

Smart Automatic Cleaner

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Abstract: Hygiene in residential societies, any commercial and institutional organisation is vital in maintaining pleasant conditions for the well-being of inhabitants and guests. In this high commotion, it is difficult and tedious to maintain the cleanliness of the hallways and lobbies on a regular basis. Our completely automated smart cleaner specifically aims to make this cleaning process easier and eliminate daily manual labour work. It is a programmed device that performs all the necessary operations in a single back and forth pass of the floor. The device is operated using motors which actuate the necessary attachments sequentially, like mops, a preset timed soap dispenser with a spraying mechanism, a microfiber cloth to wipe off the floor simultaneously, all in one single pass of the device. It will have a smart travel and guidance system to allow it to travel in the specified path and avoid any obstacles in between as it encounters them, which can be mechanical or electronic in nature.

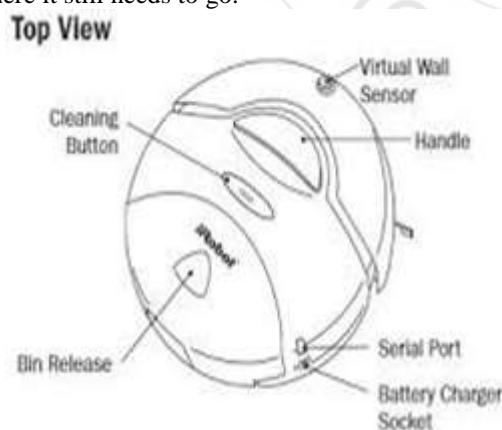
Keywords: Hygiene, smart cleaner, eliminate daily labour, single pass, preset timed, simultaneously, travel

1. Introduction

Cleanliness is one of the essential need of any habitable environment. Unhygienic or unsatisfactory cleaning is one of the major reasons that lead to spreading of germs and bacteria. Various means to maintain a pleasant environment are employed. Manual labour or cleaning carts are few of them. These means however, are quite unreliable and inefficient. To curb the drawbacks of conventional cleaning methods and minimising manual efforts, a device was designed with smart sensors and self-navigating technology.

Existing Technology

A look into the existing attempts at similar endeavours led to iRobot Braava 380t Floor Mopping Robot. It uses two reusable microfiber cleaning cloths to effectively sweep and mop all hard floor types. The system has a special reservoir cleaning pad, which dispenses liquid throughout the cleaning process to keep the mop damp at all times. It uses NorthStarAdapt 2.0 Navigation technology to map walls, avoid obstacles and drop-offs, and track where it has cleaned and where it still needs to go.



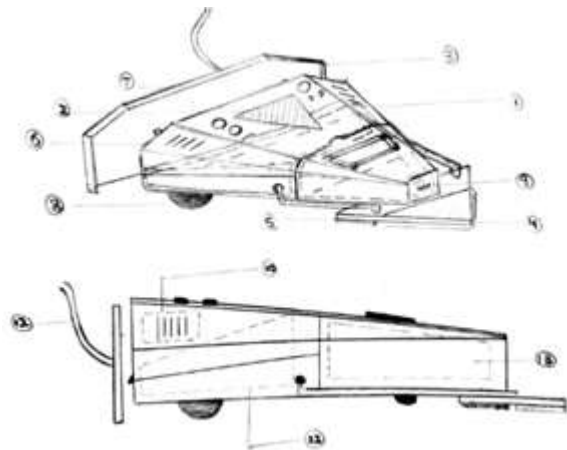
It is effective for large spaces and multiple rooms. The shortcomings to this technology are that it needs to be manually activated and involves a tedious charging process. Also, it does not ensure quiet and efficient operation.

2. Design

This device aims to rectify the shortcomings of iRobot Braava and eliminate manual work. The constructional features of the device is similar to the iRobot Braava 380t, effectively housing the battery, motor, clock or timer, NorthStar navigational technology and the Pro-cleaning system, which contains a solution of fragranced cleaning liquid. A disposable bin to collect all the dust from the floors or carpets is also enclosed at the back of the device. It employs a reusable microfiber cloth for the mopping or sweeping operation and a vacuum suction for picking up of dust or crumbs from carpets. The device is approximately 8.5 inches in width and 3 inches in height and weighs about 4lbs (1.8kgs). The device has 3 wheels to drive it, 2 larger wheels aligned at the back and 1 smaller one in the front at the centre to allow for ideal weight distribution to the front of the body for more effective cleaning. A rechargeable 12V battery pack is ideal for a variety of DC gear motors and most microcontroller. The device will be charged by docking itself into the connector pins of a charging port, which will be a little wider than in dimension than the width of the device to ensure effective clamping. An Arduino microcontroller with a Bluetooth connection is apt for establishing connection between the device and charging port, to allow it to locate its charging point automatically after the cleaning operation is finished.

A. Parts of Construction

1. Body
2. Liquid Dispenser
3. Charging Port
4. Microfiber Cloth
5. Suction vent
6. Vents
7. Toggle Buttons
8. Wheel
9. Nozzle and Spray outlet
10. Control Unit
11. Bin
12. Power supply
13. Cleaning handle



B. Working

The device has a set of preprogrammed instruction which allows it to get activated automatically on specific time set by the user. The device has a clock system for this purpose. After activation, the device uses NorthStar Self Navigation system as used by the iRobot Braava 380t to map the room using infrared. This infrared localisation system works like an indoor GPS to help robot machines know where they are in a given space, where they've been and where they need to go, using mapping and signal projection. With the incorporation of the NorthStar navigation system, the device can build a map of the cleaning area as it goes. Field Mapping is performed by dividing the unknown field in a 10 x 10cm cells grid. The device has a control unit which is a set of compactly arranged 12V batteries, Arduino microcontroller, Bluetooth system, motors to drive the wheel shaft of the device and the basic circuitry of wires. When the device is activated, the battery powers the motors to rotate the wheel shaft and hence move the device as the NorthStar system guides. The Pro Cleaning system is pre-programmed to spray the cleaning solution at a fixed interval and can be adjusted to change the frequency of spraying as desired. The device offers three modes of cleaning which can be selected by the user depending on the intensity or degree of cleaning required. This makes the device consume power more efficiently and operate more effectively. The front cleaning unit of the device has a base covered with a reusable microfiber cloth which is responsible for most of the sweeping and mopping process. It also has a provision for vacuum suction by a pump, which is powered by the battery to allow for picking up dust, hair, crumbs and other solid wastes. This dust collected is stored in the disposable bin at the back. After the completion of the cleaning operation, the device returns to its charging dock with the help of a signal established by Bluetooth. The device automatically performs the operation performed previously if no input or mode change is provided by the user. This allows for more efficient and smart power consumption resulting in longer battery life.

3. Calculations

The following data is assumed for the device:

- Capacity of Battery = 12V 2,000 mAh NiMH battery
- Battery Run time or recharge time = 4-5 hours
- Weight = 4lbs (1.8 Kgs)
- Largest Dimension = 8.5" x 3"
- Dispenser capacity = 300 – 500 ml

- Suction Pressure = 25 – 35 CFM (cubic feet/ min)

Sixteen different values can be assigned to each cell:

- n = 00 unknown cell
- n = 01-10 cell visited n times
- n = 11 obstacle found
- n = 12 gas target found
- n = 13 light target found
- n = 14 sound target found

The device can start from any position in the field which becomes the reference coordinate (0, 0) in its reference system.

- a) Travel at a given speed in a given direction – (VelDes, QDes)
- b) Travel towards a given point with coordinates (XDes, YDes)
- c) Travel for a given distance in a given direction (DistDes, QDes)

VelDes is the Velocity in a given direction

QDes is the Angle of contact with the destination surface

XDes is the coordinate of destination in X axis

YDes is the coordinate of destination in Y axis

DistDes is the distance to destination

4. Conclusion

The device allows for fully automatic operation with absolutely minimal or no human efforts by employing scheduled functioning. It also has vents to allow for heat to be dissipated efficiently with a noise free operation. The Bluetooth technology allows for the device to return to its docking point automatically. The provision of different modes allow for smart control and lower power consumption. Thus making the device more efficient and effective. The device overcomes the short comings of the existing technologies in this way.

5. Acknowledgment

We would like to thank our friends who gave their insights on our paper and helped in overcoming the discrepancies.

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