

A CLEANING DEVICE AND METHOD

TECHNICAL FIELD

[0001] This invention relates to a cleaning device and method. More particularly, this invention relates to an autonomous cleaning device and method that are suitable for cleaning an uneven surface.

BACKGROUND

[0002] The following discussion of the background to the invention is intended to facilitate an understanding of the present invention 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 invention.

[0003] Conventional vacuuming using vacuum cleaners requires a strong vacuum suction to suck up debris, dirt and dust. Such vacuum cleaners tend to be noisy during operation and require a back-and-forth motion to effectively clear a surface of debris, dirt and dust. Using such a vacuuming method in robots that can only move in a forward direction results in less than satisfactory cleaning. To improve vacuuming in such robots, a spinning brush is sometimes introduced in front of a suction inlet to aid in dislodging, sweeping and feeding debris, dirt and dust to the suction inlet. These robots which employ a powerful motor to produce the strong suction consume and drain battery power rather quickly. The vacuum inlets and brushes of these robots are also typically located at a fixed height from the base of the robots, making the robots unsuitable for cleaning uneven surfaces.

[0004] There is therefore a need for a cleaning device which addresses, at least in part, one or more of the forgoing problems.

SUMMARY

[0005] According to an aspect of the present disclosure, there is provided a cleaning device. The cleaning device includes a first tray having a first side and a second side opposite the first side. The cleaning device also includes a first roller brush adjacent the first side of the first tray, the first roller brush being configured to rotate in a first direction about its longitudinal axis. The cleaning device further

includes a second roller brush adjacent the second side of the first tray, the second roller brush being configured to rotate in a second direction about its longitudinal axis, the second direction being opposite to the first direction.

[0006] In some embodiments, the first roller brush is located at a front of the cleaning device. And the first direction of the first roller brush is against a forward direction of motion of the cleaning device.

[0007] In some embodiments, the cleaning device further includes a second tray having a first side and a second side opposite the first side. The second tray is located above the first tray. The second tray also has a width that is smaller than that of the first tray.

[0008] In some embodiments, the first side and the second side of the first tray are inwardly inclining.

[0009] In some embodiments, the first side and the second side of the second tray are outwardly inclining.

[0010] In some embodiments, the cleaning device further includes a first flap projecting from a bottom of the first side of the first tray, and a second flap projecting from a bottom of the second side of the first tray. The second flap projects further away from the bottom of the first tray than the first flap.

[0011] In some embodiments, the cleaning device includes a housing for accommodating the first tray, the first roller brush, and the second roller brush therein. The housing has an opening in a bottom thereof for exposing the first roller brush and the second roller brush. The cleaning device further includes a third tray located adjacent a side of the second roller brush that is opposite to a side facing the first tray.

[0012] In some embodiments, the first tray, the third tray, the first roller brush and/or the second roller brush is detachably mounted to the housing.

[0013] In some embodiments, the cleaning device further includes an actuator coupled to the housing for raising the housing from a base of the cleaning device, and lowering the housing to a lowered position that is lower than the base of the cleaning device. The housing is configured to freely move upwards when in the lowered position without the actuation of the actuator.

[0014] In some embodiments, the cleaning device further includes a frame having at least one guide rail. In these embodiments, the housing includes at least one guide for allowing the housing to be slidably mounted to the frame via the at least one guide

rail. The actuator is coupled to the frame so as to be able to raise and lower the housing.

[0015] In some embodiments, the frame includes a plurality of wheels.

[0016] In some embodiments, the housing defines an opening above the first tray, and the cleaning device further includes a suction unit coupled to the opening in the housing.

[0017] In some embodiments, the suction unit includes a suction unit housing defining an air inlet and an air outlet, a filter bag connected to the air inlet, and at least one exhaust fan located at the air outlet.

[0018] In some embodiments, the first roller brush and the second roller brush include chevron brushes.

[0019] In some embodiments, the cleaning device includes an autonomous cleaning device.

[0020] According to another aspect of the present disclosure, there is provided a method a cleaning method. The cleaning method includes moving a cleaning device in a forward direction of movement to clean a surface. The cleaning device includes a first tray having a first side and a second side opposite the first side. The cleaning device also includes a first roller brush adjacent the first side of the first tray, and a second roller brush adjacent the second side of the first tray. The cleaning method further includes rotating the first roller brush in a first direction and rotating the second roller brush in a second direction opposite to the first direction to sweep debris into the tray as the cleaning device is moved in the forward direction.

[0021] In some embodiments, the first direction of the first roller brush is against the forward direction of movement of the cleaning device.

[0022] Other aspects and advantages of the invention will become apparent from the following detailed description, taken in conjunction with the accompanying drawings, illustrating by way of example the principles of the invention.

BRIEF DESCRIPTION OF DRAWINGS

[0023] The invention will be better understood with reference to the drawings, in which:

Figure 1 is an isometric drawing of an autonomous cleaning device having a sweeping unit according to an embodiment of the invention;

Figure 2 is a side sectional drawing of a sweeping module of the sweeping unit in Figure 1;

Figure 3 is a side view drawing of the autonomous cleaning device in Figure 1 showing the sweeping unit in a raised position;

Figure 4 is a side view drawing of the autonomous cleaning device in Figure 1 showing the sweeping unit in a lowered position;

Figure 5 is an isometric drawing showing a lifting frame and the sweeping module in Figure 2 of the sweeping unit in Figure 1;

Figure 6 is an isometric drawing showing the sweeping module in Figure 5 slidably mounted to the lifting frame;

Figure 7 is an exploded isometric drawing of the sweeping module in Figure 5;

Figure 8 is a bottom isometric drawing of the sweeping module in Figure 5;

Figure 9 is a side view drawing of the sweeping module of Figure 5;

Figure 10 is an isometric drawing of the sweeping module showing a tray system detached from a housing of the sweeping module;

Figure 11 is an exploded isometric drawing of the tray system in Figure 10;

Figure 12 is an isometric drawing of the sweeping module showing a rear panel detached therefrom;

Figure 13 is an isometric drawing showing a hose that is attachable to the sweeping module;

Figure 14 is an isometric drawing of a suction unit to which the sweeping module is couplable to; and

Figure 15 is a flowchart of a cleaning method using the cleaning device of Figure 1.

DETAILED DESCRIPTION OF THE EMBODIMENTS

[0024] 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.”

[0025] Furthermore, throughout the specification, 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.

[0026] Unless defined otherwise, all 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.

[0027] As shown in the drawings for purposes of illustration, the invention may be embodied in a cleaning device that is operable to effectively clean an uneven surface in one pass. Existing devices tend to be less effective in cleaning, needing more than one pass to achieve the same result. Referring to Figures 1 and 2, a cleaning device generally includes a first tray having a first side and a second side opposite the first side. The cleaning device also includes a first roller brush adjacent the first side of the first tray. This first roller brush is configured to rotate in a first direction about its longitudinal axis. The cleaning device further includes a second roller brush adjacent the second side of the first tray. The second roller brush is configured to rotate in a second direction about its longitudinal axis. The second direction is opposite to the first direction.

[0028] Specifically, Figure 1 shows an autonomous cleaning device 2 according to an embodiment of the invention. The cleaning device 2 includes a controller (not shown), a sensor module 4, a sweeping unit 6 and a suction unit 8 (Figure 14), amongst other components known to those skilled in the art, to allow autonomous operation of the cleaning device 2. During use, the cleaning device 2 is moved across a surface to sweep and trap debris, dirt and dust from the surface. The sweeping unit 6 can be raised, as shown in Figure 3, when not in use and lowered onto the surface, as shown in Figure 4, when the cleaning device is used to clean the surface.

[0029] The cleaning device 2 may also include an optional remote controller (not shown). The controller performs mapping localization, planning and control for the cleaning device. When brought to clean a new area, an operator drives the cleaning device around the area using the remote controller. While the operator is performing this function, the controller learns and maps a floor plan for the area including identifying any existing stationary objects in that area. The controller first detects characteristics of the environment, including existing obstacles, using the sensor module. After that, the controller maps the environment from the detected characteristics and stores an environment map in a memory (not shown). The controller next determines a route for the cleaning device to traverse in order to clean the area based on the environment map. The controller stores the route for future

reference during subsequent autonomous operations in the area. Such environment mapping allows cleaning to be performed automatically subsequently based on the mapped environment stored in the memory.

[0030] The sweeping unit 6 is next described in detail with the aid of Figures 5-12. The sweeping unit 6 includes a lifting frame 10 and a sweeping module 12 as shown disassembled in Figure 5. The lifting frame 10 includes a top panel 14, and a front panel 16 and a rear panel depending from the top panel 14. Mounted to the front and the back panels are castor wheels 20. The lifting frame 10 is of sheet metal. Figure 5 shows two front castor wheels 20 mounted to two lower ends of the front panel 16 and two rear castor wheels 20 mounted to a lower medial section of the rear panel. Fixedly attached to the top panel 14 are two vertically projecting shafts 22. Steel cables (not shown) are connected to free ends of the shafts 22. The cables are coupled to an actuator (not shown), such as but not limited to a linear actuator, which can be actuated to retract the cables to haul the lifting frame 10 up to a raised position and extend the cables to lower the lifting frame 10 down to a lowered position. Guides (not shown) in the cleaning device 2 are sleeved over the shafts 22 to guide movement of the lifting frame 10 in the up and down directions. When in the raised position, a base of the lifting frame 10, defined by the castor wheels 20, is offset from a base of the cleaning device 2 defined by wheels 24, 26. When in the lowered position, the cables are taut and the base of the lifting frame 10 is lower than the base of the cleaning device 2. In this lowered position, the sweeping unit 6, which includes the lifting frame 10 and sweeping module 12, is free to move upwards without actuation of the actuator to allow the sweeping unit 6 to ride undulations in an uneven surface as the cleaning device 2 is moved over the surface. There will be slack in the cables when the sweeping unit 6 moves upwards from the lowered position. An opening 30 is defined in the top panel 14 of the lifting frame 10. On an undersurface of the top panel 14 on either side of the opening 30 are a pair of longitudinal guide rails 32. A latch 34 is pivotably attached to an edge of the top panel 14.

[0031] Turning to the sweeping module 12 next, the sweeping module 12 includes a housing 40. The housing 40 includes a top housing panel 42, a front housing panel 44, a rear housing panel 46 and two side panels 48. The rear housing panel 46 is detachably connected to the two side panels 48 via a pair roller catches 47 (Figure 12). Fixedly attached to the top housing panel 42 are guides 50 for engaging the guide rails

32 of the lifting frame 10 to allow the housing 40 to be slidably attached under the top panel 14 of the lifting frame 10. An opening 51 (Figure 8) is defined in the top housing panel 42 to serve as an air outlet. Surrounding this opening 51 on the outside of the top housing panel 42 is a foam ring (not shown). Adjacent the opening 51 on the outside of the top housing panel 42 is a spring-loaded latch 53. On the four corners of the housing 40 are mounted four roller wheels 49 for rolling of the sweeping module 12 on the ground when attaching it to and detaching it from the lifting frame 10. When the sweeping module 12 is slidably attached to the lifting frame 10, the latch 34 of the lifting frame 10 can be rotated to engage one of the guides 50 of the housing 40 to lock the sweeping module 12 in place within the lifting frame 10. In this manner, the sweeping module 12 can be raised or lowered together with the lifting frame 10 as the lifting frame 10 is raised or lowered using the actuator. Figure 6 shows an assembled state of the sweeping unit 6 where the sweeping module 12 is locked in place to the lifting frame 10.

[0032] Figure 7 is an exploded isometric drawing of the sweeping module 12. The sweeping module 12 further includes a front lower tray 52, a front upper tray 54, a rear tray 56, a front roller brush 58 and a rear roller brush 60 in the housing 40. As more clearly shown in Figures 2, 10 and 11, the front lower tray 52 includes a front panel 62, a rear panel 64 opposite the front panel 62 and two side panels 66. The front panel 62 and the rear panel 64 are inwardly inclining at an angle of between 30-75 degrees as more clearly shown in Figure 2. The front upper tray 54 includes a front panel 68 and a rear panel 70. In this embodiment, the front panel 68 and the rear panel 70 of the front upper tray 54 are outwardly inclining as shown in Figure 2. However, in other embodiments, the front panel 68 and the rear panel 70 of the front upper tray 54 may be vertical or inwardly inclining. This front upper tray 54 increases the debris and dirt collection capacity of the cleaning device 2. The front upper tray 54 has a width that is smaller than that of the front lower tray 52.

[0033] A front flap 72 is attached to the front panel 62 of the front lower tray 52, and a rear flap 74 is attached to the rear panel 64 of the front lower tray 52. The rear flap 74 projects further away from a bottom of the front lower tray 52 than the front flap 72. The flaps 72, 74 are of rubber and the rear flap 74 is more flexible than the front flap 72.

[0034] On each side panel 66 of the front lower tray 52 is a flange 76. Mounted on each flange 76 is a roller catch striker 78. Fixedly attached to a bottom of the front upper tray 54 are a pair of supports 80. Each support 80 includes a disc-shaped magnet 81 affixed to a bottom thereof. The front upper tray 54 is magnetically attached to the base of the front lower tray 52 by aligning the magnets 81 with corresponding magnets 83 on the base of the front lower tray 52. The front upper tray 54 is thus spaced apart from the base of the front lower tray 52 to be above the front lower tray 52. With such a tiered tray arrangement, more debris and dirt can be held therein. Typically during use, bigger and heavier debris and dirt are collected in the front lower tray 52 while smaller and lighter debris and dirt are collected in the front upper tray 54. The rear tray 56 is attached to the rear panel 46 and is therefore easily accessible by simply removing the rear panel from the housing 40.

[0035] Located on each side panel 48 of the housing 40 of the sweeping module 12 is a roller catch body 82. The front lower tray 52 with the front upper tray 54 mounted thereon is detachably mounted to the housing 40 by pushing its roller catch strikers 78 into corresponding roller catch bodies 82 of the housing 40. The front roller brush 58 and the rear roller brush 60 are also detachably mounted between the two side panels 48 of the housing 40. In this embodiment, the front roller brush 58 and the rear roller brush 60 are chevron brushes with soft bristles 100. However, in other embodiments, other types of roller brushes may be used.

[0036] On one end of each roller brush 58, 60 is a mating member, such as a member having a shaped depression (not shown). On the other end of each roller brush is a bearing 84 (Figure 7). Supporting the bearing end of the roller brush 58, 60 is a spring-loaded pin 86 for engaging the bearing 84 of the roller brush 58, 60. Rotatably mounted to the other side panel 48 of the housing 40 is a driven pulley assembly 88. The driven pulley assembly 88 includes a mating member, such as a member having a protrusion 90 corresponding in shape to the depression at the end of the roller brush 58, 60. When mounted to the housing 40, the protrusion 90 of driven pulley assembly 88 mates with the depression of the roller brush 58, 60 to thereby engage the roller brush 58, 60 to rotate the roller brush about its longitudinal axis. The roller brushes 58, 60 are driven by two motors coupled by belts 94 to the respective driven pulley assemblies 88. The spring-loaded pin 86 includes a knob 96 which can be pulled to draw the pin 86 out of the end of the roller brush 58, 60 so that the roller

brush 58, 60 may be removed from the housing 40. When mounted to the housing 40, the front roller brush 58 is adjacent the front side 62 of the front lower tray 52 and the rear roller brush 60 is adjacent the rear side 64 of the front lower tray 52. Bristles 100 of the front roller brush 58 press against the front flap 72 of the front lower tray 52 while bristles 100 of the rear roller brush 60 press against the rear flap 74 of the front lower tray 52. When the sweeping module 12 is attached to the lifting frame 10, the bristles 100 of the roller brushes 58, 60 extend below the base of the lifting frame 10 as defined by the castor wheels 20. In this embodiment, the length of the bristles 100 extending below the base is about 8mm. In this manner, pressure exerted by the bristles on a surface can be maintained constant to ensure optimal cleaning performance. The length of the bristles 100 digging into the surface is kept constant. Having too much or too little of the bristles 100 in contact with the surface may result in less than optimal cleaning.

[0037] Located above the front upper tray 54 and the roller brushes 58, 60 is a gauze filter (not shown) held in a frame 97 to prevent large size debris from being sucked out of the opening 51.

[0038] The suction unit 8 is next described with the aid of Figure 14. The suction unit 8 is located within a body of the cleaning device 2. The suction unit 8 includes a housing 101 having an inlet (not shown) and an outlet 102. One end of a hose 104 is connected to the inlet of the suction unit housing 101. The other end of the hose 104 is connected to an attachment head 106. The attachment head 106 is connected, through the opening 30 in the lifting frame 10, to the top of the housing 40 of the sweeping module 12 to be over the opening 51 at the top of the housing 40. The attachment head presses against the foam ring on the top panel 42 of the housing 40 to form a good air seal around the opening 51. The attachment head 106 is securely latched to the sweeping module 12 via the spring-loaded latch 53. Located at the outlet 102 of suction unit housing 101 is a pair of exhaust fans 110 for drawing air out of the suction unit housing 101. Connected to the inlet within the suction unit housing 101 is a filter bag (not shown). Attached to the outside of the suction unit housing 101 covering the outlet 102 is a high-efficiency particulate air (HEPA) filter (not shown) that is used for further trapping fine dust that might escape from the filter bag to thereby ensure that clean air exits the cleaning device 2.

[0039] When the cleaning device 2 is not in use, the actuator is actuated to lift the sweeping unit 6 off the floor to its raised position so that the sweeping unit is no longer in contact with the floor surface. This facilitates moving of the cleaning device 2.

[0040] When used for cleaning a surface, the actuator is actuated to lower the sweeping unit 6 onto the surface such that the castor wheels 20 are in contact with the surface. In this position, the bristles 100 of the roller brushes 58, 60 and the rear flap 74 press against the surface. There is a clearance between the front flap 72 and the surface. The cleaning device 2 is then moved in a forward direction as shown by arrow A in Figure 2 to clean the surface. The motor 94 coupled to the front roller brush 58 is operated to rotate the front roller brush 58 about its longitudinal axis at around 1200 rpm in a direction against the forward direction of the cleaning device 2, i.e. in an anti-clockwise direction as shown in Figure 2. The rotating roller brush 58 dislodges and picks up debris, dirt and dust in its path to sweep them up the front flap 72 on the slanted front panel 62 of the front lower tray 52 into the front lower tray 52 and the front upper tray 54. Debris, dirt and dust that are not picked up by the front roller brush 58 go through the clearance under the front flap 72 to the rear of sweeping module 12. The rear flap 74 which is flexible is able to go over the debris, dirt and dust. The rear roller brush 60 rotated at around 1200 rpm in the forward direction of the cleaning device 2, i.e. in a clockwise direction as seen in Figure 2, then picks up and sweeps the debris, dirt and dust that cleared the rear flap 74 up the rear flap 74 into the front lower tray 52 and the front upper tray 54. Debris, dirt and dust that are swept towards the rear of the sweeping module 12 are trapped by the rear tray 56 so that little or none are left behind.

[0041] The exhaust fans of the suction unit 8 are operated to draw air out of the suction unit housing 101. By doing so, an air flow is created from under the sweeping unit 6, through the hose 104, into the filter bag in the suction unit housing 101 and out of the suction unit housing 101. Dirt and dust that are airborne and not deposited in the trays 52, 54, 56 can thus be sucked into and trapped by the filter bag in the suction unit 8. Larger sized debris and dirt are prevented by the gauze filter in the sweeping module 12 from being sucked into the hose 104 so that the hose 104 and the suction unit inlet will not be clogged up.

[0042] To clear the trays 52, 54, 56 of debris and dirt, an operator can unlatch the sweeping module 12, slide it out from under the lifting frame 10, remove the trays 52,

54 from under the housing 40 to clear the debris and dirt collected in the trays 52, 54. The back panel 46 of the housing 40 where the rear tray 56 is located may also be similarly removed so that debris and dirt collected therein may be cleared. If the roller brushes 58, 60 need to be cleaned or replaced, they too can be easily removed from under the housing 40.

[0043] Figure 15 is a flowchart showing a method 120 of cleaning a surface according to another embodiment of the invention. The method 120 generally includes moving a cleaning device in a forward direction of movement to clean a surface. The cleaning device includes a tray having a first side and a second side opposite the first side. The cleaning device also includes a first roller brush adjacent the first side of the first tray, and a second roller brush adjacent the second side of the first tray. The cleaning method further includes rotating the first roller brush in a first direction and rotating the second roller brush in a second direction opposite to the first direction to sweep debris, dirt and dust into the tray as the cleaning device is moved in the forward direction.

[0044] More specifically, the method 120 starts in a START step 122, wherein an operator commands the cleaning device 2 to start cleaning an area. The method 120 next proceeds to a LOWER SWEEPING UNIT step 124 wherein the cleaning device 2 lowers the sweeping unit 6 to its lowered position onto a surface. The method 120 next proceeds to a SPIN ROLLER BRUSHES AND TURN FANS ON step 126, wherein the motors 94 are operated to rotate the front roller brush 58 in a first direction and the rear roller brush 60 in a second direction that is opposite to the first direction. In this step 126, the exhaust fans 110 are also turned on. The method 120 next proceeds to a NAVIGATE CLEANING DEVICE step 128, wherein the cleaning device 22 is moved in a forward direction along a predetermined route for that area, picking up any debris, dirt and dust in its path as described above. In one embodiment, the first direction of the front roller brush 58 is against the forward direction of movement of the cleaning device 2. In other embodiments, the first direction of the front roller brush 58 may be in the same direction as the forward direction of movement of the cleaning device 2. The method 120 ends in an END step 130, when the cleaning device 2 reaches the end of the route. The cleaning device 2 then turns off the motors 94 and exhaust fans 110, and raises the sweeping unit 6 off the surface to its raised position.

[0045] Advantageously, the cleaning device 2 has a sweeping module 12 that can ride undulations in a surface to remain in contact with the surface to ensure that the surface is more effectively covered and cleaned. Cleaning efficiency is further enhanced using the two roller brushes 58, 60 rotating in opposite directions to effectively shake and agitate debris, dirt and dust on different flooring types to remove them therefrom and collect them in the trays 52, 54, 56. The sweeping module 12 can be easily inserted and removed from the cleaning device 2. The roller brushes 58, 60 and the trays 52, 54, 56 are also easily removable from the housing 40 of the sweeping module 12 for cleaning and/or replacement. And with only the use of exhaust fans instead of powerful suction motors, the cleaning device 2 is also quieter in operation compared to vacuum cleaners.

[0046] Although the present invention is described as implemented in the above described embodiments, it is not to be construed to be limited as such. For example, although it is described that sweeping module 12 is implemented in an autonomous cleaning device 2, the sweeping module 12 may also be implemented in a manually operated cleaning device wherein the cleaning device can be wheeled around by an operator and movement of its wheels are translatable to movement of the two roller brushes 58, 60 as described above.

[0047] As another example, it is described that the two roller brushes 58, 60 are rotated in opposite directions, it is to be appreciated that the two roller brushes can be rotated in the same direction.

[0048] As a further example, it is described that the cleaning device 2 includes a number of trays 52, 54, 56. However, in other embodiments, the cleaning device 2 may include one or more trays depending on the debris, dirt and dust collection capacity that is required.

[0049] As yet another example, the cleaning device 2 may include one or more sensors in the sweeping module 12 to determine the level of debris, dirt and dust in the trays 52, 54, 56 and to alert an operator when they are full.

[0050] It should be further appreciated by the person skilled in the art that one or more of the above modifications or improvements, not being mutually exclusive, may be further combined to form yet further embodiments of the present invention.

CLAIMS

1. A cleaning device comprising:
 - a first tray having a first side and a second side opposite the first side;
 - a first roller brush adjacent the first side of the first tray, the first roller brush configured to rotate in a first direction about its longitudinal axis; and
 - a second roller brush adjacent the second side of the first tray, the second roller brush configured to rotate in a second direction about its longitudinal axis, the second direction being opposite to the first direction.
2. The cleaning device according to Claim 1, wherein the first roller brush is located at a front of the cleaning device and the first direction is against a forward direction of motion of the cleaning device.
3. The cleaning device according to Claim 1 or 2, further comprising:
 - a second tray having a first side and a second side opposite the first side, the second tray being located above the first tray, the second tray having a width smaller than a width of the first tray.
4. The cleaning device according to any one of the preceding claims, wherein the first side and the second side of the first tray are inwardly inclining.
5. The cleaning device according to Claim 3 or 4, wherein the first side and the second side of the second tray are outwardly inclining.
6. The cleaning device according to any one of the preceding claims, further comprising:
 - a first flap projecting from a bottom of the first side of the first tray; and
 - a second flap projecting from a bottom of the second side of the first tray;
 - wherein the second flap projects further away from the bottom of the first tray than the first flap.

7. The cleaning device according to any one of the preceding claims, further comprising:

a housing for accommodating the first tray, the first roller brush, and the second roller brush therein, the housing having an opening in a bottom thereof for exposing the first roller brush and the second roller brush; and

a third tray located adjacent a side of the second roller brush that is opposite to a side facing the first tray.

8. The cleaning device according to Claim 7, wherein at least one of the first tray, the third tray, the first roller brush and the second roller brush is detachably mounted to the housing.

9. The cleaning device according to Claim 7 or 8, further comprising:

an actuator coupled to the housing for raising the housing to a raised position away from a base of the cleaning device, and lowering the housing to a lowered position that is lower than the base of the cleaning device;

wherein the housing is configured to freely move upwards when in the lowered position without actuation of the actuator.

10. The cleaning device according to Claim 9, further comprising:

a frame having at least one guide rail;

wherein the housing includes at least one guide for allowing the housing to be slidably mounted to the frame via the at least one guide rail; and

wherein the actuator is coupled to the frame.

11. The cleaning device according to Claim 10, wherein the frame includes a plurality of wheels.

12. The cleaning device according to any one of Claims 7 to 11, wherein the housing defines an opening above the first tray; and the cleaning device further comprises:

a suction unit coupled to the opening in the housing.

13. The cleaning device according to Claim 12, wherein the suction unit comprises:

a suction unit housing defining an air inlet and an air outlet;
a filter bag connected to the air inlet; and
at least one exhaust fan located at the air outlet.

14. The cleaning device according to any one of the preceding claims, wherein the first roller brush and the second roller brush comprise chevron brushes.

15. The cleaning device according to any one of the preceding claims, wherein the cleaning device comprises an autonomous cleaning device.

16. A cleaning method comprising:

moving a cleaning device along in a forward direction of movement to clean a surface, the cleaning device including a first tray having a first side and a second side opposite the first side; a first roller brush adjacent the first side of the first tray, and a second roller brush adjacent the second side of the first tray;

rotating the first roller brush in a first direction to sweep debris into the tray as the cleaning device is moved in the forward direction; and

rotating the second roller brush in a second direction opposite to the first direction to sweep debris into the tray as the cleaning device is moved in the forward direction.

17. A cleaning method according to Claim 16, wherein the first direction of the first roller brush is against the forward direction of movement of the cleaning device.