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Automatic Cleaner Robot

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ABSTRACT

Robots have become an integral part of 21st century due to their excessive use in household, hotels, offices etc. Cleaning which is of paramount importance for healthy living is being neglected due to lack of time arising from busy lifestyle. Taking this in consideration we are proposing an automatic cleaner robot that can perform all the cleaning activities without any human guidance. Even though there are various cleaner robots that are available today but their high costs and low versatility are the major reasons that hold back their selling rates. Therefore the aim of this project is to design a cost efficient, low maintenance and a versatile robot that can perform floor mapping, dry vacuum cleaning as well as wet cleaning. It operates in an autonomous mode along with some additional features like scheduling for specific time and dirt container with auto dumping mechanism. This robot is basically designed for the handicapped people having mobility issues to clean the house without any external help. In addition to it, for commercial purpose it will save the time and enhance the lifestyle of individuals.

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I. INTRODUCTION

Even though there is considerable work done in this application of robotics, none of it concerns with the cleaning of both dry and wet floors by respective detection. The conventional vacuum cleaner consists of large mechanical and electrical parts which are more costly and consume more power whereas the autonomous cleaner robots consists of low power consumer electronics and mechanical parts and it can operate during power outage period and does not need any human guidance.
Robotic cleaners are basically distinguished on their cleaning expertise like floor mapping, dry vacuum cleaning etc. The motto of this project is to evaluate cost efficient, light weight, less noisy and low maintenance robotic system.

Simultaneously having the facility of automatic avoidance of any obstacles and capable of finding its way around after fall from a height. A couple of spinning brushes are attached to the underneath of the cleaning machine to accumulate dirt, debris during the move along the way. Robot can clean along edges and into other hard-to-reach places. They are guided by certain algorithms for path planning and navigation, accordingly robot cleans the surface. Sensors present in it are used for obstacle detection. The robot's bumper prevents it from bumping into walls and furniture by reversing or changing path accordingly.

The robot will remember its path to docking station as it starts mapping area and path of motion right from when it undocks from the station. When the battery charge is below a certain percentage, the robot shall start finding its way back to the docking station and get charged before resuming cleaning.

II. LITERATURE REVIEW

Recently there is surge of innovative cleaner robots in the market. All these robots are based on the technical

analysis of research work published in some of the papers described below. Manreet Kaur and Preeti Abrol, in the paper "Design and development of floor cleaning robot" have made the cleaning using automatic and manual modes. They have used RF modules for wireless communication between remote and robot having range of 50m. In the automatic mode, robot controls all operations itself and changes the lane in case of hurdle detection and moves back. In the manual mode keypad is used to perform the expected task and to operate the robot. The drawback in this model is that it does not have the feature of self-charging.

The another paper which was pubished by Jens Steffen Gutmann, Kristen Culp, Mario E. Munich and Paolo Pirjanian in the paper "Social impact of a systematic floor cleaner" explain mint cleaning robot which is an automatic cleaning robot that sweeps and mops hard surface floors using dusting and moping cloth was developed. It investigates the product's social impact with respect to the attitude of customers towards a systematic floor cleaner and how much a robot influences a lifestyle. Systematic cleaning was an important feature and modifications to the environment to support the navigation of the robot. The robot employs a systematic cleaning strategy that maps the environment using GPS like indoor localization.

Many more systems were proposed and among that is the system proposed by J.Y. Sung, R. E. Grinter and H. I. Christensen in "Housewives domestic robot technology international journal of social robotics". In this paper a new type of home intelligent cleaner adopted the ultrasonic and IR sensor array which had the function of real time environment perception is introduced and the cleaner is driven by step motor has the ability of autonomous working by itself and the functions of automatic detection and obstacle avoidance. This paper adopts grid scan algorithm placed on electric map, realize floor coverage task and designs synthesis detection system based on sensor array finding method technology according to algorithm characteristics. However this system did not support wet detection and it only performed dry cleaning.

Therefore we are proposing a system to overcome the drawbacks of the existing system.

III. BLOCK DIAGRAM

The main components of this proposed system are raspberry pi microcontroller, sensors and motor assembly interacting with each other as shown in block diagram.

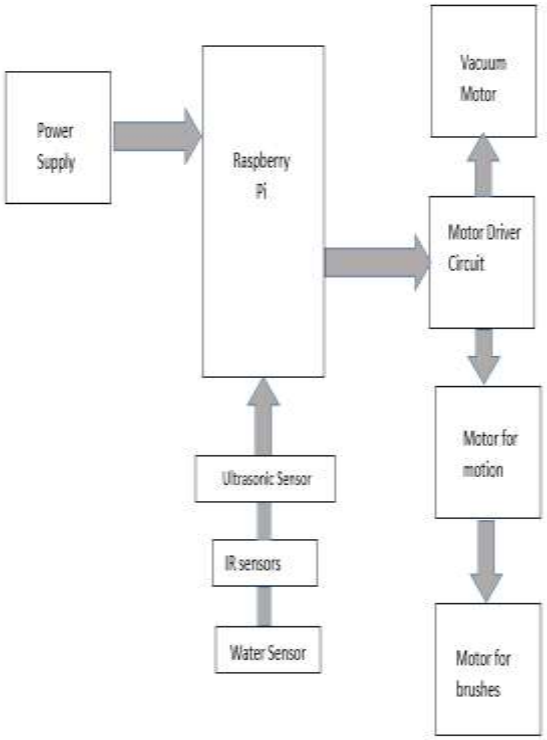

Fig 1. Basic block diagram

IV. WORKING

For the aimed feature of application, the robot will be provided with a wet surface detector as he moves along his path sequentially mapping the given area while sweeping and vacuuming the floor simultaneously. As soon as a wet patch is detected, the cleaning mechanism shall change from sweeping and vacuuming to wiping/soaking and blow drying. The mechanism shall revert back to dry cleaning once the wet detector shows no sign of wet floor. The robot shall avoid bumping into obstacle & falling down from edges. These goals will be achieved by using infrared sensors, cliff sensor and US sensors. The robot is fitted with IR sensors on all sides which detect the surrounding walls and helps the robot map the area and choose its paths accordingly. Cliff sensor is nothing but IR sensor facing downwards so that it could detect the increased distance from floor when it happens to be going over an edge. This way, the robot shall stop immediately and alter its path.

The robot will remember its path to docking station as it starts mapping its area and path of motion right from when it undocks from the station. When the battery charge is below a certain percentage, the robot shall start finding its way back to the docking station and get charged before resuming cleaning. The robot is fitted with two rotating brushes parallel to the cleaning surface and rotating in opposite directions such that the dust in the way is collected and fed to the vacuum mouth which is just behind the rotating brushes. For the wet cleaning, the robot shall first soak the wet patch with a sponge and then the vacuum function shall change to blowing which

should dry the wet patch. Once the level of wetness is diminished, the robot shall move on its path.

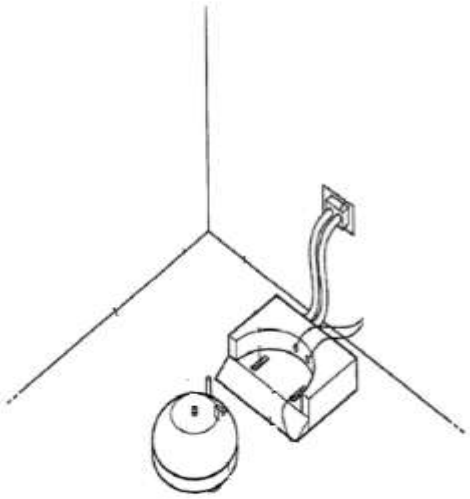

Fig 2. Docking Station

V. ALGORITHM

Robot will follow the spiral area coverage pattern. It will assign coordinates to its instantaneous position. By using two IR Sensors on Left and Front direction, it will sense the obstacles and shape of the room to carry out its operation.

Whenever it reaches a corner, i.e., both the sensors sense the wall, it will take a right turn by rotating corresponding motors in appropriate manner. While doing so, it also stores co-ordinates at every point until it returns to a unit before its original position.

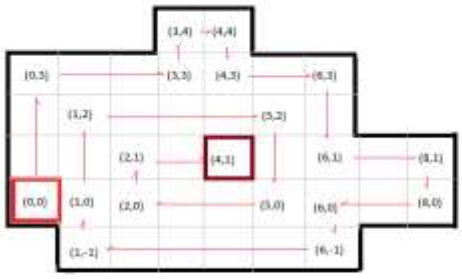

Fig 3. Path Tracing Algorithm

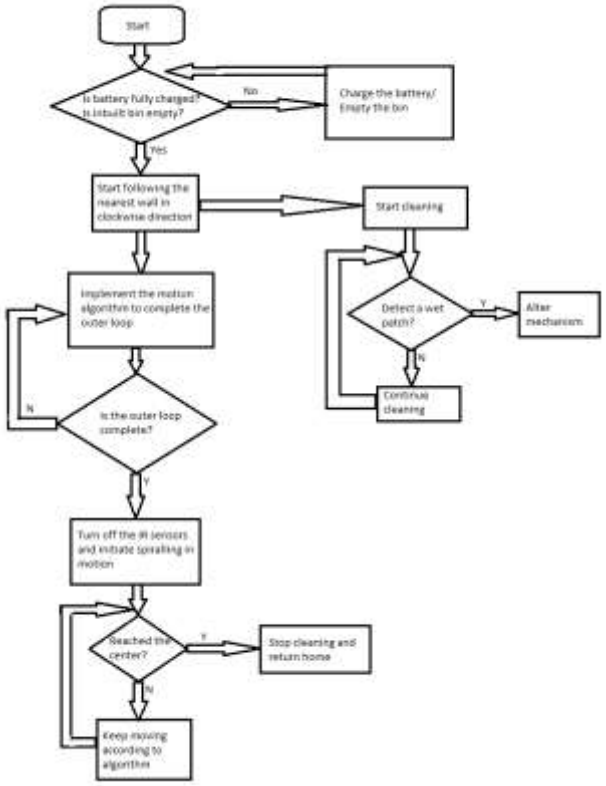

Fig 4. System flow diagram

VI. MECHANICAL DESIGN

Mechanical design consist of chassis, brushes, vacuuming and dirt disposal.

Chassis- Especially designed wooden circular chassis with 30cm diameter, two floored has been used as a base to mount all the components of the robot.

Brushes- The robot is fitted with two rotating brushes parallel to the cleaning surface and rotating in opposite directions such that the dust in the way is collected and fed to the vacuum mouth which is just behind the rotating brushes.

Wet sponge mop- When the wet surface is detected by the sensor then the sponge mop will be lowered from the base of robotic assembly to clean the wet surface. The wet sponge is connected by a solid contact.

Vacuum and dirt disposal- When the two brushes rotate in the opposite direction parallel to the cleaning surface, dust collected is fed to the inlet of vacuum which is located right behind the brushes. The collected dust is then accumulated in a dirt container which can be automatically emptied as needed.

VII. CONCLUSION

Therefore we have developed an automatic cleaner robot that performs dry cleaning as well as wet cleaning. This robot operates in an autonomous mode have some additional features like scheduling for specific time and dirt container with auto dirt mechanism. This robot is more versatile and cost efficient than the existing systems. As it has scheduling feature which is being operated by an android app makes this system more user friendly. This robot is designed for the handicapped people having mobility issues for cleaning purpose without any external help. It can be used in industries and for other commercial purposes to save the time and also to enhance the lifestyle.

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