Automated Vacuum Cleaner

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Abstract— In the modern workplace, robots are indispensable in all facets of employment. Robots have greatly simplified human labor and saved time and energy. This paper proposes a floor cleaning robot that might be programmed to clean both wet and dry using an Android device. This robot used a wireless method to make cleaning simple and extremely effective. Two vacuum compressors are positioned in front and behind the robot to facilitate dry cleaning, while a cleaning pad with water storage underneath is positioned behind the robot to facilitate wet cleaning.

The proposed robot is controlled via the Blynk software for Android smartphones, which functions as a transmitter and sends commands to the Node MCU receiver, which has 11 input/output pins and 1 analog pin. Through a Wi-Fi receiver, the Node MCU receives instructions from an Android app, decodes them, and steers the robot in the proper direction.

Keywords— Node MCU,Motor Driver,Wi-Fi Module,IR Sensor,Autonomous System,Blynk App.

I. INTRODUCTION

The technique of cleaning floors has advanced with the robot evolution. Many people perform floor cleaning on a daily basis; takes a long time as well as human energy. Naturally, the exorbitant expense of that kind basic duty led to the creation of substitute options, among which is the Automatic Floor Cleaner.

The way we interact with and manage our household equipment has changed dramatically in recent years because to the introduction of Internet of Things (IoT) technology into common appliances. One such breakthrough is the creation of smart vacuum cleaners, which use Internet of Things platforms to provide improved control and monitoring capabilities Moreover,automating the cleaning process.

As a consequence of their evolution into smart, networked systems, household appliances now offer far better convenience, efficiency, and user experience.

In this research study, we discuss the development of a smart vacuum cleaner system that offers improved cleaning capabilities for home applications by integrating Bo motors, a submersible pump, and IoT technology.

This study describes the conception and implementation of a smart vacuum cleaner system with remote control integration via the Blynk smartphone application and is outfitted with Nodemcu, a motor driver, DC Gear Motors, IR sensors, and lithium rechargeable batteries. With extra features like a compressor for dust compression and a water tank for sprinkling and mopping, The system's purpose is to clean homes effectively by executing sweeping and mopping tasks.

The front brush and movement are provided by the Bo motors, which provide effective debris collection and mobility on a variety of surfaces. By accepting water tank operations for mopping duties, the inclusion of a submersible pump improves the system's functioning and guarantees that hard floors are thoroughly cleaned.

Additionally, the Nodemcu platform and the Blynk app's integration of IoT technology allows users to remotely control the vacuum cleaner's features, such as turning it on and off for both mopping and sweeping. Users may start cleaning jobs from anywhere within the Wi-Fi network's coverage area thanks to this integration, which offers them freedom and convenience.The vacuum cleaner uses infrared sensors to identify obstacles, and lithium rechargeable batteries ensure portability and convenience by allowing portable operation without the need for frequent recharging.

The device also includes a dust container to collect waste during sweeping, which guarantees effective cleaning and simple disposal of accumulated dirt and dust.

II. LITERATURE REVIEW

Recent years have seen an increase in interest in the creation of autonomous vacuum cleaner systems due to the growing need for smart, connected home appliances.This section looks at relevant studies from a variety of academic journals.

and conference proceedings, with an emphasis on how automated vacuum cleaner design incorporates cutting-edge technology including motor control, sensor mechanisms, and the Internet of Things.

Singh and colleagues, "Designing a Smart Vacuum Cleaner in Two Modes of Remote & Automatic" - (2020)[1]:
The development and execution of an intelligent vacuum cleaner with two working modes—remote and automatic—are examined in this study. Singh and associates investigate the incorporation of IoT technology to provide remote control features, providing perspectives on increasing user comfort and adaptability.

"Design & Implementation of Floor Cleaning Robot using IoT" - (20 21) [2] according to S. Gupta and colleagues:
The work by Gupta and associates focuses on the creation and use of a floor-cleaning robot with Internet of Things capabilities.The study emphasizes how crucial IoT connectivity is for improving coordination and communication between the robot's cleaning tasks, which eventually optimizes coverage and efficiency.

"IoT Based Smart Auto Cleaner Robot using Node MCU" - (20 21) [3] R. Sharma and colleagues:
Sharma et al. investigate a Node MCU platform-based Internet of Things (IoT) smart automobile cleaner robot.

To enhance the cleaning robot's autonomy, their research investigates the integration of IoT for remote monitoring and control.

M. Patel et al.'s "Automatic Floor Cleaning Robot" (2014)[4]:
The design and development of an autonomous floor cleaning robot is the subject of this groundbreaking study by Patel and associates. So as to facilitate effective and autonomous cleaning operations, their study focuses on navigation algorithms and sensing systems.

"Automatic Domestic Vacuum Cleaner" - (2023)[5] P. Jain and associates: Author Design and execution of an autonomous home vacuum cleaner are examined by Jain and co-authors. Their work explores advancements in IoT integration, sensor systems, and motor control with the goal of maximizing cleaning efficiency and user comfort.

"Smart Vacuum Cleaner" by Q. Li and colleagues (2021)[6]:
Li and associates showcase the latest developments in intelligent vacuum cleaner technology, emphasizing the amalgamation of sensor mechanisms, motor control, and Internet of Things. Their study emphasizes how crucial intelligent features like autonomous operation and remote control are to improving user experience.

III. OBJECTIVE

The automated vacuum cleaner project's goal is to create and put into practice a smart cleaning solution that improves user experience, convenience, and efficiency for cleaning duties around the house.

The specific objectives include:

Advanced technology integration: Using the Nodemcu platform and the Blynk mobile application, integrate parts like lithium rechargeable batteries, IR sensors, submersible pumps, DC Gear motors, motor drivers, and IoT connection.

Remote control functionality: Using the Blynk app, allow users to turn the vacuum cleaner ON and OFF remotely for both the sweeping and mopping modes.

Ability to clean autonomously: Use infrared sensors to identify obstacles during autonomous navigation, which will guarantee effective and safe cleaning procedures.

Multipurpose cleaning functions: provide additional features such a water tank system for sprinkling and mopping in addition to sweeping and mopping skills,

and a compressor for compressing dust.

IV. METHODOLOGY

There are several important elements in the process for the automated vacuum cleaner project that makes use of the

NodeMCU, WiFi module, and Blynk app:

Components to Select: Pick the right parts, such as brush rotation and power from Bo motors, water tank operations from a submersible pump, obstacle detection from IR sensors, precise control from a motor driver, power from lithium rechargeable batteries, and Internet of Things connectivity from a NodeMCU with a WiFi module.

Hardware Design: Design the vacuum cleaner system's hardware architecture, keeping compatibility, wiring, and component location into consideration. Make sure the chosen parts are connected and working properly as you integrate them into the system.

WiFi Communication Setup: To enable remote communication with the Blynk app, configure the NodeMCU to connect to the nearby WiFi network. Create secure communication protocols that protect private information and data integrity.

Software Development: Develop the software elements needed for the vacuum cleaner system's management and control. Create firmware for the NodeMCU to manage motor control, WiFi connectivity, sensor data processing, and Blynk app interface. Put algorithms into practice for cleaning tasks, obstacle detection, and autonomous navigation.

Blynk App Development: Create and implement an intuitive user interface for the Blynk app, which enables remote control and operation monitoring of the vacuum cleaner. Incorporate features for real-time status updates, notifications, and ON/OFF control of the sweeping and mopping modes.

The entire process is managed by the NodeMCU, a microcontroller development board with wifi connectivity. The entire system is controlled in automatic mode, with communication via the Blynk app for ON and OFF operation as manual mode. In automatic mode, the robot can carry out all tasks without assistance from a human to complete the necessary tasks.An infrared sensor interfaced with a Node MCU microcontroller makes it easier to find obstructions in the path of the floor cleaning.The robot adjusts its course without pausing the cleaning process if the sensor finds any obstacles in its route as it is going. The dust is collected using front brush towards the suction machine.The robot can clean more effectively and get to the corners with greater efficiency .It moves in the direction -Forward,Backward and Right.

The automated vacuum cleaner has three distinct functions.
1) Sweeping and mopping simultaneously.
2) Just mopping.
3) Just sweeping

With the given toggle, these three operations can be altered. If the floor is extremely dirty, it must be swept and mopped.

If there are simply a few hand-picked dust particles rather than actual dust on the floor, it needs to be swept by itself.

If a few little dust particles are visible, the floor must be wiped by itself. A water sprayer is installed to automatically spray water for mopping purposes.

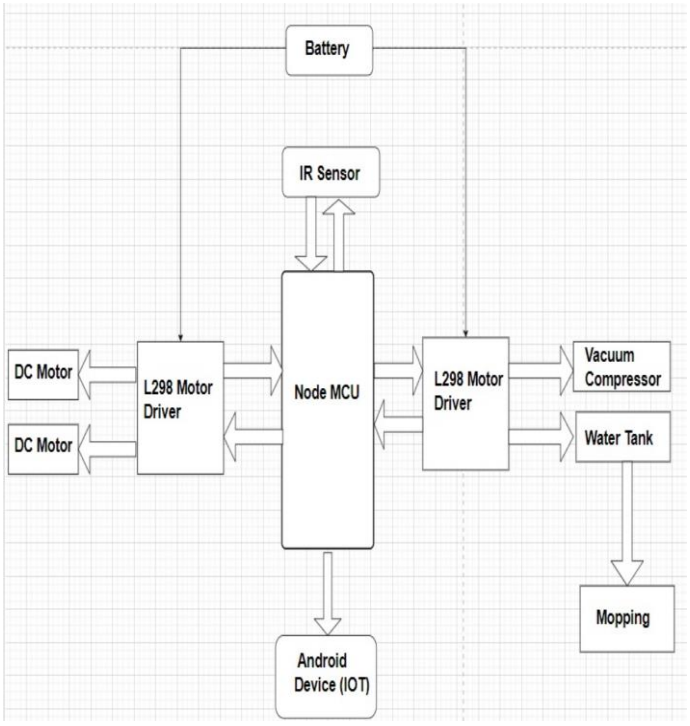
V. BLOCK DIAGRAM

In this, We provide power supplies of 3.7V and 11.1V, respectively, from lithium rechargeable batteries to the motor driver and Node MCU.Every motor driver is linked to the Node MCU in order to provide command and control.

To provide movement in this device, it is recommended that two motor drivers be employed.These have two motor drivers: one for moving the system and the other for cleaning and mopping.Every single motor driver is linked to the four D.C. motors. Motor drivers are utilized, respectively, for vacuuming and mopping.

The node MCU is being powered by an external USB power supply.The left motor driver is linked to DC motors for motion, while the right motor driver is linked to the water tank and vacuum compressor for sweeping and mopping.

In order to prevent collisions, The vacuum cleaner uses infrared sensors to detect objects in front of it.



I **Fig1. Block Diagram**

VI. COMPONENTS

A. Node MCU

Fig.2 shows Node MCU,The Node MCU micro controller is employed in the suggested model. It is an open source project development platform for electronics. The ESP8266-12E, a high integration wireless SOC (system on chip), serves as its primary controller.

It can include Wi-Fi capabilities into systems or function as a stand-alone application.Its recommended input voltage range is 4.5-10V, while its operating voltage is 3.3V. It has one analog pin and eleven digital input/output pins. Node MCU dimensions are 49 x 26 mm, with a clock speed of 80 MHz and a temperature range of -45 °C to -125 °C. Although it comes with a simplified programming language called "Lua Script," we may also use the Arduino IDE to program in C or C++.

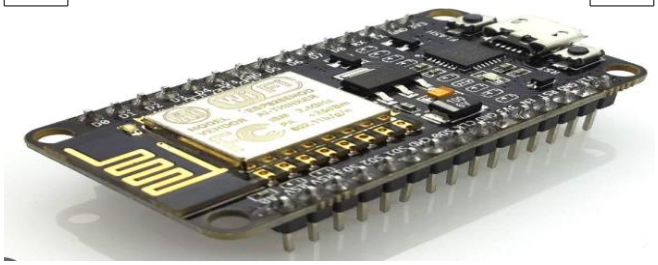


Fig2. Node MCU

B. L298 Motor Driver Module

Fig.3 shows Motor Driver,Integrated into a single monolithic circuit, the L298N motor driver is a twin full bridge driver with high voltage and high current.

It can run four DC motors or two two-phase stepper motors. The embedded stabilvolt tube 78Mo5 allows the module to receive 5V from the power source.

However, the drive voltage must be maintained at a level higher than 12V to avoid damage to the 78M05 chip; external 5V logic should be utilized. Its input voltage range is 5-35V, and its high operating voltage is up to 40V with a peak current of up to 3A. The PCB is 4.2 by 4.2 cm and has 15 input/output pins.

Fig3. Motor Driver

C. Lithium Ion Rechargeable Batteries

Fig.4 shows Li-ion (Lithium-ion) rechargeable batteries ,They are a common kind of battery used in automatic vacuum cleaners connected to the Internet of Things (IoT).Li-ion batteries' high energy density, light weight, and rechargeability make them perfect for lightweight, portable, and energy-efficient products like vacuum cleaners.

Lithium-ion rechargeable batteries are widely used I in vacuum cleaners and other electrical devices due to their high energy density, lightweight design, and multiple rechargeability.Lithium-ion batteries are applied in vacuum cleaner projects as the device's power source. They supply the electrical energy required to run the motor, sensors, and other electronic parts.

Fig4. Rechargeable Lithium Ion Battery

D. IR Sensor

Fig.5 shows IR sensor.Usually, An IR sensor module is made up of an IR emitter and an IR receiver fitted into one box. Infrared light is emitted by the emitter, and reflected infrared signals are detected by the receiver. The sensor module detects the obstacle to avoid collisions.

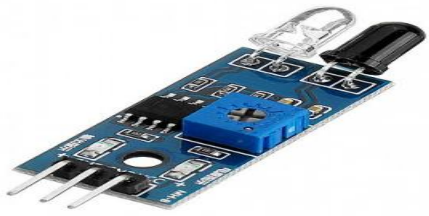


Fig5. IR Sensor

E. DC Gear Motor

Fig.6 shows DC Gear motor,The DC Gear motors, which offer efficient trash collecting and motion on a range of surfaces, supply the front brush and movement. A submersible pump ensures that hard floors are completely cleaned and enhances the system's functionality by accepting water tank operations for mopping tasks.

Fig6. DC Gear Motor

F. Wheel

Fig.7 shows Wheel.With the usage of a DC motor, a wheel is employed to move the body from one location to another. An axle bearing is positioned through the center of a wheel, which rotates when a moment is applied by the torque to the wheel about the axis, enabling the automatic vacuum machine to move together and easily. Wheels are typically circular in shape, hard, and composed of durable material. Heavy weights can be transported effectively when a wheel is positioned vertically under a load-bearing platform. Conversely, when a wheel is positioned horizontally, its vertical axis rotation allows adjustment of the spinning motion.

Fig7. Wheel

G. Submersible Water Pump

Fig.8 shows Submersible water pump.The "Automated Vacuum Cleaner" project's submersible water pump is essential to making the device's mopping function possible. This kind of pump is perfect for pulling water from a tank or reservoir and transferring it to the vacuum cleaner's mopping mechanism because it is made especially to function when submerged underwater.

A small design is one of the main benefits of a submersible water pump. Since these pumps are usually lightweight and compact, they can be seamlessly integrated into the vacuum cleaner's general design without adding a considerable amount of weight or size. This guarantees that the vacuum cleaner maintains its portability and maneuverability while continuing to provide wet mopping functions.

Fig8.Submersible Water Pump

H. Small Water Tank

Fig.9 shows small water tank.Depending on the model of vacuum cleaner and how it will be used, the water tank's dimensions and design may change. To guarantee the vacuum cleaner's best performance and longest lifespan, users should fill, empty, and maintain the water tank according to the manufacturer's instructions. Maintaining the vacuum cleaner properly keeps it from developing problems like mold or bacterial growth and guarantees that it can continue to clean both wet and dry messes.

Fig 9.Small Water Tank

I. Mop

Fig.10 shows mop.A mop, also known as a floor mop, is a piece of cloth, sponge, or other absorbent material that is fastened to a pole or stick, or it can be a mass or bundle of coarse strings, yarn, etc. It can be used to mop up dust, clean floors and other surfaces, absorb liquid, and perform several other cleaning tasks.

There are two types of mops:

- Dry Mops
- Wet Mops

The purpose of a dry mop, often called a dust mop, is to remove loose, dry contaminants from floors, such as sand, dust, and dirt. It can be used as the initial stage in floor cleaning and is made of yarn or microfiber.

In the second stage of surface cleaning, a wet or moist mop is employed in professional cleaning. To remove and absorb contaminants such as fat, muck, and dried-in fluids, a wet mop is brushed across the surface. Expert wet mop heads are made of a single, microfiber sheet.

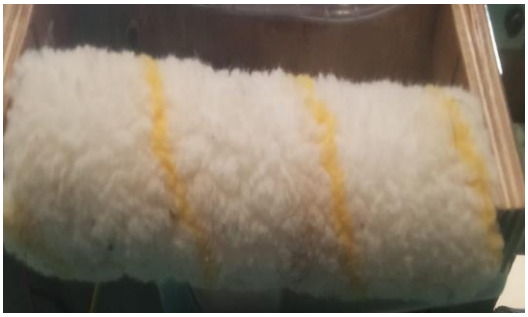


Fig10. Mop

J. Front Brush

Fig.11 shows Front Brush.An essential part of the "Automated Vacuum Cleaner" project for gathering dust and particles from the floor is the front brush. It is ideally positioned at the front of the vacuum cleaner and has a disk- or cylindrical-shaped design with ridges or bristles to efficiently collect waste. The brush, whether it is motorized or not, collects and stirs up dirt to keep bigger particles out of the vacuum cleaner's internal workings. Its adaptability and adjustability guarantee ideal contact with various floor kinds, improving cleaning efficacy. Its longevity and effectiveness depend on routine maintenance. All things considered, the vacuum cleaner's capacity to effectively maintain clean floor surfaces is greatly dependent on the front brush.It rotates in clock wise direction to collect debris towards the vacuum compressor.

Fig 11. Front Brush

VII. ADVANTAGES

Timesaving: Saving time is one of the main benefits of autonomous floor cleaning robots. They don't need the operator to exert any human labor; they can clean floors swiftly and effectively. This enables users to concentrate on other duties as the robot does the floor cleaning.

Consistency: Robots that automatically clean floors consistently deliver a pristine finish. They are designed to clean floors according to a predetermined pattern, so they never miss any patches or regions.

Productivity gains: When floor cleaning chores are assigned to autonomous robots, workers can concentrate on other duties while the robot cleans. In business contexts when time is of the importance, this is especially advantageous.

Cost-and energy-effective: Compared to conventional cleaning techniques, automatic floor cleaning robots use less electricity, making them more energy-efficient. They also don't need any supplies or chemicals for cleaning, which eventually lowers cleaning expenses.

Enhanced hygiene: To guarantee complete cleaning and disinfection of floors, automatic floor cleaning robots use cutting-edge cleaning technology, such as IR sensors for obstacle identification,This will get rid of every microscopic particle.

Simple to operate and safe: Automatic floor cleaning robots are made with simplicity via blynk app to ON and OFF the vacuum cleaner system.

VIII. Model of the Project

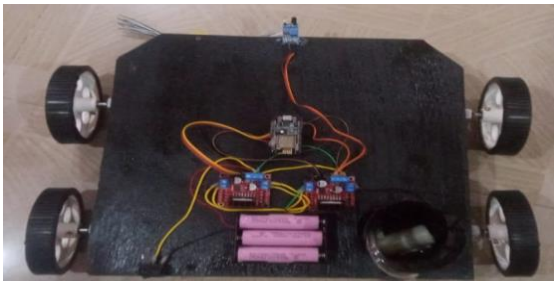


Fig12. Automated Vacuum Cleaner

Fig13. Vacuum Cleaner with Design

IX. CONCLUSION

The project's goal was to create an inexpensive, autonomous, smart auto cleaner that operated in a new field using the Internet of Things (IoT). This smart cleaner can be operated from any Android smartphone using the Blynk app, simplifying manufacturing and offering a more user-friendly interface for normal users . The system is designed to remove both dry and wet dust in both residential and office settings. Many of the floor cleaning robots on the market are unable to clean far-off places because they are out of range. Since our suggested robot is entirely internet-based, we may use it anywhere there is an internet connection, which also helps to maintain hygienic surroundings. When compared to the cost of labor, robots are far more economical for both industrial and residential applications. Because of their cost and flexibility, they are a better option for floor cleaning.

X. REFERENCES

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