4. A squeegee unit according to claim 3, wherein the suspension system comprises a spring arrangement engaging each of the plurality of guide
20 units.
5. A squeegee unit according to claim 3 or 4, wherein the suspension system further comprises elevation means for raising and lowering the squeegee cartridge away from or towards the floor surface during operation of the cleaning apparatus.
- 25 6. A squeegee unit according to any one of claims 3 to 5, wherein the suspension system maintains the one or more squeegee blades at an angle of about 45 degrees relative to the floor surface during operation thereof.

7. A squeegee unit according to any one of the preceding claims, wherein the one or more squeegee blades are supported on the squeegee cartridge to form an arcuate shape.

5 8. A squeegee unit according to claim 7, wherein the one or more squeegee blades are releasably secured to the squeegee cartridge.

9. A squeegee unit according to claim 8, wherein the one or more squeegee blades are releasably attached to the squeegee cartridge using a tab and cooperating slot arrangement.

10 10. A squeegee unit according to any one of claims 7 to 9, wherein the one or more squeegee blades is formed from rubber.

11. A squeegee unit according to any one of the preceding claims, wherein the squeegee cartridge comprises a wastewater tank for receiving water collected by the one or more squeegee blades.

15 12. A squeegee unit according to claim 11, wherein the one or more squeegee blades comprises one or more perforations to allow the water to be sucked into the wastewater tank.

13. An autonomous cleaning apparatus including a squeegee unit according to any one of the preceding claims.

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