



# **Automated Operating Room Cleaning Robot**

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**ABSTRACT:** The operating room cleaning robot provided with ‘Manual’ and ‘Automatic’ control is used for operating room cleaning purposes. The cleaning procedure comprises of vacuum suction of dust, disinfecting the area followed by mopping. The cleaning is done for both horizontal and vertical surfaces of the operating room. This battery-driven robot has the capability to store the overall dimensions of the operating room along with the predetermined path that it is being trained off to follow during the cleaning process. It can be manually controlled using the remote control in order to have some specific function done apart from the normal trained cleaning. It is equipped with ultrasound sensor for obstacle detection thus do not cause harm to any objects or persons around.

**KEYWORDS:** Trace-retrace mechanism, obstacle detection, mopping, vacuum suction, GPS, wireless communication.

## **I.INTRODUCTION**

Robot is any electromechanical machine and used for various purposes in industrial and domestic applications. In early 2010, a new automatic floor cleaner robot “Mint” was developed by Jen Steffen. Detachable clothes were attached for sweeping and mopping purposes. For tracking, mint used the GPS-like indoor localization system. Talking about the conventional cleaning procedure in any operation theatre, it comprised of spraying medically approved disinfectants, mopping the floor, cleaning all the four vertical surfaces or the walls of the operating theatre. It is a very hectic and time consuming procedure, as the operating room has varied biomedical equipments. These equipments are not only expensive but also very sensitive. Thus utmost care needs to be taken when cleaning the area they are placed in. Also, operation theatre is a place where there should be complete sterility maintained at all times. However, more the number of tasks involved in the cleaning procedure, more number of staff are employed there. This hinders the operating theatre’s sterile environment, as humans are potential carriers of bacteria and infection. This is where our ‘**AUTOMATED OPERATING ROOM CLEANING ROBOT**’ offers engineering solutions to the medical fraternity. In this project work, a floor cleaning robot based on AT89S52 has been developed. This cleaning robot is a machine to be used in operating rooms, which works in two modes as per the user convenience “Automatic and Manual”. Unlike other floor cleaning robots, it performs vacuum suction, disinfection and mopping operation with minimal or zero human intervention. It not only ensures clean and sterile operating environment but also reduces the time for which an operating theatre is not functional. Also limits the labour cost. These employees can to put to work in some other hospital department where ever the need be.

## **II.FEATURES**

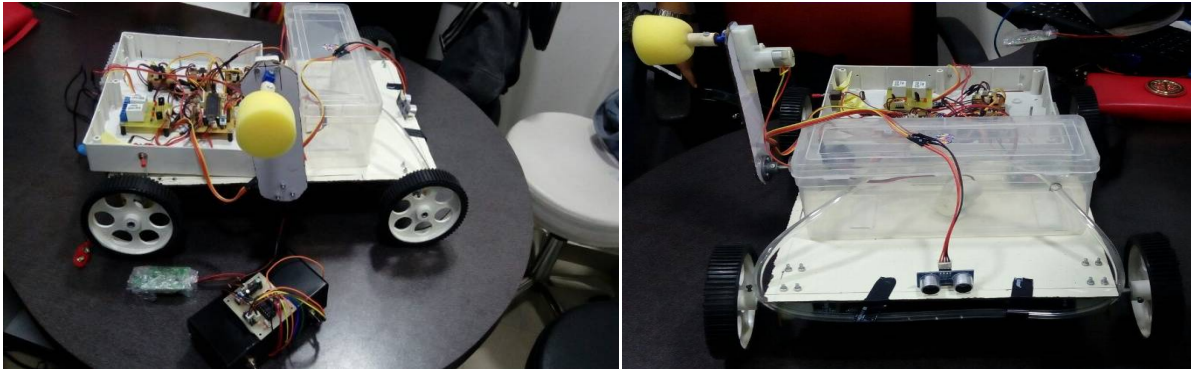
- A. A robot provided with vacuum and mopping facility.
- B. Obstacle detection at the front centre of the robot.
- C. Spraying of solution is possible.
- D. Vertical shaft is provided with cleaning brush for cleaning of walls.
- E. A Microcontroller to follow trace re-trace mechanism.

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## III.WORKING



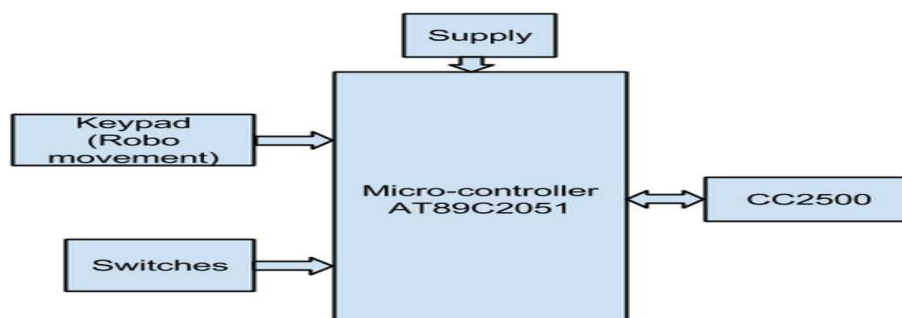
1. Robot side view

2. Robot front view

In the automatic mode, robot performs all the operations itself. The operations such as vacuum suction, mopping and changing the path in case of hurdles are performed automatically. Initially the robot is to be operated in the manual mode. Here the memory of the robot is being fed with the overall dimensions of the operating room and the path it needs to follow during the entire cleaning process for a particular operation theatre. After this, the robot can be switched to the automatic mode of operation. Firstly when robot starts, it moves forward and performs cleaning action. For obstacle detection and to avoid hurdles, ultrasonic sensor has been used. The obstacle detection range is 1ft. RF modules provide wireless communication between remote and robot and their range is 50m. If any hurdle is detected, the robot will alter its pathway and continue with its work. Now if the same robot is to be used, to work in a different operation theatre it again should be trained for its new path in the manual mode and then can be operated in the automatic mode without any further human assistance. An automatic disinfectant liquid spray is attached which automatically sprays the disinfectant before mopping. The liquid sprayer can also be provided with water if just mopping is desired as there would then be no need to attach wet cloth again and again for mopping for the convenience of user. To make whole system wireless, CC2500 have been used in automatic and manual mode. CC2500 module has been used to transmit and receive the signal to operate the robot through remote. Motor driver circuit have been used to drive the motors. A total of 7 motors are used in the robot to achieve the different degrees of motion. In the manual mode, user itself operates the robot. The microcontroller can be easily used to modify and enhance the various capabilities of any robot, evolving its capabilities to explore new pathways of working efficiently. Sensors and bump are effective in movement of robot around cliff and boundaries of the room. The block diagrams below show the possible interfacing of various components both at the remote side and the robot side.

## IV.BLOCK DIAGRAM

### A. REMOTE CONTROL SIDE

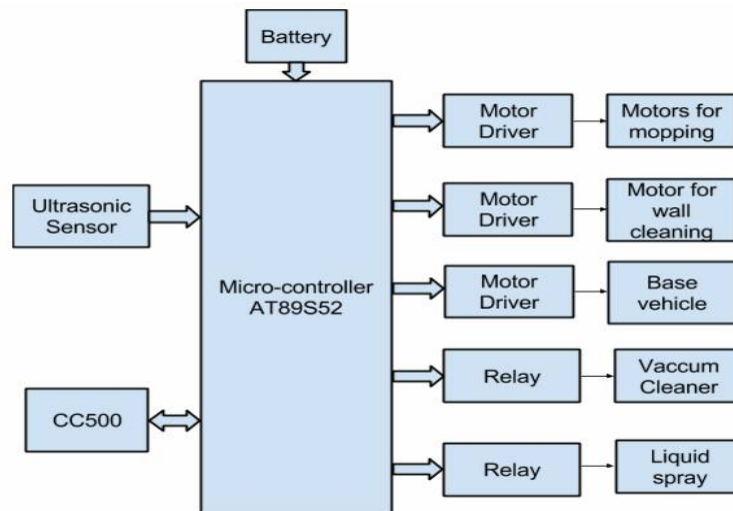


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## B. ROBOT SIDE



## V.ADVANTAGES

- It reduces human labour.
- Better maintenance of sterility in operating room.
- It can be used anytime and anywhere, it does not get tired and is never busy.
- Saves on labour costs and time, as a single machine can do the work of multiple laborers in lesser time.
- It can clean areas of hazardous environment and biomedical wastes.
- Cleaning surfaces at any height.
- Any path can be fed into its memory thus eliminating human involvement during operation

## VI. ESTIMATED TEST RESULTS

PARAMETERS	VALUE
Frequency of base motor	60 rpm
Frequency of vertical shaft	30 rpm
Vacuum pressure	6.8 psi
Ultrasonic detection range	1 foot
Wireless communication range	30m
Disinfectant released at a time	5 ml

## VII.APPLICATIONS

- The robot cleans the room as per the instructions given in limited time.
- Mopping of the operating room can be done to remove blood droplets and other solutions thus preventing human contact with it.
- Used to remove dust particles and other minute particles sticking to the horizontal and vertical surfaces.
- Cleans all corners and edges with its capability of 360 degree rotation.
- Disinfectant of required quantity can be sprayed.



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## VIII.FUTURE SCOPES

- A. The robot can be modified in a way to separate the type of wastes collected and deposit in to separate waste bags thus preventing people from getting hurt by the surgical wastes.
- B. This robot can be equipped with high end cameras to monitor its work and point out problems if any and navigation purposes.
- C. Bacterial filtration mechanism can also be provided along with air filtration.
- D. Instead of RF module, Xbee pro series module can be used to improve the range of wireless communication.
- E. GSM module can be used to send message that the robot has done the cleaning task.
- F. Sweeping can also be done with vacuum cleaning and mopping.

## IX.CONCLUSION

The operating room cleaning robot has the capability of mopping the floor and vacuum suction of the dust and disinfecting the operating room surfaces. It detects obstacles in the range of 1 ft and can work on both automatic and manual control. It does not involve human intervention (apart from the first usage of the robot to direct it the dimensions of a particular operating room) and it can work in any surgical areas involving metals and other hazardous and incisive biomedical wastes.

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