© MAR 2026 | IRE Journals | Volume 9 Issue 9 | ISSN: 2456-8880
DOI: https://doi.org/10.64388/IREV9I9-1713024

Automatic Vacuum Cleaner

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Abstract- ***Nowadays, technologies are upgrading day by day. Robots are taking the place of human beings for making work simpler and time- efficient. Due to which they are getting more attention in the field of research. As we all know, Health is Wealth, hence hygiene is a major part of everyone's life and floor cleaning is also one of the important parts of hygiene. To keep ourselves healthy, hygiene is required. The main purpose behind designing of cleaning robot is to make the life of mankind happy, easy and comfortable by consuming manpower. The autonomous robotic vacuum cleaner is an automatic and programmed device to clean the surface with the help of a mop and vacuum cleaner. This is the robot that automatically cleans the dirty surface by using a set of commands given by the user through the smart phone. This cleaning robot includes two different types of cleaning. Mopping (wet mopping) and cleaning with the help of a vacuum. The microcontroller and Wi-Fi module are the main components. The Wi-Fi module is responsible for exchanging commands the micro controller. The device is operated by using three different modes, which will be presented in App. 1. Manual mode, 2. Automatic mode and 3. Timer mode, respectively.***

Index Terms- ***Node MCU, Timer mode, Automatic robot, cleaning assembly, etc.***

I. INTRODUCTION

Cleaning is important at every place, whether it's household or industry. Sometimes it is possible to do so but sometimes it may not, due to some reasons. In today's generation we all are busy with our heavy work and always often to AI the floor clean. Many times, cleaning is required in such areas where the presence of human beings is risky or dangerous, so we cannot assign human beings to such places. Also, if the cleaning area is a larger, then we could need more than one person for cleaning. Also, human capability can be the main issue that occurs while cleaning larger area, human can get tired during cleaning larger area. In areas like nuclear plants or chemical industries the dangerous radiations, chemicals, air, pollutions can make a man sick or death [9]. So, this device can be used in such areas. The main purpose of this project is to design and implement which will work in autonomous, manual, and timer mode via a phone application.

Some of the bigger companies like Mi, Xiaomi, Dyson have already designed similar products, having different features which are commonly available in the market, but their cost is high. So, they are not affordable to everyone. To overcome this problem, we made an autonomous floor-cleaning robot that cleans the floor with the help of cleaning assembly in a risky as well as safe environment. By programmed accordingly, it works similarly as a human being. The device can be used in offices, industrial places, or for household use. Our project is categorized into three different sections. 1) Obstacle detection and avoidance unit 2) Cleaning unit 3) Control unit. We used an ultrasonic sensor to detect and avoid obstacles. Cleaning has two types of cleaning. i.e. Wet Mopping and Vacuum Cleaning. Since the project is IoT based project, hence Wi-Fi module is an interface between a microcontroller and the smart phone. It exchanges commands from smart phone to microcontroller and vice versa. The robot is operated manually, autonomous as well as timer mode. By choosing the required mode and cleaning type, the robot performs its cleaning operation and after completion, it automatically gets so stop.

II. LITERATURE SURVEY

The robotic vacuum cleaner is an autonomous electronic device that has self-drive mode and it automatically cleans the surface by cleaning assembly, without any human assistance. There are many successful products available in the market. Trifon, Eureka Forbes, I Robot Roomba, Eco cars Excellent Ready Maid Robotic Vacuum Cleaner, Jests, these are some top 10 Robotic vacuum cleaners in the year of 2021[2]. Every product has some advantages and disadvantages. Roomba is one of the vacuum cleaner robots which include amazing

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features. One of the features of Roomba is it has a powerful motor suction unit that sucks the dirt into the filtered dust bin [8]. Also, it is arranged at an angle of 270 degrees, so that a sweeping brush can easily sweep the dust present at the corners or the edges. The main issue with these products is they are not only costly but also not much compatible with Indian users [3]. These products are much effective for the wooden floors than tiles. So such kind of product is used for only wooden floors. We can't use this product for tiles. There are some products which do work for the tiles but this is available in high-end versions only [4].

Before the early discussions on the project, a market survey has been done in which a target group of 100 families was consulterd and enquired about the cleaning and mopping robots [5]. The below figure shows the result of the given survey which as follows

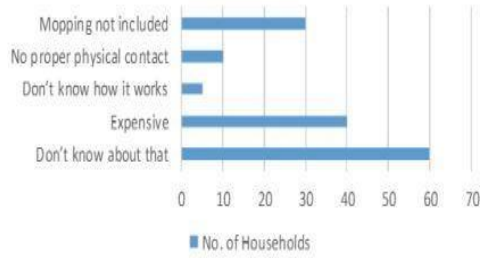

Figure1: Market Survey on Automatic Cleaning Robot

Fig.1 depicts the result of the market survey conducted on target group of100 families; from the figure it is understood that more than 60% of the families don't about the existence of such kinds of robots. They don't aware of these robots, and 40% of them felt that the price of the robot is too high [6]. Also, 5% of them don't know how the cleaning robot works. And 10% of the already designed devices don't have proper physical contact. Around 30% of the devices have notincluded mopping features. An automatic floor cleaner robot has ultrasonic sensors to detect an obstacle; brushes attachedto its sides to collect the dust. Also, it includes a suction unitto sucks the dust. But the drawback of this robot is it cannot clean the wet floor [1]. Some of the available products can brush around sharp edges and corners while others include several additional features such as wet mopping and UV sterilization rather than vacuuming [7]. One can add Artificial intelligence for future development.

III. PROPOSED SYSTEM

The "Autonomous robotic vacuum cleaner" is a device that cleans the surface automatically as well as manually.Fig.2. shows a better understanding of the proposed work. This block diagram of the device consists of a 12V Battery, Node MCU, L293DIC, Ultrasonic sensor, Relay, Scrubbing wheels, Buzzer, DC motors, Servo motor, and cleaning assembly, etc. The Power supply is given to both Node MCU as well as the relay. The relay acts as a switch so that it controls the water pump whenever any instructions are received from App. The L293D motor driver is used to driving the dc motors. A Buzzer is used to give the indication of an obstacle. The Wi-Fi module acts as an interface between the device and the smart phone. The 3D printed vacuum cleaner is used to suck the dust from the floor. And it is fixed on the right side of the robot. The dust sucked by the vacuum cleaner is collected by a box. After cleaning user can easily remove that dust from that Box. Also, mop is used forwetmopping, whichfitted at the backend of the robot.

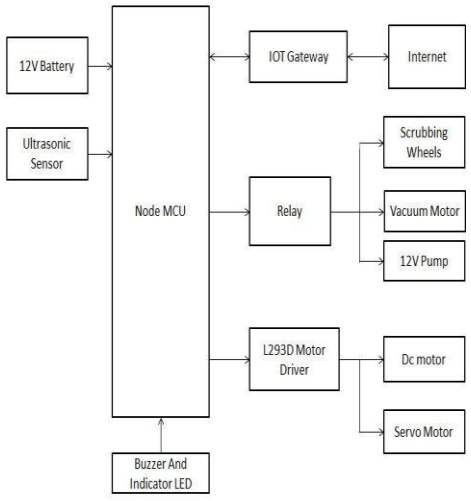

Figure2: Block Diagram

IV. DESIGN AND DEVELOPMENT

The working of the device is divided into three different units.

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A) Obstacle detection and Avoidance Unit

The ultrasonic sensor is used to detect an obstacle in its path. The ultrasonic sensor transmits ultrasonic waves which detect the presence of an sense or measures the distance of the obstacle with the help of an ultrasonic sensor and changes its direction accordingly. The sensing distance range of the robot is set by Arduino Nano programming and within this range, the robot senses the obstacle and turns back.

B) Cleaning Unit

Once the obstacle is successfully avoided by the robot, it starts its cleaning operation. If there is no obstacle in the path, the robot continues its cleaning. The cleaning unit includes two types of cleaning, i.e.

i. Wet Mopping: Stain cleaning is done by using wet mopping. The mop is fitted at the back end of the robot. We used a 12V DC water pump that is deep into the water tank, so when the relay gets start we get water through the DC water pump for cleaning.
ii. Vacuum Cleaning: Dust is clean by using a vacuum. We used a 3D printed vacuum cleaner. By using a Vacuum cleaner dust can be easily sucked from the floor.

C) Control Unit

To make communication between a user and the system an interface is required. The Wi-Fi module acts as an interface between Microcontroller and Smartphone. We used Blynk App to give commands to the robot. There are three modes to operate the robot accordingly. i) Manual mode: The user can navigate the robot by using the navigation key present on the App. ii) Automatic mode: In thismode, without any navigation robot works automatically. iii)Timer mode: If we set a particular time, then the robot will work for that several times only. In this mode, the user doesn't need to stop the robotfrom the app; it will automatically stop after completion of that set time.

D) How does the robot work?

The project is an IoT-based project, so when an internet connection is given to both the robot and smart phone, robots start to accept the commands from the smart phone given by the user.

The robot is controlled through smart phones. When a user'startes the robot through the App, it get steady to work.After selecting any one of the mode and cleaning types to clean the surface, the robot starts to work accordingly. When obstacles or walls come in front of the robot, then buzzer turns ON & robots stop its cleaning. i.e. relay turns OFF and the robot will change its direction with the help of DC motors. All the data will continuously be displayed on the BLYNK App through ESP8266. When the obstacle is detected and at the same time if any instructions come from the user through the app, then the robot will follow that instruction & move forward. Otherwise, it continues its cleaning when the cleaning is done. The robot automatically stops. Fig 2 shows the flow of the work.

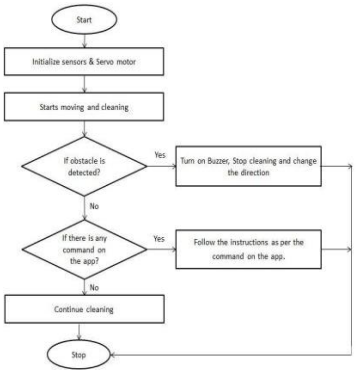

Figure 3: Flow chart

V. HARDWARE SPECIFICATIONS

A) Node MCU ESP8266

Node MCU is an open-source IoT platform. It is mainlyused for IoT based projects. It includes Lua-based firm ware since firmware uses Lua as a scripting language. This firm ware executes on the ESP8266 Wi-Fi So C from Express if Systems, and hardware that is based on the ESP-12 module [12].

Figure4: Node Mcu

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Features:

- Interactive
- Open source
- Programmable
- Low-cost
- Small size
- WI-FI enabled

Specifications: The Development Kit totally based on ESP8266which combinesGPIO, PWM, I2C, 1-wire, all in one. Power your development within the fastest way in combination with Node MCU Firmware!

- Digital I/O Pins(DIO):16
- Analog Input Pins(ADC):1
- USB-TTL included plug & play.
- FCCCERTIFIEDWI-FI module.
- PCB antenna.

B) Ultrasonic Sensor

This sensor is a high-performance ultrasonic range finder. It is very small in size and measures a wide range from 2cmto 4m. The distance can be measured in time required for traveling of the sound signal using simple formula as below [10].

Distanceincm=(Echo pulse width high time(inus)/58
OR
Distance=(Echopulsewidthhightime*VelocityodSound (340m/s))/2

Specifications

- Operating voltage:+5V
- TheoreticalMeasuringDistance:2cmto450cm
- PracticalMeasuringDistance:2cmto80cm
- Accuracy:3mm
- OperatingFrequency:40Hz

C) L293D Motor Driver

It is a monolithic integrated chip. It is also called motor driver. It has dual built-in H-bridge circuits with the help of it controls two DC motor at a time. L293D produces high voltage, high current to accept standard DTL or TTL logic levels and drive inductive loads and switching power transistors [11].

Figure6:L293DMotorDriver

Specifications:

- 600 mA output Current capability per channel.
- Enable facility.
- Over temperature protection.
- High Noise-Immunity inputs.
- Internal clamp diode.

VI. SOFTWARESPECIFICATIONS

Figure7: Blynk App representation on smart phone

The Circular shape Joystick is used to navigate the robot- like forward, backward, left, and right respectively. When the manual mode is selected by

the user, then with the help of a joystick user can operate the robot easily. When the auto- mode is selected by the user, the robot works automatically without any human control. Similarly, when the user selects timer mode, then the robot will work up to the set time which is set in the program already. By changing the time, we can work that device accordingly. Again, there are Brush1and Brush2, when it gets selected robot starts brushing. And when vacuum and water pump selected, Vacuuming and Wet mopping will get starts. The LED is also present there, for the indication of an obstacle with this; a user easily and comfortably controls or uses the robot.

VII. RESULTANDANALYSIS

After the implementation of a robot, we have done testing of the robot. In the testing, were corded results obtained by the robot.

1. The Robot successfully detects and avoids obstacles with the help of an ultrasonic sensor.
2. The Robot performs both wet mopping and vacuum cleaning operations to clean the floor.
3. The Robot easily operated from the smart phone through the App.
4. The Robot transmits and receives commands from the user successfully.

Below fig.8 represents the hardware of the Autonomous Robotic Vacuum Cleaner.

Figure8: Autonomous Robotic Vacuum Cleaner

VIII. CONCLUSION

We designed an “Autonomous robotic vacuum cleaner” which cleans the floor by using cleaning assembly in three different modes. These features of the robot make the device user-friendly. It also reduces human efforts. Also, the implementation cost of the robot is less compared to the other cleaning robots. So, it can be affordable for everyone.

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