SMART VACUUM ROBOT

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***Abstract*—In recent years, people are becoming more career oriented and due their irregular working schedule it becomes challenging to maintain both home and office together especially for women. Most of the cases, they hire the cleaners to clean the home, office etc., but no trust on cleaners. To overcome the problem, Smart Vacuum Cleaner has come up with the more advancement in technology and is designed to automate cleaning process. The application is used to initiate the robot. The navigation of the robot is according to the S-curve planning and with the help of sensors it detects and avoids obstacles. To save the time of the people the smart vacuum cleaner helps to clean the surface of the floor without any human intervention.**

Keywords— IOT, Mobile, Bluetooth, Dust particles

I. INTRODUCTION

The Internet of things (IoT) is a network of physical devices that are embedded with electronics, sensors, software and network connectivity to share the data. The IOT gives access to sense and control the objects remotely in a network which gives direct integration of physical world into computer based systems. The robotics details with design, operations, construction and application of robots. It also details with computer system for the control, information processing and sensory feedback. The Internet of things and Robotics have been hand holding each other contributing to individual growth and development.

In modern era robots are playing an important role in life of mankind with their advance technologies, making the human life easier and comfortable. The cleaning robot are effective in assisting humans in floor cleaning applications at homes, hotels, restaurants, offices, hospitals, workshops, warehouses and universities etc. so they have taken more recognition in robotics research. Fundamentally, the robot cleaners have been distinguished by their cleaning competence like dry vacuum cleaning, floor mopping etc. Some existing products are built based on the simple obstacle avoidance using infrared sensors or ultra-sonic sensor and some use laser mapping technique. The operations and cleaning mechanism of each cleaning robots have its own advantages and disadvantages. For example, some of the robots using laser mapping are relatively less time consuming, faster and energy efficient but costly. The laser mapping technique has few drawbacks such as it requires high-end hardware for data processing and purchasing of new software that uses clouds. The obstacle avoidance based cleaning robots are relatively time consuming and less energy efficient due to random cleaning but less costly. The countries that don't manufacture Cleaning robots have to be imported from other country so the cost increases. To provide a substantial solution to the problem of manufacturing robotic cleaner utilizing local resources while keeping it low costs. To provide a substantial problem solving for manufacturing cleaning robot can be built by utilizing local resources and by keeping it low costs. The Smart vacuum cleaning is built based on obstacle avoidance with low cost. This work gives the design and development of smart vacuum floor cleaning robot. The robot can be used in domestic and industrial purpose for cleaning the floor periodically without human intervention.

A. SCOPE OF WORK

The smart vacuum robot is built to collect the dry dust particles on the smooth tiles without human intervention.

B. PROBLEM STATEMENT

To design a vacuum cleaner that is intelligently programmed to clean the floor.

C. OBJECTIVES

The objectives of the project are as follows:

1. To automatically detect and avoid the obstacles.
2. To collect the dust particles into the vacuum.
3. To indicate the battery level.
4. To control the robot through application.

This paper is arranged into six sections. Section I discusses the brief introduction of IoT, section discusses the literature survey, section III deals with methodology use for robot implementation, section IV covers the implementation and section VI conclusion.

II. LITERATURE SURVEY

In the field of robotics, there appear several autonomous as well as the manual based cleaning robots. They include many unique features which are subjected to make user friendly. According to the survey [1-5] automatic cleaning robots are more convenient than manual based machines. The autonomous cleaning robots are intelligently programmed that serves the basic function of cleaning i.e., dry as well as wet cleaning. Some of the cleaning robot products are available with a brush around sharp edges and corner while other includes wet mopping and Ultra Violet (UV) sterilization. The robot with UV sterilization

concentrates its cleaning processes on visible dirt as well as invisible bacteria. This type of cleaning keeps humans from disease free but robot with this kind of advance technique can cost high. To show cleaning efficiency there are different mapping techniques involved. Some of them are s-curve mapping, use cell-wise Poisson processes on a regular grid to estimate the distribution of dirt on the floor [1], artificial intelligent camera to have 2-D panoramic image view [6] of the regions, laser mapping technique and random move technique etc. Even though wheeled robots are autonomous, they are independently planned to perform the peculiar tasks. To have control over robot to complete the tasks, there are different controlling techniques.

There are many existing paper and models that represent the additional features for cleaning robot [7-10]. Few of the models may have drawback that can be overcome by applying the intelligently programmed with advance techniques. The below papers provide over view of their models.

A. Robotic Vacuum Cleaner

The paper addresses about the robot which is controlled by the android application through Bluetooth module [10]. The application sends the information to microcontroller to have control over robot. The distance of the obstacles is detected using the ultrasonic sensors and the distance is displayed on LCD and as well as on application. Here man controls the overall operation indirectly.

B. Bluetooth Based Automatic Floor Cleaning System

In the published paper [11], the model is designed to clean the floor with wet and dry. The Bluetooth module is used for controlling entire system with the help of remote or mobile. By using Bluetooth module we can direct and turn the system as the user needs.

III. METHODOLOGY

The Figure.1 describes block diagram which includes components like ultrasonic sensors, motor drivers, Wi-Fi module and vacuum cleaner which are connected to microcontroller and the power supply of 12V is given. The dotted lines represents that microcontroller controls the Ultrasonic sensors and motors for obstacle detection and to move in a particular direction. Wi-Fi Module is used to control the robot through dashboards for ON/OFF by connecting to cloud.

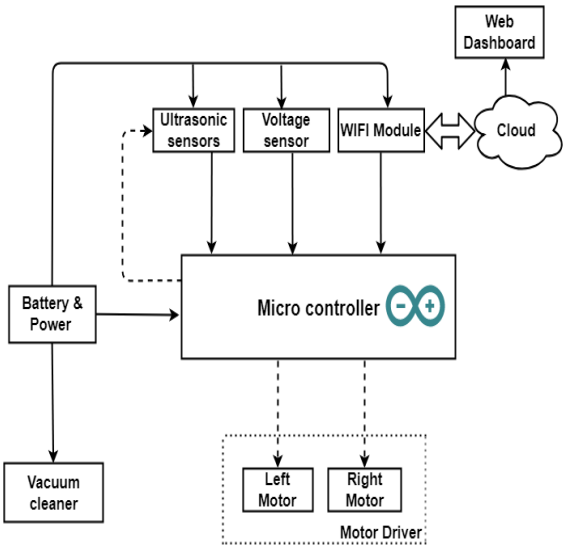

Figure.1: Functional Block diagram

The Figure.2 describes the flow of information between the components. When the application is started, the user must authenticate then s/he can control the robot through dashboards. When the robot is turned on the ultrasonic sensors check for the obstacles on its path. If obstacle is detected, the robot stops for few seconds and changes its direction according to the program. Every time the robot moves it checks for the obstacles and continue its cleaning process. If battery is less than 40%, then notify the user through application or else continue the cleaning process.

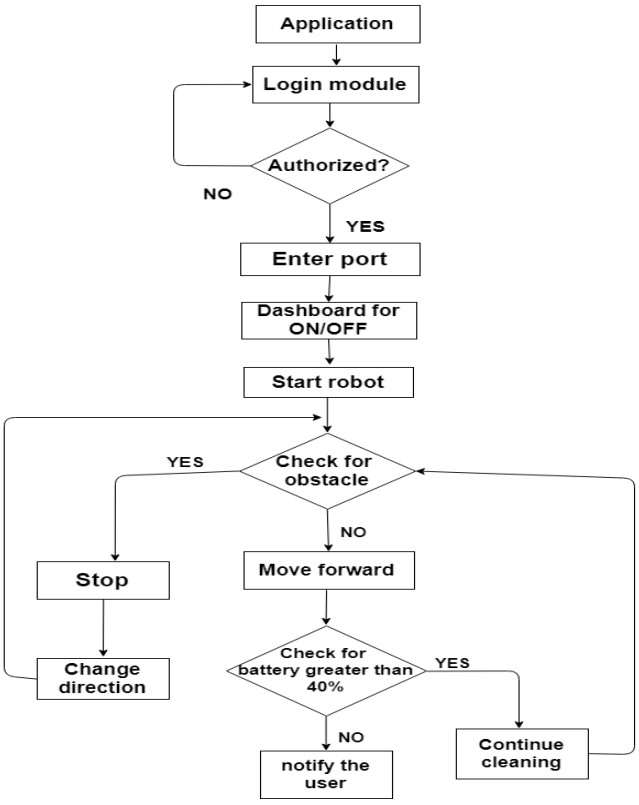

Figure.2: Flow diagram.

Smart vacuum robot is initiated through application by connecting to the Wi-Fi access point and entering port number. After initiating the robot, three ultra-sonic sensors, motor driver are initiated and the robot is navigated according to the logic. The communication between software and hardware is shown the Figure.3.

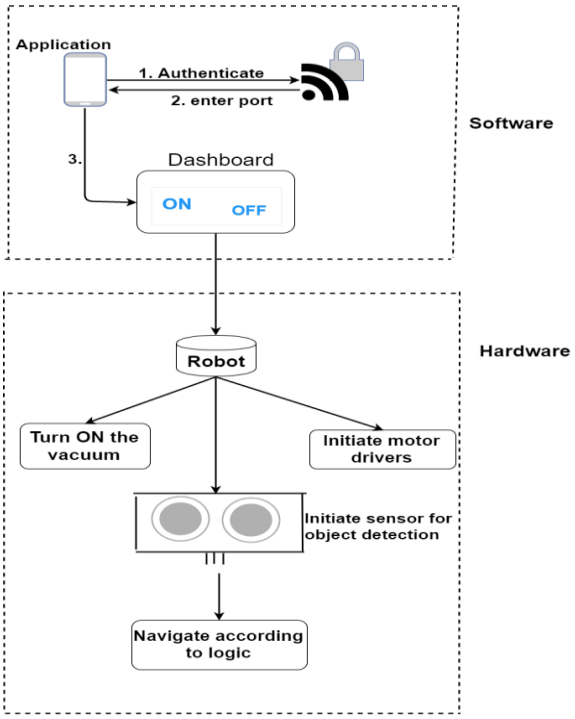

Figure.3: Architecture diagram of the Smart vacuum robot.

IV. IMPLEMENTATION

The hardware components of robot and application are integrated using microcontroller. The robot is made automatic that satisfy main objective of cleaning. The testing of the robot showed the functionality which user can operate (on/off) the robot for cleaning process that navigates in the s-curve logic. It also helps the user by indicating the battery level through application such that user can recharge as per required.

The microcontroller is used to integrate and control all three ultrasonic sensors, motor driver, voltage sensor and Wi-Fi module. The VCC and GND of all the sensors are made common using bread board to get battery supply as shown in the Figure.4.

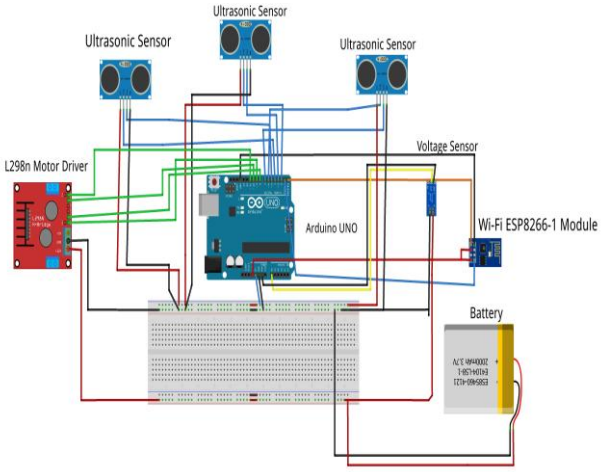

Figure.4: Circuit Diagram of Robot

Table 1 shows the modules of the proposed solution and their specifications.

Table 1. MODULES AND SPECIFICATIONS

SL.No	Modules	Specifications
1	Battery life	1 hour
2	Dust box	9*7.5*5.5=371.25cm^3
3	Robot weight	1kg
4	Wi-Fi range	46m indoor,92m outdoor

The smart vacuum robot is initiated by following steps-

1. The mobile need to get connected to the hotspot that is created by the Wi-Fi module as shown in Figure.5.The Figure.6 shows to provide the authentication password need to be entered. In Figure.7, the application gets connected by providing the port number.

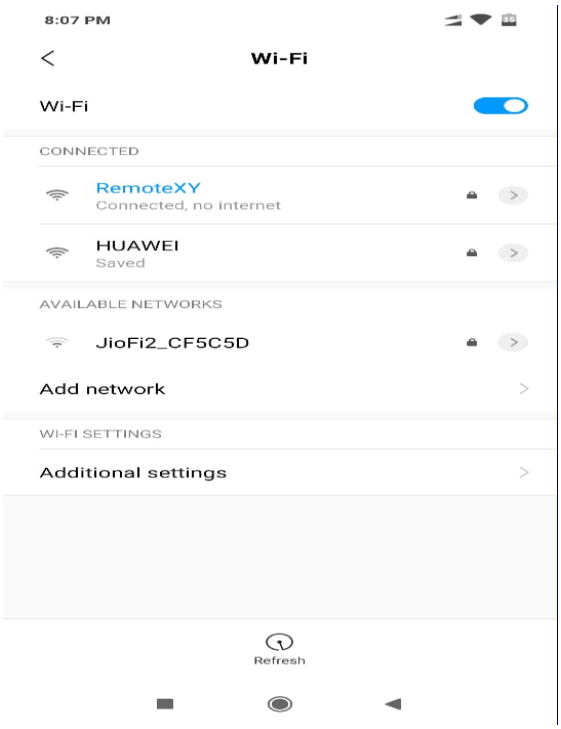

Figure.5: Mobile connection to the Remote XY Hotspot

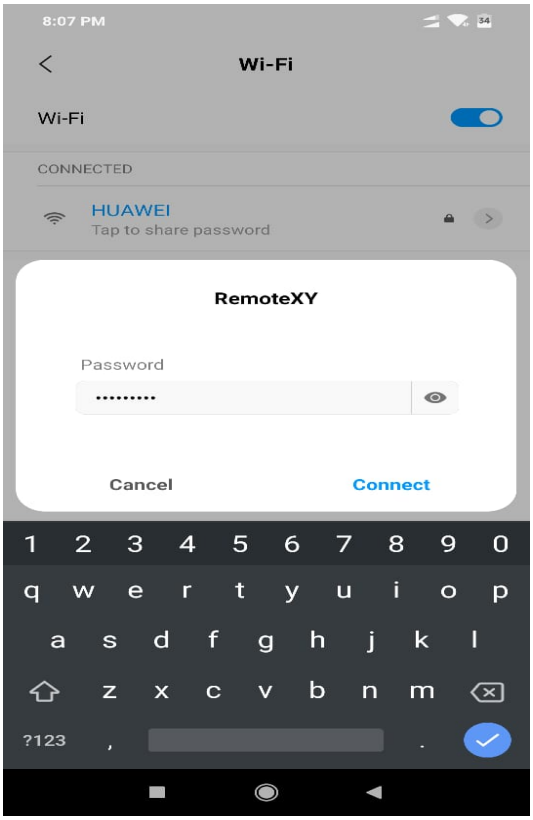

Figure.6: Password authentication for Hotspot.

Figure.7: Application is connected by port number

2. The Figure.8 show the display of application with ON button that need to be swiped to turn on the robot. The Figure.9 shows the indication of the low battery level.

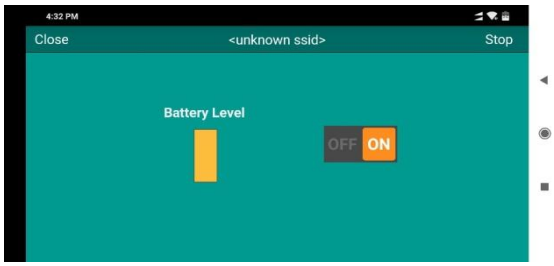

Figure.8: Turning ON the robot in application.

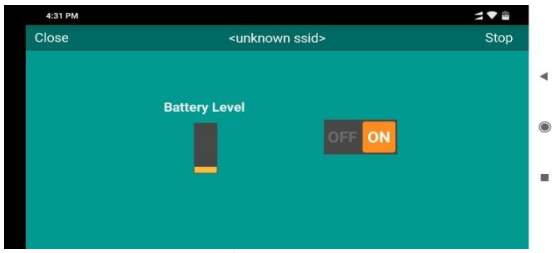

Figure.9: Indication of Battery Level in the Application.

3. The robot gets turned on with sensors, vacuum and motor driver. The Figure.10 and Figure.11 shows the top view and the front view of the robot. It begins to navigate according to the logic of the program.

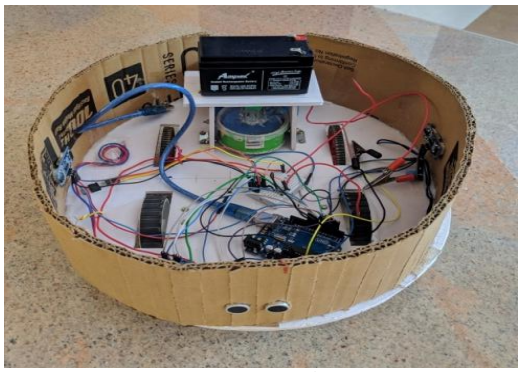

Figure.10: Top view of the robot.

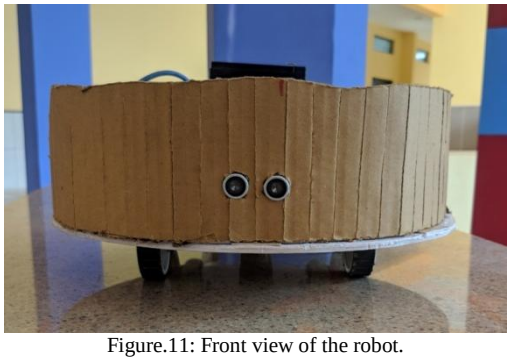

Figure.11: Front view of the robot.

4. The vacuum is designed as shown in Figure.12. To cover the cleaning surface area the as shown in Figure.13 cleans with the efficiency greater than 75%.

Figure.12: Vacuum of the robot

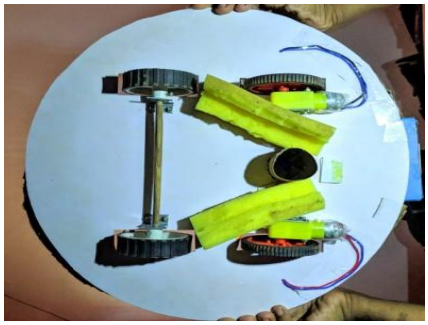

Figure.13: Vacuum Attached to the Robot.

VI. CONCLUSION

The developed robot is developed is fully operational that navigates according logic. It is operated to achieve cleaning of dry dust particles with more efficiency. Since robot is wireless device it can navigate to cover the large area. It also makes less human interaction which reduces the human work. The robot can be further used to upgrade with the functionalities such as to sense and detect as well as to move in the direction of dust which results in better cleaning, self charging, self dust disposal and to schedule timing for cleaning.

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