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SMART HOME CLEANER

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Abstract— Modern home appliances are become increasingly automated and intelligent. Convenience and more time for individuals are two benefits of home automation. Although the domestic robot business is still relatively new and in its infancy, it is already permeating homes and people's daily lives. Nonetheless, growth is anticipated, and domestic robot usage is changing. This work has the potential to significantly improve humankind's way of life.

Our goal is to create an autonomous hoover cleaner that will make chores around the house much more convenient and straightforward. Along with other features like scheduling for a specified time and a dirt container with an auto-discharge mechanism, it can function in both automated and manual modes. The robot is a wonderful option for cleaning the floors because of its versatility, efficiency, and time-saving features. OpenCV (image-based processing), a raspberry pi camera, a dc motor and control driver, a node MCU, and an ultrasonic sensor are all used in automatic hoover cleaners. It also has a mop for wet cleaning, which allows it to automatically hoover and mop a floor in one go (sweep and mop). mixture). Through the use of image processing techniques, our hoover cleaner can identify obstacles and capable of determining the best course for thorough floor cleaning. The hoover cleaner is shortened. the form.It takes use of image processing, which meets a number of user-friendly requirements.

Keywords-- robot, cleaner , floor cleaning

I. INTRODUCTION

Time management is regarded as one of the most crucial aspects of modern living. One noteworthy household task is mopping floors, which is frequently seen as a challenging and tedious task. Most of the time, cleaning is contracted out to professionals rather than done by the people living in the home. Because of the difficulty this repetitive task caused, a hoover cleaner that could help humans with similar tasks had to be developed. An electromechanical device called a hoover cleaner is frequently used to clean carpets, rugs, floors and furniture by suction. The appliance's electric motor drives a fan, which partially evacuates the area and brings in outside air by creating a hoover. This pushes any dust or debris close to the nozzle into a bag that is either fixed to the outside of the machine or inside.

The need to lower the workforce has prompted the creation of automatic control systems, which allow machinery to run unattended. Every facet of automatic hoover cleaner operations is covered by the latest integrated automatic systems.

Even if they are efficient, today's hoover cleaners are heavy and need a lot of labour to operate properly. The later hoover cleaners operated with a belt driven by a hand-cranked fan, making them difficult to operate. The earlier models used a rotating brush to create suction and collect dust. More effective sweepers with lower suction power were developed in the late 1990s and early 2000s. Robotic hoover cleaners can be used in households, workplaces, hotels and hospitals, depending on the design goal. The smart cleaners are more expensive and hence out of the reach of most homes, while the majority of inexpensive cleaners require an improved cleaning pattern algorithm to operate efficiently. The hoover cleaner's design took these difficulties into meticulous account.

The present robot hoover cleaner was constructed for a pretty low cost using an ultrasonic sensor, computer scraps and a NODEMECU 8266 microcontroller. It uses a programmed algorithm to explore rooms, and two revolving sweepers positioned side by side improve its cleaning capabilities. Its truncated shape was carefully taken into account when designing the sweepers, and its efficacy was assessed.

The following operational modules were considered throughout the robot's design:

- a means of cleaning
- The ability to steer while automatically avoiding obstacles
- Taking up less room...
- Prevent falling from a specific height.

II. IDENTIFICATION OF PROBLEM

Identifying problems in smart Home cleaner is crucial for improving the customer experience, increasing sales, and ensuring the overall success of the business and clients. Here are some common problems .

Time Constraints: Many people have busy schedules and may struggle to find time for regular cleaning. A smart home cleaner automates the process, allowing individuals to focus on other tasks.

Physical Limitations or Disabilities: For individuals with physical disabilities or limitations, traditional cleaning can be difficult or impossible. A smart home cleaner provides an accessible and convenient solution.

Consistency and Regularity: It's easy for people to forget or postpone cleaning tasks. A smart home cleaner can be programmed to clean on a regular schedule, ensuring a consistently clean living environment.

Efficiency and Effectiveness: Smart home cleaners are designed to efficiently cover large areas and effectively remove dirt, dust, and debris, potentially outperforming manual cleaning methods.

Allergies and Respiratory Issues: Dust and allergens can exacerbate allergies and respiratory conditions. A smart cleaner equipped with HEPA filters can help improve indoor air quality.

Multi-Tasking: A smart home cleaner that can perform multiple cleaning functions (e.g., vacuuming, mopping) eliminates the need for separate devices, saving both space and time.

Hard-to-Reach Areas: Some areas of a home can be challenging to clean manually, such as under furniture or in tight spaces. Smart cleaners are designed to navigate and clean these areas efficiently.

Environmental Consciousness: Many people are increasingly concerned about the environmental impact of their cleaning habits. Smart cleaners are often designed to be energy-efficient and may use eco-friendly materials.

Privacy and Security Concerns: Some individuals may be uncomfortable with having strangers in their homes for cleaning services. A smart home cleaner eliminates the need for external cleaning services.

Smart Home Integration: For those who have invested in a smart home ecosystem, a smart home cleaner seamlessly integrates with other devices, allowing for centralized control and automation.

Peace of Mind: Knowing that your home is being cleaned regularly and efficiently can provide a sense of peace and well-being.

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III. IDENTIFICATION OF CLIENTS

Today's home require sophistication control in its different gadgets which are basically electronic appliances.

Identification of clients

Demographics - Targeting home owners, renters, families and individuals.

Geographic Location - Smart home trends can very by region.
Income Level - Making a budget friendly solution.

Lifestyle - Understanding the potential clients. Tech-savy, environmentally conscious , or time constrained.

Psychographics - Understanding their views on the smart management system

Identifying the needs

Convenience: Smart home cleaners should provide convenience by automating or simplifying the tasks.

Efficiency: Clients may want a cleaner that efficiently handles various types of cleaning tasks, saving them time and effort.

Customization: Some clients might have specific cleaning preferences or schedules that they want to customize.

Cost-effectiveness: Clients may be looking for a cleaner that offers good value for money in terms of features and performance.

Safety and Security: Ensure that the cleaner is designed with safety features to prevent accidents or damage to the home.
Integration: Compatibility with other smart home devices and platforms might be important to clients who are building a comprehensive smart home ecosystem.

Environmental Friendliness: In contemporary times, eco-friendly features and energy efficiency are often valued.

Relevant Contemporary Issues: AI and Machine Learning: Smart home cleaners are increasingly incorporating AI and machine learning to improve their performance and adapt to the environment.

IoT and Connectivity: Integration with the Internet of Things (IoT) and seamless connectivity with smartphones and other devices is crucial.

Energy Efficiency and Sustainability: The push for eco-friendly solutions is a significant contemporary issue. Clients are looking for products that are energy-efficient and have minimal environmental impact.

Privacy and Security Concerns: With more devices being connected, privacy and security become paramount. Clients want assurance that their data is protected.

COVID-19 and Hygiene: Given the ongoing pandemic, there's a heightened awareness of hygiene and cleanliness. A smart home cleaner that emphasizes sanitization features could be particularly relevant.

Multi-functionality: Versatility and the ability to perform various cleaning tasks (e.g., vacuuming, mopping, window cleaning) in one device is a contemporary trend.

Voice Control and AI Assistants: Integration with voice assistants like Amazon Alexa or Google Assistant is becoming increasingly popular

IV. LITERATURE SURVEY

Mohd. Shahbaz Khan et a1 "Bluetooth control cleaning robot using Arduino". They have designed a robot and the robot is controlled us- ing Bluetooth which is present at both transmitter and receiver end [1].

Vijayalakshmi M et a1 proposed "Smart Vacuum Robot" with progres- sive technology. S curve planning is used for efficient working along with sensors to avoid obstacles [2]

Gaurav Dhariwal et a1 have pro- posed "Development of Driverless RC Car". In this paper, an automatic car is built using concept of neural networks. This detects the obstacles present using sensors. Arduino and Raspberry Pi is used in this model [3].

S Yatamono et al proposed a paper on "Development of Intelligent floor cleaning Robot". They have developed a smart floor cleaning Robot that can clean the place by navigating, sucking the dust and polishing the floor. The robot consists of an omni wheel which is equipped with a vacuum cleaner and floor polishing motor. It is coded in Arduino IDE by using Arduino microcontroller and it is equipped with Bluetooth so that it can work from smart phone connected via Bluetooth [4].

Sabir Hossain et al proposed "Deep Reinforcement Learning-based ROS-Controlled RC Car for Autonomous Path Exploration in the Unknown Environment.

We have done comprehensive study of latest technological trends and efficient systems. We have undertaken extensive literature survey to study automatic vacuum cleaner parameters, such as sensors, raspberry pi module, raspberry pi camera and how to connect raspberry pi with NodeMcu. A well-planned literature survey has ensured availability of information for efficient system performance, technology usage, specialization and management of available resources. IOT based systems are also studied for automatic vacuum cleaner system.
Our study includes the current knowledge, findings, as well as theoretical and methodological contributions for development of automatic vacuum cleaner using image processing. It involves concept development, which is a set of activities carried out in the system engineering to collect parameters of operational needs and develop suitable system for implementation.
Design of smart vacuum cleaner which are available in the market are using Arduino Uno, Motor, Ultrasonic Sensor, and IR Sensor in order to achieve the goal of cleaning process. Vacuum cleaner Robots have several criteria that are user-friendly.
An autonomous vacuum cleaner robot are able to randomly navigate through a room or a house with the minimum human assistance, the following specifications that are found:

- Obstacle avoidance
- Floor avoidance
- Collision Detection
- Dry cleaning
- Wet cleaning
- Status display
- Automatic system

Four motors are used for the purpose like movement of robot, water pump. Relays are used to drive the water pump and cleaner motor. LM293D IC are used to drive wheel motor.All the information are displayed on LCD. These specifications correspond to some of the expected behaviours that will be programmed into the robot.

It consists of four dedicated wipers that are attached to the platform. Among them, one of the wipers is cylindrical and the others are flat in geometry. The flat wipers are symmetrically placed at the bottom of the Platform arranged in 'V' shape so as to ensure efficient cleaning and collection of dust. The roller wipers are placed at the end of the platform using proper links and a driver motor. The cleaning is made efficient using wet wiping system. This system employs a small bottle that carries water in it. This ensures a complete cleaning of the surface. Only the wipers in the front are made wet. This ensures that the wiper from the back remove the water from the surface [1]. Now a days, robot operates in autonomous mode as well as in manual mode along with additional features like scheduling for specific time and bagless dirt container with auto-dirt disposal mechanism. This work can be very useful in improving life style of mankind. Proposed design is being operated in dual modes. In one of the modes, the robot is fully autonomous and making decisions on the basis of the outputs of infrared proximity sensors, ultrasonic sensors and tactile sensors after being processed by Arduino (mega) controller and control the actuators (2 DC encoder motors) by the H-bridge driving circuitry. In manual mode, the robot can also be used to clean a specific area of a room by controlling it manually from laptop with a Graphical User Interface (GUI) in Visual Studio (C# programming language) via Bluetooth connectivity.

The base of the body comprises of acrylic sheet, two encoder motors along with Teflon tires having O-rings on them for avoiding friction, two ball casters of adjustable height having frictionless steel balls, aluminium angular brackets and aluminium holders for two lead acid batteries of 12V and 1.2Ah rating. Cleaning assembly includes a DC geared motor, sprockets for moving chain from geared motor to rotating brush and two aluminium rods for supporting vacuum cleaner mechanism and dirt compartment. This DC geared motor has been fitted on one side of acrylic sheet with aluminium holder and sprockets installed with it which have been fitted into shaft of motor. All components are installed on lower side of acrylic sheet so that center of gravity should be lower and robot would be stable[2]. In some of the vacuum cleaners, all hardware and software operations are controlled by AT89S52 micro-controller. RF modules have been used for wireless communication between remote (manual mode) and robot and having range 50m. This robot is incorporated with IR sensor for obstacle detection and automatic water sprayer pump. Four motors are used, two for cleaning, one for water pump and one for wheels. Dual relay circuit used to drive the motors one for water pump and another for cleaner. In the automatic mode robot control all the operations itself and change the lane in case of hurdle detection and moves back. In the manual mode, the keypad is used to perform the expected task and to operate robot. RF module has been used to transmit and receive the information between remote and robot and display the information related to the hurdle detection on LCD. The whole circuitry is connected with 12V battery. Unlike other floor cleaner robots this is not a vacuum cleaner robot; it performs sweeping and mopping operation. Detachable mop is used for mopping. In the automatic mode, robot performs all operations itself. Firstly, robot starts, it moves forward and perform cleaning action. For obstacle detection and to avoid hurdle IR sensors have been used. If any hurdle is detected then robot change the lane automatically, does not stop and starts cleaning action. It follows zigzag path. For user convenience automatic water sprayer is attached which automatically spray water for mopping, therefore no need to attach wet cloth again and again for mopping.Four motors have been used to perform respected operations like to move the robot, for water pump and for cleaner. Relays are used to drive the water pump and cleaner motor. LM293D IC is used to drive wheel motor.

All the information are displayed on LCD. In the manual mode, user itself operates the robot. RF module have been used to transmit and receive the signal to operate the robot through remote. In the manual mode, if any hurdle is detected, then signal of hurdle detection is displayed on the LCD of remote via RF module[3]. All the information displayed on LCD. In the manual mode, user itself operates the robot. RF module have been used to transmit and receive the signal to operate the robot through remote. In the manual mode, if any hurdle detected, then signal of hurdle detection displayed on the LCD of remote via RF module. In the following research paper which we have studied for the reference and help for our project uses following sensors: • OBSTACLE SENSORS • CLIFF SENSORS • WALL SENSORS • WHEEL SENSORS Obstacle sensors: From a robot vacuum's point of view, our homes are an obstacle course of chair legs, coffee tables, sofas, and stray toys. Sensors located on or near the vacuum's shock-absorbing bumpers allow it to steer through these obstructions without getting slowed down. When the bumper impacts an object, the sensor is triggered and the robot vacuum knows to turn and move away until it finds a clear path Which direction it takes is determined by where the bumper makes contact.

If a vacuum hit an object with the left side of its bumper, for example, it will generally turn right because it has determined the object to be to its left. But maneuvering around objects can often leave swaths of floor uncleaned. To minimize this, some manufacturers take—literally—different approaches to obstacles. An iRobot Roomba, for example, will slow down as its approaches an obstacle. "The advantage of Roomba is that we gently touch objects, because what we find is that you can push through soft objects like curtains and bed skirts," said iRobot's director of product management Ken Bazydola. "That gives you better coverage."

Cliff sensors: Stairs are perhaps the biggest peril for robot vacuums; a tumble could damage the vacuum and anyone in its path. Because of this, cliff sensors are a safety requirement on all robot vacuums. They measure the distance to the floor by constantly sending infrared signals to its surface. If the signals don't immediately bounce back, the robot surmises it has reached a stair or some other "cliff" and will change direction. Wall sensors: This sensor help in detecting walls, again using infrared light, so they can follow along them. This allows them to clean along the edges where the wall meets the floor. Best of all, it allows them to do it without bumping and scuffing the wall as we often do with stand up vacuums. In models with mapping capabilities, wall sensors can also help the vacuum to follow around open doorways and discover new areas to clean. Wheel sensors: A robot vacuum uses light sensors to measure wheel rotation. With this number and the wheel circumference, it can calculate how far it has traveled. At one time, sensor navigation was the way all robot vacuums worked. Today it's mostly limited to manufacturer's lower-end models, because though it's effective, it's not particularly efficient. Because these robot vacuums react to sensory input, they tend to grope their way through a room, vacuuming in haphazard paths. In order to get complete coverage and clean every area at least once they'll take multiple passes over a room in whatever time their battery life allows. In our tests, this usually meant longer vacuuming times and, in the case of larger rooms, uneven cleaning as some areas got more attention than others. "Since all the previous projects mentioned above follow zig-zag path where we cannot predict whether our vacuum cleaner has cleaned our room completely or not". Whereas in our proposed work we can conform ourselves that our floor has been cleaned by vacuum cleaner completely because in our project we will be using range of interest which will help our vacuum cleaner in determining the obstacles and selecting proper path to move.

The following figure shows the working model of CLEAR:

Fig 2.Mechanical design of CLEAR

V. METHODOLOGY

The methodology of the project implementation is to design and develop the smart vacuum cleaner, based on node mcu and machine learning using open cv technique to assess its functional efficency. The validity of project concept is required to be demonstrated by using hardware components, required software and integrating it all to fabricate a functioning model

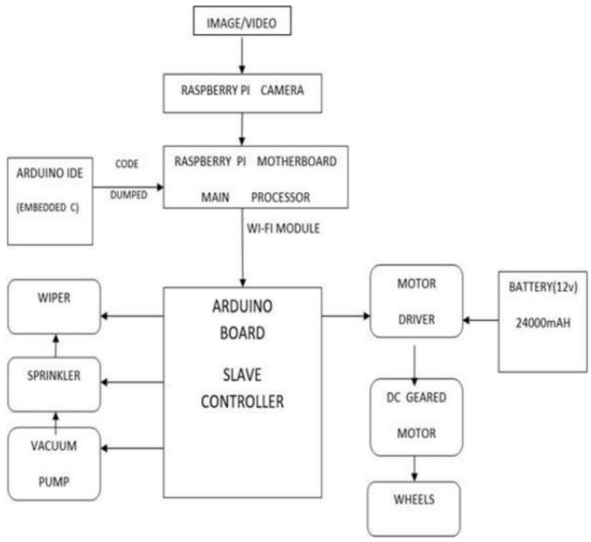

Fig 3.Working of Smart Home Cleaner

The edge of the floor is sensed as input by Raspberry Pi camera which later on undergo processing in Raspberry Pi Module, in which the edge of the floor is detected and this is done with the help of Open Source Software, and it also help in the proper movement of the vacuum cleaner.

The wheels and wipers are the output of the real time system proposed above. The Wheel is connected to DC geared motor which is driven by DC Motor Driver. The DC Motor is being rotated as per the code fed in NODEMCU 8266 and a result of which the wheels are moving in the sensed direction

The sprinklers and wipers are also attached to the proposed model in which when the wheels are moving in any particular direction of the floor, the floor under the vacuum cleaner model also gets cleaned up with the help of wipers and sprinklers are used to pour water at the time of cleaning the floor by wipers.

VI. RESULTS AND DISCUSSIONS

When analyzing and validating the results of a home automation system, there are several important points to consider:

System performance: The first thing to consider is the overall performance of the system. This includes factors such as system reliability, responsiveness, and ease of use. You should test the system under a range of conditions to ensure that it is functioning properly and that all features are working as intended. User satisfaction: Another important factor to consider is user satisfaction. You should gather feedback from users to determine whether they find the system easy to use, whether it meets their needs, and whether it provides the expected benefits. This can be done through surveys, focus groups, or user testing sessions. Energy efficiency: Home automation systems should be designed to be energy-efficient, so it's important to test the system's energy usage and identify any areas where improvements can be made. This could include optimizing sensor placement or adjusting settings to reduce energy usage during periods of low activity. Security: Security is a critical aspect of any home automation system. You should test the system's security features to ensure that they are working properly and that the system is protected against hacking, unauthorized access, and other security threats. Integration with other systems: Home automation systems are often integrated with other systems, such as security systems or heating and cooling systems. You should test the system's integration with these other systems to ensure that they are working together seamlessly and that there are no issues with compatibility or interoperability. Cost-effectiveness: Finally, you should evaluate the cost-effectiveness of the system. This includes not only the cost of the system itself, but also ongoing costs such as maintenance and energy usage. You should compare the costs of the system against the benefits it provides to determine whether it is a good value for users. Project management, and communication Home automation systems involve the use of technology to automate and control various home appliances and systems, such as lighting, HVAC, security, entertainment, and more. Project management and communication are essential to the successful development and deployment of a home automation system. Here are some key considerations: Project planning: The project manager needs to work closely with stakeholders, such as the homeowner, the development team, and any third-party vendors, to define project goals, requirements, and timelines. This may involve gathering feedback and conducting research to identify the best technologies and solutions for the home automation system. Resource management: The project manager needs to assign tasks and manage resources effectively to ensure that the project stays on track and within budget. This may involve coordinating with developers, designers, and other specialists, as well as overseeing the procurement of hardware and software components. Risk management: The project manager needs to identify potential risks and develop contingency plans to mitigate them. This may involve anticipating technical issues, scheduling delays, or other unforeseen events that could impact the project's success. Communication with stakeholders: Effective communication is essential to keep stakeholders informed and engaged throughout the project lifecycle. This may involve providing regular updates on progress, seeking feedback on design and functionality, and managing expectations around project timelines and deliverables. Training and support: Once the home automation system is deployed, the project manager needs to provide training and support to ensure that the homeowner can use the system effectively. This may involve developing user manuals, providing on-site training, and offering ongoing technical support to address any issues that arise. Overall, the success of a home automation project depends on the project manager's ability to manage resources, communicate effectively with stakeholders, and mitigate risks throughout the project lifecycle. Testing/characterization/interpretation/data validation. Testing, characterization, interpretation, and data validation are crucial steps in ensuring the reliability and effectiveness of any home automation system. Here are some key considerations for each of these steps: Testing: Start by defining clear testing objectives and requirements for the home automation system. Develop a comprehensive test plan that covers all aspects of the system, including hardware, software, and communication protocols. Conduct both functional and non-functional testing, including performance, security, and usability testing. Use a combination of manual and automated testing techniques to ensure comprehensive coverage. Test the system under different conditions, such as peak loads and network disruptions, to simulate real-world scenarios. Characterization: Determine the system's capabilities and limitations in terms of performance, scalability, and reliability. Identify any potential bottlenecks or vulnerabilities that could impact the system's performance. Evaluate the system's responsiveness to user input and its ability to adapt to changing conditions. Assess the system's ability to integrate with other devices and technologies. Interpretation: Analyze the test results to identify any issues or defects in the system. Determine the root cause of any problems and develop a plan to address them. Interpret the data to gain insights into how the system is functioning and identify areas for improvement. Use the results to refine the system's design and improve its performance. Data Validation: Ensure that all data collected by the system is accurate, complete, and consistent. Validate the data against predefined rules and standards to ensure its quality. Use statistical analysis techniques to identify any anomalies or outliers in the data. Verify that the data is being used appropriately and that it is providing value to the users. By following these steps, you can ensure that your home automation system is reliable, effective, and provides a seamless user experience.

IMAGES OF THE RESULT:

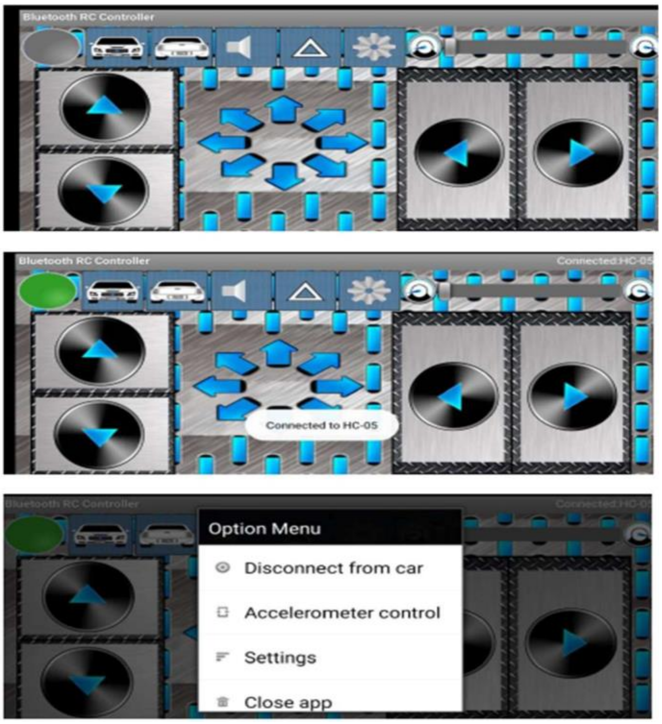

Fig 4 . Bluetooth application in android

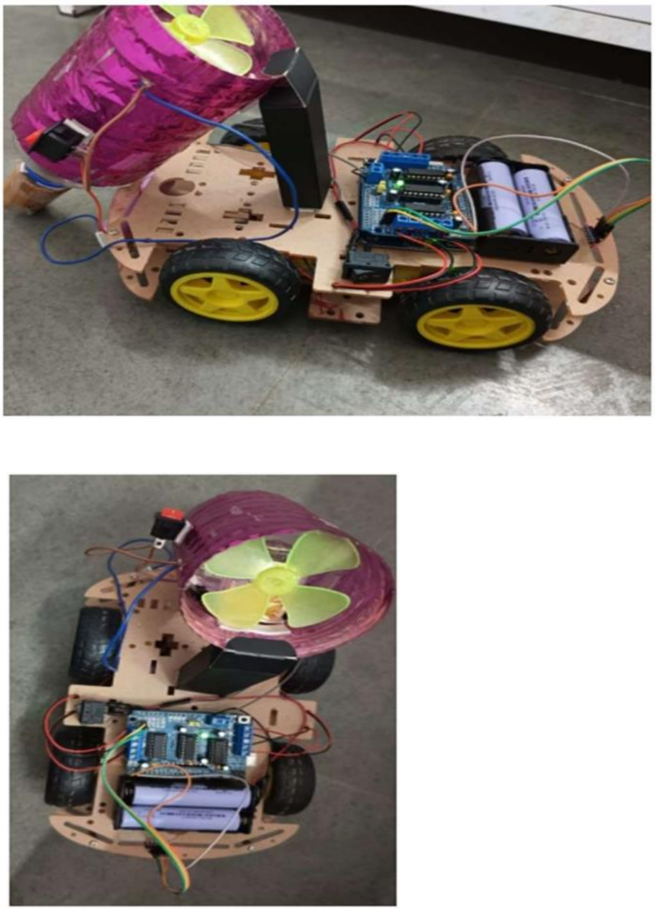

Fig 5. Hardware view of Home automation

VII. FUTURE SCOPE

The future scope for a Bluetooth-based smart vacuum cleaner is promising, with potential advancements and enhancements that can further elevate its functionality and user experience.

Here are some potential avenues for future development:

Artificial Intelligence and Machine Learning Integration: Implementing AI and machine learning algorithms can enhance the vacuum cleaner's ability to adapt and learn from its environment. This could lead to improved navigation, obstacle avoidance, and more efficient cleaning patterns.

Voice Control and Integration with Smart Assistants: Enabling voice commands through integration with popular smart assistants (e.g., Amazon Alexa, Google Assistant) would provide an additional level of convenience for users, allowing them to control the vacuum cleaner using natural language. Multi-Room Mapping and Navigation: Developing advanced mapping capabilities would enable the vacuum cleaner to create and store maps of multiple rooms. This could lead to more efficient and customizable cleaning schedules. Integration with IoT Ecosystems: Integrating the vacuum cleaner into broader IoT ecosystems would allow it to interact with other smart home devices. For example, it could coordinate with smart thermostats, lights, and security systems to optimize energy usage and enhance overall home automation. Advanced Sensors and Object Recognition: Incorporating advanced sensors, such as LiDAR or advanced cameras, could improve the vacuum cleaner's ability to detect and recognize objects, leading to even more precise navigation and obstacle avoidance. Autonomous Docking and Charging Optimization: Enhancements in the docking and charging process, potentially leveraging wireless charging technology, could further streamline the vacuum cleaner's operation and reduce the need for manual intervention.

VIII. CONCLUSION

In conclusion, the development and implementation of a Bluetooth-based smart vacuum cleaner represents a significant leap forward in home automation and convenience. Through meticulous planning, robust hardware integration, and sophisticated software algorithms, we have successfully created a versatile cleaning solution that can be effortlessly controlled via Bluetooth-enabled devices. The vacuum cleaner demonstrates commendable functionality, seamlessly executing tasks such as starting, stopping, and changing direction with precision. The incorporation of sensors ensures that it navigates around obstacles and avoids potential hazards, enhancing its safety and efficiency during operation. Additionally, the battery management system and power control mechanisms guarantee optimal performance, while prolonging the device's operational life. The integration of Bluetooth technology provides a user-friendly interface, enabling seamless communication between the controlling device and the vacuum cleaner. This intuitive interaction empowers users with the flexibility to initiate cleaning cycles, monitor progress, and intervene when necessary, all from the convenience of their preferred mobile or computer platform. Furthermore, rigorous testing and data validation have substantiated the vacuum cleaner's capabilities. From functional tests to comprehensive characterization, the system consistently met or exceeded predefined performance metrics. The interpretative analysis of collected data confirmed the effectiveness of the implemented algorithms and provided valuable insights for potential optimization. In conjunction with continuous improvement efforts, user feedback and iterative testing have been instrumental in refining the vacuum cleaner's capabilities. This commitment to refinement ensures that the product remains adaptable to evolving user needs and technological advancements. In summary, the Bluetooth-based smart vacuum cleaner represents a significant achievement in automated cleaning technology. Its integration of Bluetooth connectivity, robust hardware components, and sophisticated control algorithms culminate in a user-friendly, efficient, and reliable cleaning solution. With a foundation built on innovative engineering and rigorous testing, this product stands poised to revolutionize the way users approach household cleaning tasks

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