A
Project Stage I
Report
on
Floor Cleaner Robot with Self Charging Power Station

Submitted By:

Bachhav Vaibhav Bharat
Pawar Megha Nepalsing
Borse Madhuri Sunil
Rajput Rohit Jyotising

T Y B.Tech [Electronics & Telecommunication]

Guided By:

Prof. J.P.Patil

Department of Electronics and Telecommunication

R. C. Patel Institute of Technology, Shirpur

[An Autonomous Institute]

2023-24

R C Patel Institute of Technology, Shirpur
An Autonomous Institute

Vision:

To achieve excellence in engineering education with strong ethical values.

Mission:

To impart high quality Technical Education through :

- Innovative and Interactive learning process and high quality, internationally recognized instructional programs.
- Fostering a scientific temper among students by the means of a liaison with the Academia, Industries and Government.
- Preparing students from diverse backgrounds to have aptitude for research and spirit of Professionalism.
- Inculcating in students a respect for fellow human beings and responsibility towards the society.

Department of Electronics & Telecommunication

Vision:

To produce globally competent Electronics and Telecommunication Engineers with a commitment to serve society.

Mission:

To prepare and transform students from socially and economically diverse backgrounds into highly skilled engineers in the field of Electronics and Telecommunication Engineering for a successful professional career.

Shirpur Education Society's

R. C. Patel Institute of Technology, Shirpur, Dist-Dhule

[An Autonomous Institute]

CERTIFICATE

This is to certify that report for Project Stage I entitled ***"Floor Cleaner Robot with Self Charging Power Station"****, being submitted by* ***Bachhav Vaibhav Bharat, Pawar Megha Nepalsing ,Borse Madhuri Sunil & Rajput Rohit Jyotising*** *under the guidance of* ***Prof J P Patil*** *in the partial fulfilment of the requirement for degree of Bachelor of Technology (Semester- VI) in the Electronics and Telecommunication Engineering of Dr.Babasaheb Ambedkar Technological University, Lonere,during academic year 2023-2024.*

Date:

Place: Shirpur

Project Guide **Prof J P Patil**	**Project Stage I Coordinator** **Prof Dr R D Badgujar**
Head of Department **Prof Dr P J Deore**	**Principal** **Prof Dr J B Patil**

Acknowledgement

It is a privilege for us to have been associated with **Prof. J. P. Patil**, our guide, during this project work. We have been greatly benefited by their valuable suggestions and ideas. It is with great pleasure that we express our deep sense of gratitude to them for their valuable guidance, constant encouragement and patience throughout this work.
We express our gratitude to **Prof. Dr. P. J. Deore**, Head of Department of Electronics & Telecommunication for his constant encouragement, co-operation, and support.
We express our sincere thanks to **Dr R. D. Badgujar** for their unfailing inspiration and for providing the lab facilities.
We take this opportunity to thank all our classmates for their company during the course work and for useful discussion we had with them.
We would be failing in our duties if we do not make a mention of our family members including our parents for providing moral support, without which this work would not have been completed.

Bachhav Vaibhav Bharat
Pawar Megha Nepalsing
Borse Madhuri Sunil
Rajput Rohit Jyotising

Abstract

Smart cleaning robot to makes the tedious, tiresome household works to simpler and automatic.The main objective of this robot is to reduce the human interaction in the cleaning process. The proposed system has mopping section.Smart floor cleaning robot can be used for cleaning and mopping purpose in home, airport platforms, railway platforms, hospitals, bus stands, malls and in many other commercial places. The robot can be used autonomously to wipe and sweep floors in the house from time to time thus keeping the house clean and maintaining Hygiene.

The objective of this robot is to reduce the human interaction in the cleaning process. The proposed system has mopping section and vacuum section. Mopping section consists of a mop attached to the robot which is used for cleaning the floor. It is attached to a small water container from which water is dipped in order to make the mop wet.This robot can perform sweeping and mopping task. The robot is able to avoid obstacles and must be capable of cleaning the room upon user command and is designed for a collision free navigation.The main objective of this project is to design and implement a floor cleaner robot prototype by using ESP8266, Motor Shield L298N, Ultrasonic Sensor,Bo Motors, battery and to achieve the goal of this project. floor cleaner Robot will have several criteria that are user-friendly.

Contents

List of Figures

List of Tables

Chapter 1

Introduction

Cleaning has been a challenging task for humanity since the dawn of time. Throughout history, various methods have been employed to tidy up spaces, but they often demanded significant effort and time. As society evolved, the working population found it increasingly challenging to allocate time for cleaning their surroundings due to the demanding nature of their schedules. Consequently, the traditional cleaning methods were deemed inefficient. However, with technological advancements, particularly in automation, cleaning processes have been revolutionized, making them far more efficient. The introduction of automatic floor cleaner with self charging power station.The primary aim of initiatives like the one described in this project is to develop and implement robots using advanced technologies such as ESP8266, Ultrasonic Sensor,Motor driver l298N module.Among various floor cleaning robots present in the world only some robots can be used especially for doing the household chores of man. Among those robots, one special kind of robot that is very useful for everyone is cleaning and mopping robot.

A cleaning robot, characterized by its simplicity and automation, relies on predetermined algorithms and programmed instructions to efficiently clean designated areas. Its primary purpose is to minimize human involvement in the cleaning process, which is often time-consuming. These versatile robots find application in various settings, including offices, residences, and industrial spaces. Users can effortlessly activate them either by pressing a single button or by scheduling them to start at specific times, offering unparalleled convenience and flexibility in maintaining cleanliness.Before the early discussions on the project, a market survey has been done in which a target group of 100 families was consulted and enquired about the cleaning and mopping robots. The result of this survey is as shown in the Figure depicts the result of the market survey conducted on a target group of 100 families, from the figure it is understood that more than 60% of the families don't about the existence of such kind of robots and the 40% of them felt that the price of the robot is too high[1].

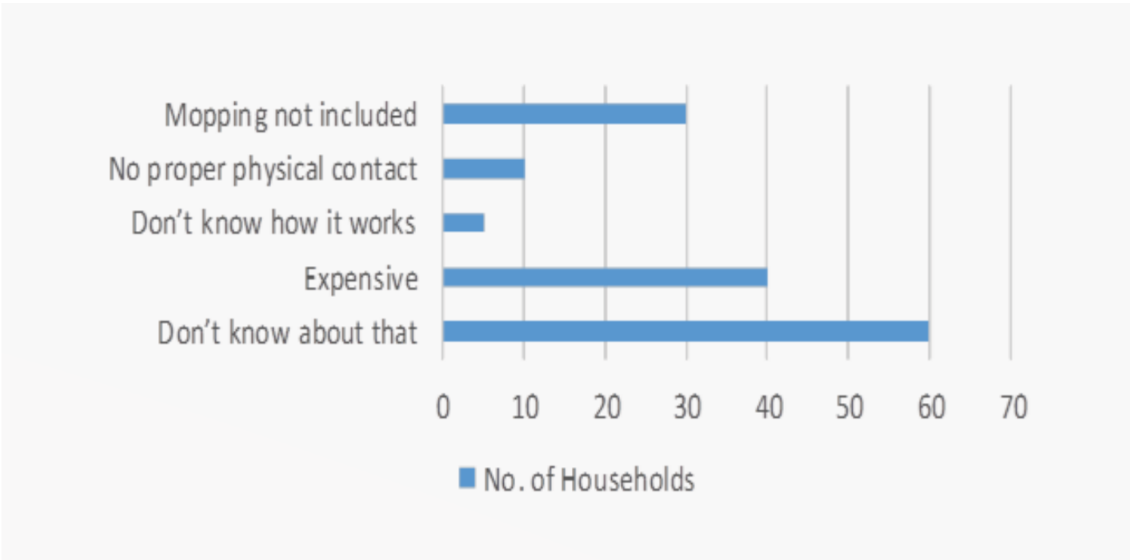

Figure 1.1: Market Survey on Automatic Cleaning Robot

The Floor Cleaner Robot with mopping pads and a water container represents a groundbreaking advancement in the realm of floor cleaning technology. In today's fast-paced world, where time is a precious commodity and cleanliness is paramount, this project aims to revolutionize the way we approach floor maintenance across various sectors including residential, commercial, and industrial.
Traditional methods of floor cleaning have long relied on manual labor, consuming time and energy that could be better spent elsewhere. While robotic vacuum cleaners have offered a degree of automation in recent years, they often fall short when it comes to effectively tackling stubborn stains and spills, particularly on hard surfaces. Moreover, their lack of wet mopping capabilities limits their utility in environments where thorough cleaning is essential.

The Floor Cleaner Robot addresses these shortcomings by combining the convenience of robotic automation with the effectiveness of traditional mopping. Equipped with mopping pads and a water container, the robot can scrub and sanitize floors with unparalleled efficiency, removing dirt, stains, and debris with ease. Its versatile design makes it suitable for use in a variety of settings, from homes and hospitals to industries and commercial spaces.At the core of the Floor Cleaner Robot are several key components that enable its seamless operation. The ESP8266 micro-controller serves as the brain of the robot, facilitating communication, sensor integration, and control. This versatile platform provides the necessary computational power to navigate environments, detect obstacles, and execute cleaning tasks with precision.

Driving the locomotion of the robot are the motor driver L298N module, DC motors, and durable tires. These components work together to ensure smooth and reliable movement across different surfaces, from hardwood floors to tiled corridors. With the ability to navigate tight spaces and obstacles, the robot can effectively cover large areas without human intervention.Complementing the locomotion system are the mopping pads and water container, which constitute the heart of the cleaning mechanism. The mopping pads, affixed to the underside of the robot, are designed to scrub and sanitize floors, removing dirt and grime with each pass. The water container supplies a continuous stream of cleaning solution, ensuring thorough coverage and optimal cleaning performance.

The versatility of the Floor Cleaner Robot makes it well-suited for a wide range of applications across various industries. In residential settings, the robot offers a convenient and efficient solution to floor maintenance, allowing homeowners to enjoy clean and hygienic floors without the hassle of manual labor. Its autonomous operation and smart connectivity features make it an indispensable tool for busy households.

In healthcare facilities, where sanitation is of utmost importance, the Floor Cleaner Robot can play a critical role in maintaining cleanliness and reducing the risk of infections. By using hospital-grade cleaning solutions and antimicrobial agents, the robot ensures that floors are thoroughly sanitized, contributing to a safe and healthy environment for patients and staff alike.Similarly, in industrial settings, the Floor Cleaner Robot can enhance productivity and safety by keeping floors clean and free of debris. Whether in manufacturing plants, warehouses, or distribution centers, the robot's ability to navigate complex environments and remove contaminants makes it a valuable asset for optimizing workflow and minimizing downtime.Existing floor cleaners, including traditional manual methods and robotic vacuum cleaners, have several limitations that may hinder their effectiveness and usability. Here are some common limitations:Limited Cleaning Abilities: Traditional mops and brooms have limited cleaning abilities, often only able to remove surface dirt and debris without effectively tackling stubborn stains or spills. Similarly, robotic vacuum cleaners may struggle to thoroughly clean certain types of flooring or to remove sticky residues.

Manual Labor Intensive: Traditional floor cleaning methods require significant manual labor, which can be time-consuming and physically demanding. This can be especially challenging for individuals with mobility issues or busy schedules. Inefficient: Manual cleaning methods may be inefficient, as they often involve repetitive motions and may require multiple passes to achieve satisfactory results. This inefficiency can result in wasted time and energy.Limited Reach and Coverage: Traditional cleaning tools may have limited reach, making it difficult to clean tight spaces or areas that are inaccessible. This can lead to incomplete cleaning results and the accumulation of dirt and debris in overlooked areas.Lack of Versatility: Some floor cleaners are designed for specific types of flooring or surfaces, limiting their versatility. For example, a mop designed for hardwood floors may not be suitable for cleaning carpets or tiles.

Dependency on Human Intervention: While robotic vacuum cleaners offer automated cleaning capabilities, they still require human intervention for tasks such as emptying the dustbin, replacing filters, and troubleshooting issues. This dependency can be inconvenient and may negate some of the benefits of automation.Limited Battery Life: Robotic vacuum cleaners typically rely on rechargeable batteries for power, which may have limited battery life. This can result in interruptions to the cleaning process and may require users to manually recharge the device or replace the battery.

Maintenance Requirements: Both traditional and robotic floor cleaners require regular maintenance to ensure optimal performance. This may include cleaning brushes and filters, replacing worn-out parts, and troubleshooting technical issues.Cost: High-quality floor cleaning equipment, whether traditional or robotic, can be expensive to purchase initially. Additionally, ongoing maintenance costs, such as replacement parts and cleaning supplies, can add to the overall cost of ownership.Environmental Impact: Some floor cleaning methods, particularly those that rely on disposable cleaning pads or harsh chemicals, may have a negative impact on the environment. This can include increased waste generation and the release of harmful pollutants into the air and water.

The Floor Cleaner Robot with a self-charging station and no vacuum mechanism offers a multitude of advantages over traditional cleaning methods and existing robotic cleaners. Here are some of the key advantages:Efficiency: By automating the floor cleaning process, the robot significantly reduces the time and effort required for maintaining clean floors. Its autonomous operation allows users to focus on other tasks while the robot takes care of the cleaning, resulting in increased productivity and efficiency.Versatility: Unlike traditional vacuum-based robotic cleaners, which may struggle with certain surfaces or obstacles, the Floor Cleaner Robot is designed to navigate various environments with ease. Its robust locomotion system and advanced sensors enable it to traverse hardwood floors, tiled surfaces, and even carpets, ensuring thorough cleaning in diverse settings.

Convenience: The inclusion of a self-charging station eliminates the need for manual intervention and ensures that the robot is always ready to clean when needed. Users can simply place the robot on the charging station after each cleaning session, allowing it to recharge autonomously and prepare for the next cleaning task.Cost-Effectiveness: Over time, the Floor Cleaner Robot can result in cost savings compared to traditional cleaning methods. By reducing the need for disposable cleaning supplies and minimizing the wear and tear on flooring materials, the robot helps extend the lifespan of floors and reduce maintenance costs in the long run.

Health and Safety: In healthcare facilities and other environments where sanitation is critical, the robot's ability to sanitize floors with hospital-grade cleaning solutions and antimicrobial agents helps reduce the risk of infections and promote a safe and hygienic environment for occupants.Environmental Sustainability: With its reusable cleaning pads and refillable water container, the Floor Cleaner Robot is designed with sustainability in mind. By minimizing the use of disposable cleaning supplies and reducing waste generation, the robot contributes to environmental conservation efforts and promotes eco-friendly cleaning practices.User-Friendly Operation: The Floor Cleaner Robot is designed to be intuitive and user-friendly, with simple controls and smart connectivity features that allow users to schedule cleaning sessions, customize cleaning preferences, and monitor the robot's progress from anywhere via a smartphone app or remote control.

Chapter 2

Problem Identification and Project Objectives

Identifying potential problems or challenges with your project, the Floor Cleaner Robot with a self-charging station is crucial for ensuring its success and effectiveness. While the project offers numerous advantages and innovative features, it's essential to anticipate and address any potential issues that may arise.

2.1 Problem Identification

In the traditional floor cleaning process, we use mops and brooms to clear the dirt and dust particles on the floor which requires a lot of human effort. Also, the normal floor cleaning process is time-consuming. In the past few years different types of vacuum cleaners are developed and available in the market but they are used for dry cleaning purposes only. Whereas the cost of these vacuum cleaners is also very high, this is not affordable for common people. The additional features built on the existing systems are quite bulky and expensive. Due to manual handling, this system consumes more power. So, the motive of this work is to provide easier solutions to all these operational issues, drawbacks in the existing system.

Designing a floor cleaner robot with a self-charging station presents an exciting challenge for college-level major projects, offering students an opportunity to explore interdisciplinary concepts in engineering and robotics. The project aims to address common household chores, particularly floor cleaning, by leveraging modern technologies and efficient design principles. One of the primary goals is to simplify cleaning tasks for homeowners, reducing manual labor and time spent on maintenance activities. This endeavor involves integrating various components and modules, each playing a crucial role in the robot's functionality.

At the heart of the project lies the NodeMCU ESP8266 module, which acts as the central processing unit, enabling wireless communication and control. This component allows users to remotely command the robot, adjust cleaning settings, and monitor its performance through a smartphone or computer interface. Moreover, the NodeMCU facilitates real-time data transmission, providing feedback on cleaning progress and battery status.

Another key element is the motor driver L298N module, responsible for managing the movement and navigation of the robot. This module coordinates the operation of BO motors, ensuring smooth and precise motion across different types of flooring surfaces. By controlling motor speed and direction, the L298N module enables the robot to maneuver efficiently around obstacles and cover the entire cleaning area systematically.

Incorporating mopping pads into the design enhances the robot's cleaning efficacy, effectively removing dirt, dust, and other debris from floors. These pads can be easily attached and replaced, allowing for convenient maintenance and ensuring consistent cleaning performance over time. Additionally, the use of specialized cleaning solutions or water reservoirs may further optimize the robot's ability to tackle stubborn stains and spills.

The project also addresses power management challenges by integrating a rechargeable battery system. This component serves as the primary energy source for driving the motors and supporting the robot's functionalities. To prolong operational runtime and maximize efficiency, the battery capacity and charging mechanism must be carefully optimized. Implementing energy-saving features and intelligent charging algorithms can help extend battery life and minimize downtime during cleaning sessions.

One of the critical features of the project is the self-charging station, which enables the robot to autonomously return for recharging when the battery level is low. This functionality ensures uninterrupted cleaning sessions, eliminating the need for manual intervention or supervision. The self-charging station must be designed with safety and reliability in mind, providing secure docking and efficient power transfer to the robot's battery.

Overall, this project presents an exciting opportunity for college students to explore the integration of hardware and software components in a practical application. By addressing common household cleaning tasks, the floor cleaner robot with a self-charging station offers a tangible solution to real-world challenges, showcasing the potential of robotics technology to enhance everyday living experiences.

2.2 Objectives

The primary objective of this project is to design and implement a floor cleaning robot equipped with intelligent navigation capabilities and the ability to autonomously recharge itself. The primary objective of the Floor Cleaning Robot with self charging power station project is to design, develop, and implement a comprehensive solution that integrates a floor cleaning robot. This solution aims to address the following key objectives:

1. .To design & develop a machine that reduces human efforts & help in easy and quick cleaning at an affordable cost.
2. To develop a user-friendly system so that anybody with very less basic knowledge can handle the machine.
3. To ensure safety while handling this machine.
4. To develop a fully self-contained low maintenance system.
5. To develop a low power consumption system.

Chapter 3

Literature Survey

Earlier sawdust was used to remove water that spilled on the floor. Tea leaves were used to remove the dirt and odour on the carpets. As time passed on, broom sticks and mops were invented. Still it required manpower. The evolvement of vacuum cleaner helps the human to reduce the task of cleaning to an extent by sucking the dust particles. Even though requires the human attention. Later the emergence of room cleaning robot with random cleaning algorithm occurred but the system should be monitored by the user and they failed to produce complete cleaning [2].After this smart vacuum cleaner in various platforms emerged, but it isn't much convenient for the user and doesn't provide a particular algorithm [3]. Then smart vacuum cleaner using wireless network developed but it is much complex on obstacle detection [4]. Since our requirement is to produce a robot which offers perfect cleaning by mopping and sucking simultaneously. Most of them must be turned ON manually.

Abhishek Chakra Borty Et Al [2013] proposed the "Design of Dust Collector for Rear Wheel of Four-Wheeler" - He reported that the most significant cause of road dust to the total suspended particulate burden is vehicle travelling on paved and unpaved surfaces. Consequently data directly relating dust to road accidents are rare, but in study if dust is the cause of 10% of these accidents casualties then the cost could amount to as much as 0.02% of GDP in some developing countries and total about $800 million annually[5].

Aishwarya Pardeshi [2017] proposed the "Automatic Floor Cleaner". In this. project she conclude that the setup of hardware with a combination of software gives better accuracy and reduces the work load. Man power is minimized. It have. Low cost. It is a Time Consuming Device Making a small machine brings a flexibility to do work[6].

Anup Mendhe [2017] proposed the "Multipurpose Floor Cleaning Machine". He reported that the multiple applications provide a wide range of functions in which we can clean the pipe, scrubbing of surface for proper cleaning of the floor, remove dust and dirt from the road, provide a pick and place mechanism by which obstacles can be removed. This project is very helpful for the society and play a vital role in cleanliness of the country. The main motive of the project is to cover the aspects of cleanliness in the society. The multiple applications provide a wide range of functions in which we can clean the pipe, scrubbing of surface for proper cleaning of the floor. This project is very helpful for the society and play a vital role in cleanliness of the country[7].

Imaekhai Lawrence Et Al [2012] proposed the "Evaluating Single Disc Floor Cleaners" The evaluation has shown how the use of multiple assessment techniques can provide a comprehensive appraisal of the design, usability and musculoskeletal loading upon the operator. They suggested that the trials with a larger number of subjects would certainly strengthen the conclusions[8].

Manya Jain [2017] proposed the "Automatic Floor Cleaner". This research. facilitates efficient floor cleaning. Since in project the floor cleaner is incorporated with different devices like DC motor(s), ultrasonic sensors etc., so it will be easy to handle it also saves time and will work automatically for cleaning purpose at homes and offices. With simple algorithm and program, the cleaner will be able to cover large floor areas as well as find its way into and out of small corners. As the cleaner traverses the room, the sweeper installed in it will manage to pick up a significant amount of dirt. Manual Sweeping might not be that effective as it will not be picking up everything in as it is not in sight but using the automatic floor cleaner it can be done easily[9].

Sandeep. J. Meshram Et Al (2016) proposed the "Design and Development of Tricycle

Operated Street Cleaning Machine" He has developed the street cleaning machine by tricycle operated. In this research article he framed a model especially for rural area. He concluded that the cleaning is less effective where the street seems to be very rough and damaged. It is found that the existing street cleaning machines uses petrol and diesel. It can cause pollution and also the vibration produced in the machine causes noise pollution. While manual cleaning may cause health problem as the person directly comes in contact with dust. Also, the shoulder problem due to continuously sweeping occurs[10].

A tricycle operated street cleaning machine seems an alternative concept for avoiding such problems enlisted in first point. The tricycle operated machine can work very efficiently with respect to covering area, time and cost of street cleaning process compared with the existing machineries. Also it is economical. It was seen while testing of machine, that the cleaning is less effective where the street seems to be very rough and damaged.

Shubham Antapurkar in his research, he works on Arduino based dry and wet automatic floor cleaner. His aim is to construct a floor cleaner which will be fully automatic providing dry and wet cleaning as well as UV sterilization. The current market is occupied by cleaners with only one or two functionality. For its cost reduction and simplicity, he is using Arduino. The cleaner will be a step for providing comfortable life by resolving problems in traditional floor cleaning methods.[11]

Aadil Arshad et. al. in their research, they work on Design and development of floor cleaning machine. They designed and developed process for cleaning the floor having wet and dry surfaces. So they are developed the machine which work in both dry and wet conditions. This machine can remove the dust in summer season and also it can remove and clean the dirt, water from floor in rainy season.[12]

Ms. R. Abarna et. al. in their research, they work on Design and fabrication of automatic floor cleaning machine. Their system enables cleaning of the floor by the help of highly stabilized and rapidly functionalized electronic and mechanical control system. Current project work targets to use automatic floor cleaner for large floor in household purposes and office floors. The cleaning purpose is specifically carried out by continuous relative motion between a scrubber and the floor surface.[13]

Adeel Saleem et. al proposed "Design and Implementation of an Intelligent dust cleaner robot for uneven and non-structural environment". In this paper, a robot has been designed which stores the plan of the room and makes the working feasible. This can be used for various environments as well. It is a cost-effective system [14].

Anshu Prakash Murdan et. al proposed "A smart autonomous floor cleaner with an Android-based controller". Here, a bot is designed which can be controlled through Android. By using the application, the bot can be turned in the desired direction [15].
The main objective of this project is to design and implement a floor cleaner robot prototype by using ESP8266, Motor Shield L298N, Ultrasonic Sensor,Bo Motors,battery and to achieve the goal of this project. floor cleaner Robot will have several criteria that are user-friendly.The main motto of the project is to make a floor cleaning and mopping robot which navigates based on information received from ultrasonic sensors and limit switches using an microcontroller, affordable and suitable for the Indian users and factories.

A simple automatic robot that uses some prefixed algorithms and programs to clean the specified area is called a cleaning robot. The main use of this robot is to reduce the human interaction in the cleaning process which can be a time taking process. There are so many cleaning and mopping robots present in the market but only some of them are affordable and economic. There are very fewer robots that include both cleaning and mopping. With this work, we tried to reduce the cost of the robot and make it more compatible with the Indian Users and the Industries.

Chapter 4

Project Design

4.1 Block Diagram

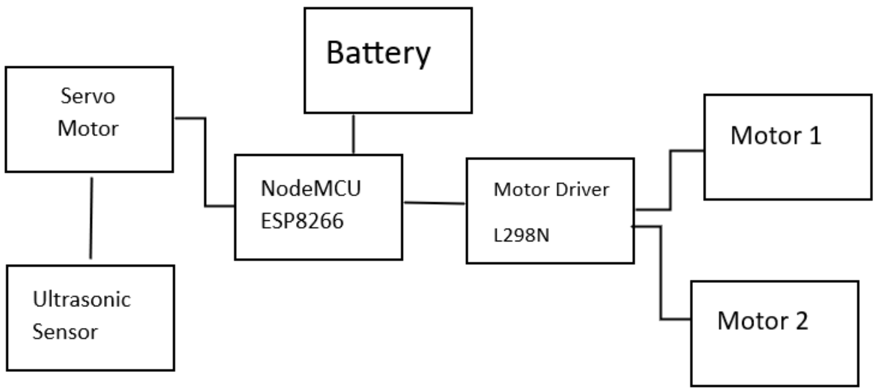

Figure 4.1: Block Diagram

4.2 Circuit Diagram

The HC-SR04 sensor is a popular sensor used in robotics for measuring distance. It works by emitting ultrasonic waves and then measuring the time it takes for the waves to bounce back from an object. This time can then be used to calculate the distance to the object. The circuit diagram also includes a servo motor, which is likely used to rotate the HC-SR04 sensor so that it can scan for obstacles in different directions. The two motors at the bottom of the diagram are likely connected to the wheels of the robot.

The circuit appears to be powered by a 9V battery.Here are the components of the circuit:

1. HC-SR04 sensor: used to detect obstacles
2. Servo motor: used to rotate the HC-SR04 sensor
3. Motors: used to drive the robot
4. 9V battery: powers the circuit

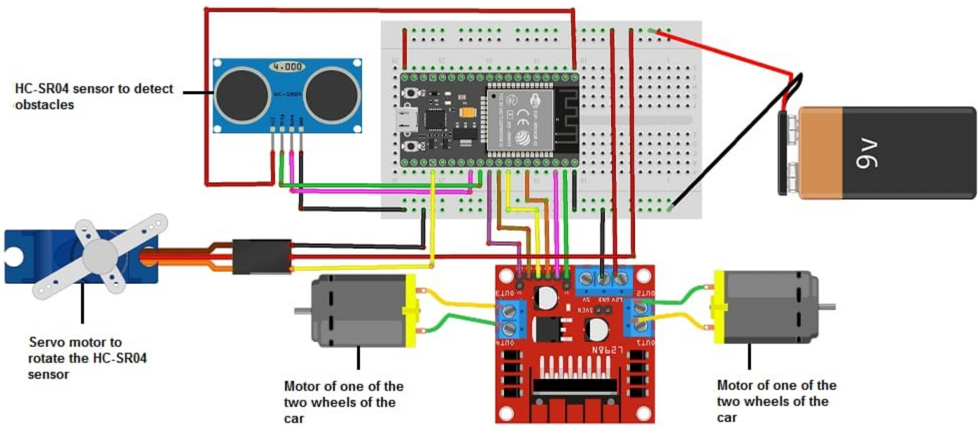

Figure 4.2: Circuit Layout

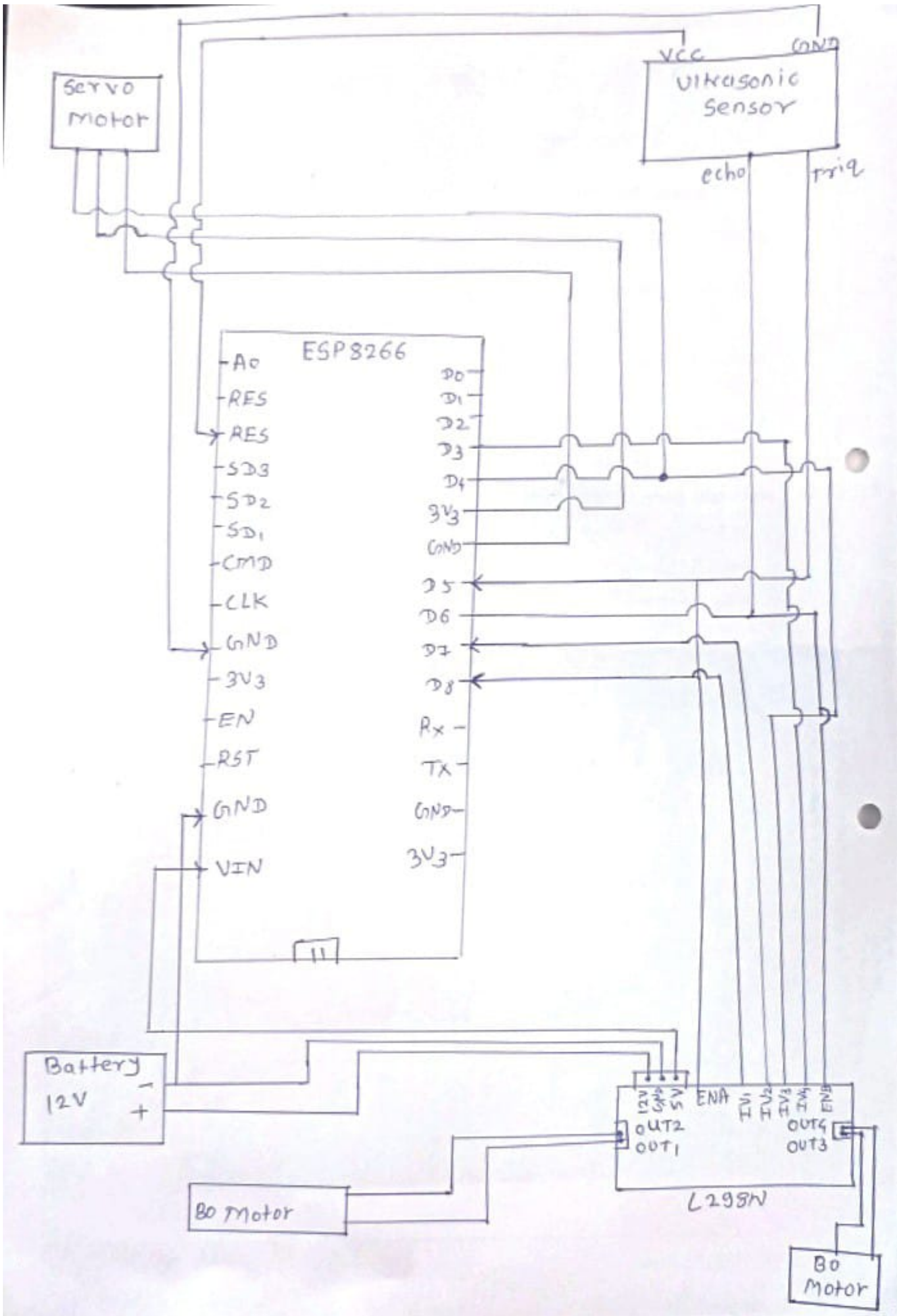

Figure 4.3: Circuit Diagram

4.3 Program Flow

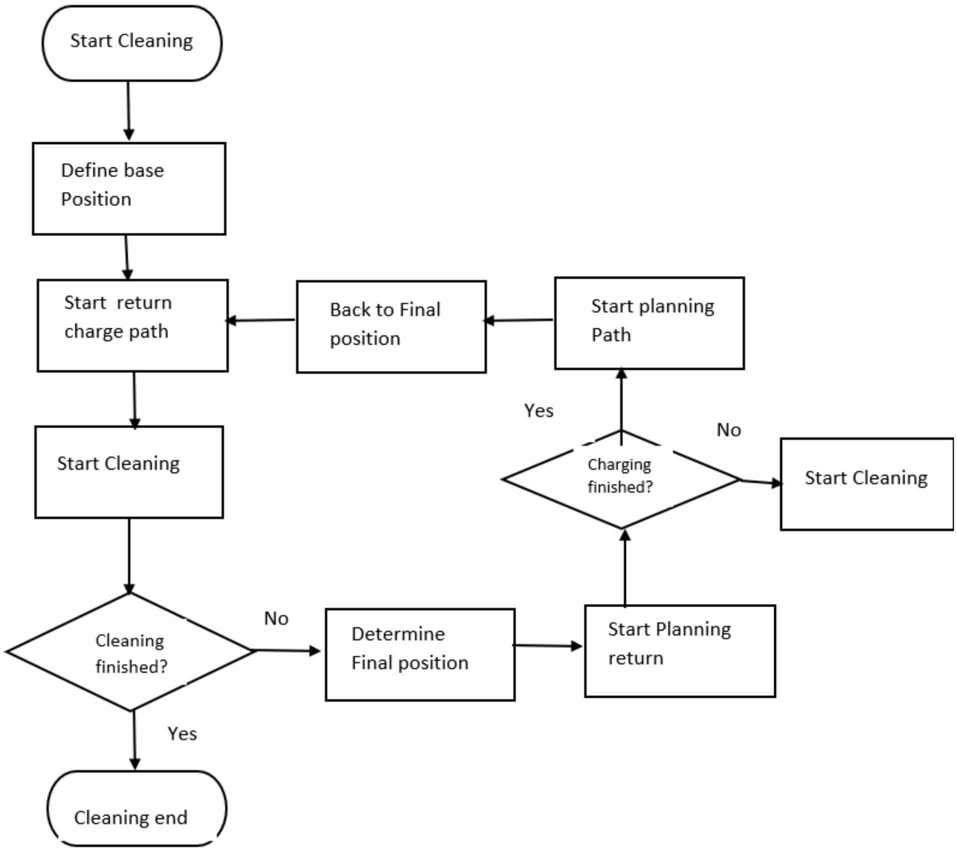

Figure 4.4: Flow Diagram

Chapter 5

Implementation

5.1 Design Methodology

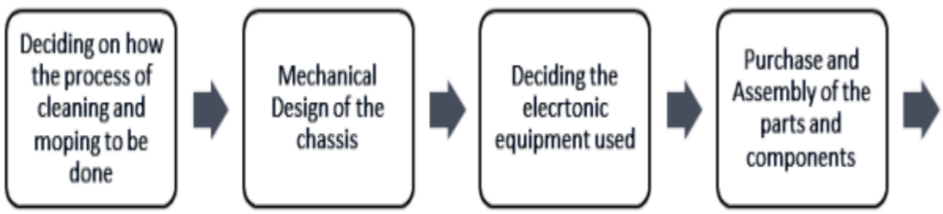

Figure 5.1: Design Methodology for project

Figure 5.1 gives A brief idea of the how the design of Automatic Cleaning and Mopping Robot is done. It starts with deciding on the how the cleaning and mopping is done and ends with the testing and calibration.

Floor cleaning is achieved by different technique which might be of different kinds. Different types of floor need different type of treatment. The floor should be totally dry after the cleaning process. Otherwise it may result in hazard. On some floors sawdust is used to absorb all kind of liquids. This ensures that there will no need of preventing them from spill of the sawdust has to be swept and replaced every day. Household cleaning is a repetitive task carried out by number of people every day. Therefore cleaning machine is very much useful in cleaning floor in houses. Many of floor cleaning machines are available but this floor cleaner is very simple in a construction and very easy to operate, anyone can operate it, without any prior training of any sorts with safety. The time taken for cleaning is very less and cost is also very less. Our floor cleaner will save huge cost of labor in future.

Advantages of Circular Shape

1. A round shape allows for better mobility and navigation around obstacles and corners.

2. A round shape reduces the likelihood of the floor cleaner getting stuck in corners or tight spaces.

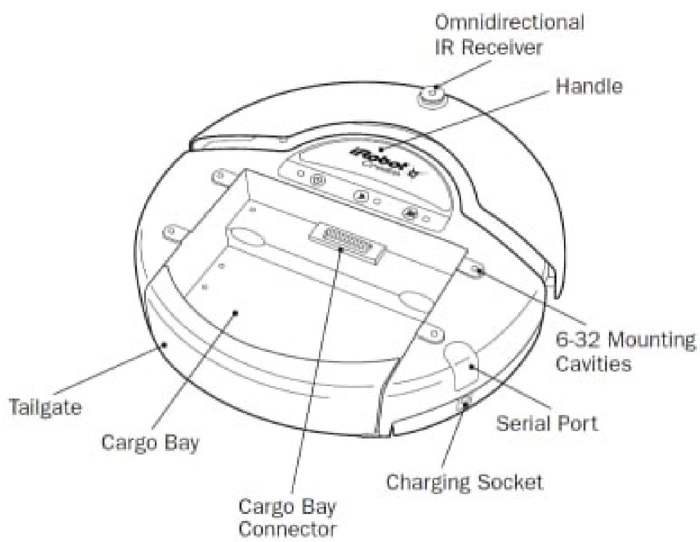

Figure 5.2: Design top view

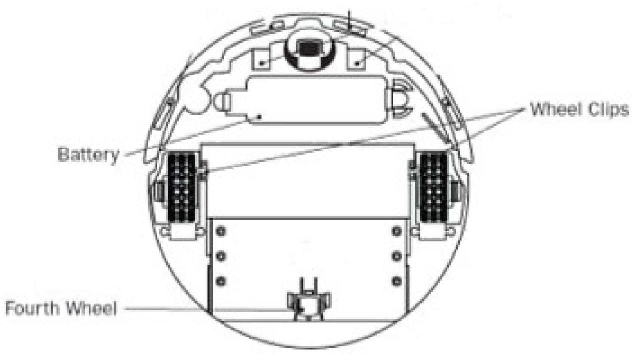

Figure 5.3: Design Bottom view

Drawbacks of other shapes

1. Other shapes of the floor cleaner getting stuck in corners or tight spaces

5.2 Component Description

5.2.1 NodeMCU ESP8266

The NodeMCU ESP8266 is a versatile development board based on the ESP8266 microcontroller chip, featuring built-in Wi-Fi connectivity and a range of GPIO pins for interfacing with external components. It supports multiple programming languages, including Lua scripting and Arduino programming, making it accessible to a wide range of developers. With its integrated Wi-Fi connectivity, the NodeMCU ESP8266 can connect to wireless networks and communicate with other devices over the internet, making it an ideal platform for IoT projects and applications. It features PWM support for generating analog output signals and analog input pins for reading sensor values, providing flexibility for various projects. Additionally, the NodeMCU ESP8266 includes a USB port for power and data communication, making it convenient to program and interact with from a computer. It is designed to be energy-efficient, with low power consumption, making it suitable for battery-powered applications. Based on open-source hardware and software, the NodeMCU ESP8266 encourages collaboration and innovation within the developer community, ensuring continuous improvement and support for the platform.

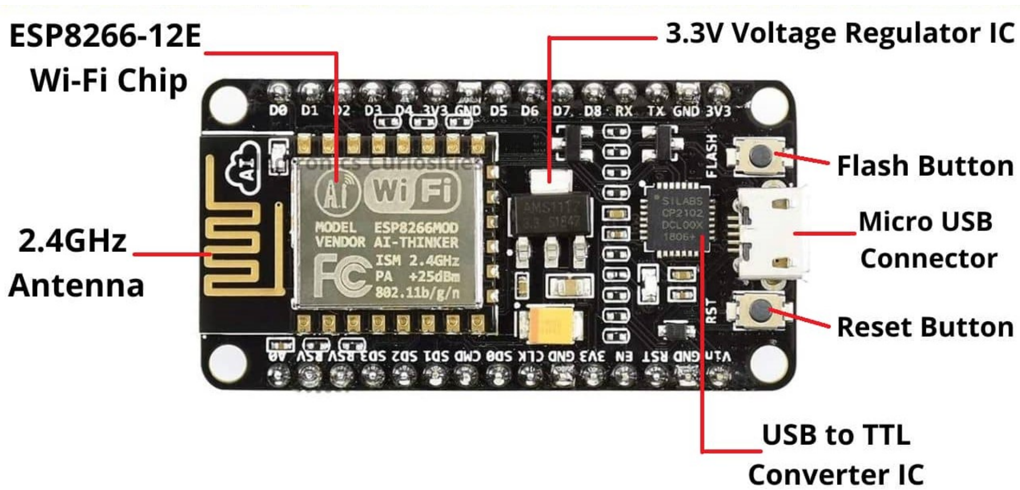

Figure 5.4: NodeMCU ESP8266

Features

1. Wi-Fi enabled for internet connection
2. 32-bit MCU for powerful processing
3. Open-source platform for easy development
4. Cost-effective for budget-friendly projects
5. Arduino IDE compatible for familiar programming
6. Multiple GPIO pins for various functionalities
7. ADC pin for reading analog sensor data
8. Decent power consumption for battery projects
9. Compact size for space-constrained applications
10. Large community for support and resources

5.2.2 Servo motor

A servo motor is a closed-loop servomechanism that uses position feedback (eitherl inear or rotational position) to control its motion and final position. The input to its control is a signal (either analog or digital) representing the desired position of the output shaft. The motor is paired with some type of position encoder to provide position feedback.

Features

1. Precise angle control: Rotates to specific angles and holds position.
2. Built-in feedback: Monitors position and adjusts for accuracy.
3. Geared for control: Slow rotation, high torque for steady movement.
4. Limited motion: Rotates within a specific range (often 180 degrees).
5. PWM control: Receives control signal to determine target position.
6. Compact size: Available in small sizes for tight spaces.
7. Wide applications: Used in robotics, animation, RC vehicles, and more.

Figure 5.5: servo motor

5.2.3 Motor Driver L298N

The L298N motor driver is a dual H-bridge IC commonly used to control DC motors and stepper motors in electronic projects. With its high current handling capacity, wide voltage range, and built-in protection features, it offers a reliable and cost-effective solution for motor control tasks in various applications such as robotics, RC vehicles, and automation systems.

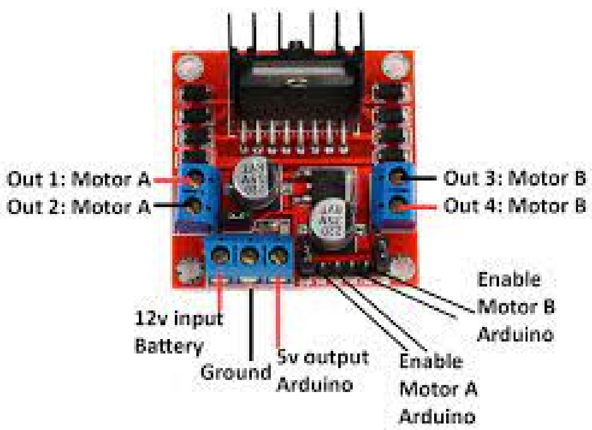

Figure 5.6: Motor Driver L298N

Features

1. Dual H-bridge: Controls 2 DC motors independently (direction & speed).
2. Directional Control: Sets motor direction (forward/backward).
3. PWM compatible: Allows for variable motor speed control (external circuit needed).
4. High Voltage Range: Works with motors from 5V to 46V supply.
5. Decent Current Handling: Drives small to medium motors (up to 2A per motor).
6. Simple Control: Easy integration with microcontrollers for control.
7. Cost-effective: Affordable option for learning and hobby projects.

5.2.4 Ultrasonic sensor

The ultrasonic sensor is a device that emits high-frequency sound waves and detects their reflections off nearby objects to measure distance. Comprising a transmitter and receiver, it calculates distance by timing the sound waves' round-trip travel. With detection ranges from centimeters to meters, it finds applications in object detection, proximity sensing, and obstacle avoidance. These sensors operate effectively indoors and outdoors, despite environmental factors like darkness and dust. Output signals, often analog or digital, represent the measured distance. Ultrasonic sensors are widely used in robotics, automotive parking assistance systems, industrial automation, and security systems due to their reliability and versatility.

Features

1. Non-contact distance measurement: Works by sending sound waves and measuring their echo, eliminating need for physical contact with object.
2. Material independence: Detects objects regardless of color, transparency, or surface texture.
3. Suitable for various environments: Functions well in darkness, fog, or dust where other sensors might struggle.

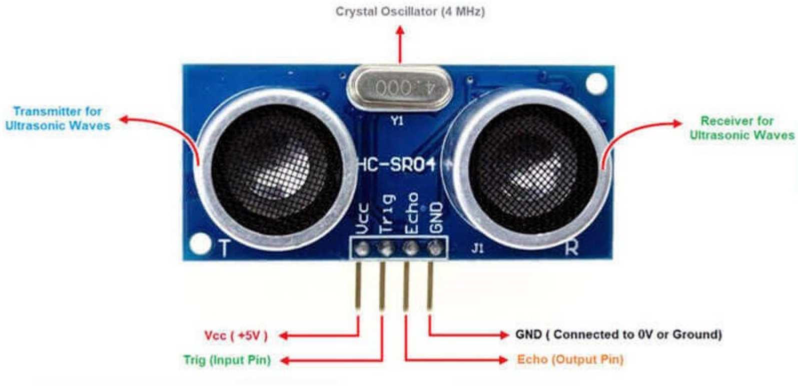

Figure 5.7: Ultrasonic Sensor

4. Limited range: Typically measures distances within a few centimeters to several meters, depending on the sensor model.
5. Trigger and echo pins: Requires separate pins for sending a sound pulse (trigger) and receiving the echo for distance calculation.
6. Relatively low cost: Affordable option for adding obstacle detection to projects.
7. Power requirements: Operates on a low voltage supply (often 5V), making it compatible with microcontrollers like Arduino.
8. Wide applications: Used in robotics, object detection, level measurement, security systems, and more.

5.2.5 BO Motors

DC motors commonly referred to as "Bo motors," are widely used in robotics and automation for their simplicity and efficiency. These motors feature a straightforward design, consisting of a cylindrical body with a shaft protruding from each end. They operate on direct current (DC) and rely on the interaction between magnetic fields to generate rotational motion. Bo motors come in various sizes and power ratings, making them suitable for a wide range of applications, from small hobby projects to industrial machinery. They offer reliable performance, high torque output, and ease of control, making them a popular choice for motion control systems.

Figure 5.8: Bo Motors

Features

1. Speed (RPM): Maximum rotations per minute the motor can achieve (usually without load).
2. Torque: Turning force of the motor, important for overcoming obstacles.
3. Voltage Rating: Specific voltage the motor needs for optimal performance.
4. Current Draw: Amount of electrical current the motor consumes while operating.
5. Mechanical Compatibility: Fits with the robot's chassis and wheels
6. Control: Requires a motor driver for speed and direction control by the Arduino.
7. Power Supply: Needs a power source that meets its voltage and current requirements.

5.2.6 Battery

Batteries are portable energy storage devices commonly used in electronic devices. They convert chemical energy into electrical energy, providing power to devices such as smartphones, laptops, and electric vehicles. Batteries come in various types, including lithium-ion, nickel-metal hydride, and lead-acid, each with specific characteristics and applications.

Features

Figure 5.9: Battery

1. Voltage (V): Provides a specific voltage (e.g., 9V, 3.7V) to power electronic components.
2. Capacity (mAh): Stores a certain amount of electrical charge, determining how long it can power a device.
3. Chemistry: Different battery types (e.g., Li-ion, NiMH) offer varying characteristics like lifespan, recharge cycles, and safety considerations.
4. Rechargeable vs. Non-rechargeable: Rechargeable batteries can be reused after depletion, while non-rechargeable batteries are discarded after use.
5. Discharge Rate (C-rating): Indicates how quickly a battery can deliver its stored energy. Higher C-ratings are suitable for applications requiring bursts of power.
6. Size and Weight: Batteries come in various sizes and weights, impacting portability and space constraints within your project.
7. Safety: Proper handling and charging practices are crucial, as some battery types can pose safety risks if mishandled.

5.3 Testing and Verification

Our meticulously designed automatic floor cleaning robot, built with the affordable and efficient ESP8266 microcontroller, L298N motor driver, battery, DC motors for mobility, and caster wheels, is no stranger to scrutiny. Before it tackles the chaos of your living room floor, we put it through a gauntlet of tests designed to simulate the messy realities of everyday use. This rigorous testing and verification process ensures our creation not only functions as intended but delivers exceptional cleaning performance with unwavering reliability.Here, we delve into the comprehensive testing methodology employed to transform our robot from a promising concept into a trustworthy cleaning companion for your home.

5.3.1 Individual Component Testing

The foundation for a well-functioning robot lies in its individual components. We don't rely solely on manufacturer specifications. Each component, from the ESP8266 brain to the powerful DC motors and the chosen drive system, undergoes a battery of tests to assess its:

Functionality: Does the component perform its intended task as designed? For example, can the ESP8266 reliably connect to a Wi-Fi network for potential smartphone app control? Do the DC motors rotate smoothly in both directions?

Performance: How well does the component perform under varying conditions? This might involve testing the range and signal strength of the ESP8266 Wi-Fi connection, the speed and torque output of the DC motors on different inclines, or the rolling resistance of the caster wheels on various floor surfaces.

Reliability: Can the component consistently perform its task over an extended period? We conduct stress tests to assess the component's endurance. For instance, we might run the DC motors continuously for hours to simulate extended cleaning sessions or subject the caster wheels to repeated impacts to ensure they maintain smooth rolling.Examples of Individual Component Testing

ESP8266 Testing: We create a controlled environment with a known Wi-Fi network. The ESP8266 is programmed to connect to this network, and its connection stability and signal strength are monitored. We can also write test programs to verify the ESP8266's ability to communicate with external devices (e.g., smartphone app) if applicable to your final design.

DC Motor Testing: A simple test bench can be devised using a multimeter to measure the current draw and voltage requirements of the DC motors at different speeds. This helps determine the appropriate power supply needed for optimal performance and battery life. We can also test the motors in forward and reverse directions to ensure smooth operation and responsiveness to control signals from the L298N motor driver.

L298N Motor Driver Testing: The L298N motor driver is tested by connecting it to the ESP8266 and the DC motors. We write test programs to send control signals to the motor driver, verifying its ability to drive the DC motors in forward, reverse, and stop functions as intended.

Caster Wheel Testing:The caster wheels are loaded with a weight equivalent to the estimated weight of the robot and rolled on various floor surfaces (carpet, hardwood, tile) to assess their rolling resistance and maneuverability. We might also subject the wheels to a wear and tear test to ensure they can withstand extended cleaning sessions.

5.3.2 System Integration Testing

Once each component has passed its individual tests, it's time to see how they work together as a whole. System integration testing focuses on verifying:

Seamless Communication: Does the ESP8266 communicate effectively with the L298N motor driver, sending control signals that translate to precise motor movements? This involves testing how motor commands are transmitted from the ESP8266 to the driver and how the driver interprets these signals to control the DC motors.

Functionality of Integrated System: Does the robot perform its core cleaning tasks as intended? We test the robot's ability to navigate using the chosen control method (remote control, smartphone app, or autonomous programming), clean different floor types with its selected cleaning mechanisms (brushes, cloths, etc.), and avoid obstacles using the ESP8266's potential connection to sensors (if applicable).

Performance Optimization: How efficiently does the robot operate as a system? We measure factors like cleaning time, battery consumption, and motor performance to identify areas for improvement. This might involve fine-tuning motor control programs on the ESP8266 to optimize power usage or adjusting cleaning patterns for better coverage.Examples of System Integration Testing:

Line Following Test Course: Black electrical tape can be used to create a course with various shapes and angles on the floor. The robot is programmed to follow this course autonomously, testing its ability to navigate and turn accurately using input from sensors and the ESP8266.

Obstacle Avoidance Test: Objects of different sizes and shapes are placed in the robot's path to simulate real-world obstacles. The robot's sensors detect these obstacles, and the ESP8266 sends signals to the motor driver to adjust the robot's trajectory and avoid collisions.

Battery Endurance Test: The robot is run continuously on a full battery charge until the battery is depleted. This test helps determine the robot's actual cleaning time under typical usage conditions and allows us to assess the effectiveness of power-saving measures implemented in the software.

5.3.3 Environmental Testing

In addition to functionality and performance testing, our robot undergoes rigorous environmental testing to ensure it can withstand the varied conditions it may encounter in a home environment. This includes:

Dust and Debris Testing: The robot is subjected to environments with high levels of dust and debris to evaluate the effectiveness of its cleaning mechanisms and to identify any areas where dust and debris may accumulate and affect performance.

Impact and Drop Testing: The robot is dropped from various heights onto different surfaces to simulate accidental falls and impacts that may occur during normal use. This helps identify weak points in the robot's design and allows us to make improvements to increase durability and reliability.

Chapter 6

Conclusion and Future Scope

6.1 Conclusion

The floor cleaner robot with a self-charging station, utilizing components like the NodeMCU ESP8266 module, L298N motor driver, mopping pads, batteries, and BO motors, represents a significant advancement in household robotics. Seamlessly blending cutting-edge technology with practicality, this project simplifies cleaning tasks by offering wireless control, precise navigation, and efficient dirt removal. The rechargeable battery system powers the robot's movements, while the self-charging station ensures uninterrupted cleaning sessions by autonomously replenishing energy when needed. This innovative solution enhances user convenience and improves cleaning efficiency, showcasing the potential of robotics to streamline everyday tasks. As the creator of this project, I'm proud of its contribution to simplifying household chores and enhancing living spaces.

References

[1] Sharada L. Kore,”Floor Cleaning Smart Robot”et. al. International Journal of Engineering Research and Applications www.ijera.com ISSN: 2248-9622, Vol. 12, Issue 9, September 2022, pp. 61-65.

[2] G Tuangzhi Dai and Tiequn Chen ”Design on measurement and control system of cleaning robot based on sensor array detection”, IEEE International conference on control automation Guangzhou, May 30 to June 1, 2007, China.

[3] Youngkak Ma, seungwoo Kim, Dongik Oh and Youngwan Cho, ”A study on the development of home mess- cleanup robot McBot”, IEEE/ASME international conference on advanced mechatronics, July 2-5, 2008, Xian, China.

[4] Zheng Zhao, Weihai Chen, Chen C.Y. Peter and Xingming Wu ”A novel navigation system for indoor cleaning robot”, IEEE International Conference on Robotics and Biomimetics (ROBIO), Dec. 3 to Dec. 7, 2016, Qingdao, China.

[5] Abhishek Chakraborty and Ashutosh Bansal (2013) ’Design of Dust Collector for Rear Wheel of Four-Wheeler’, International Journal of Emerging Technology and Advanced Engineering, Vol.3, No.7, pp. 199-216.

[6] Aishwarya Pardeshi,”Automatic Floor Cleaner”,International Journal of Electronics & Communication Technology, Vol. 8, Issue 1, Jan - March 2017.

[7] Anup Mendhe, Mayank Lalka, Dinesh Shende et al, ”Multipurpose Floor Cleaning Machine”, International Journal for Scientific Research & Development, ISSN (online): 2321-0613, Volume 5, Issue 01, 2017,740-742.

[8] Imackhai Lawrence (2012) 'Evaluating Single Dise Floor Cleaners', An Engineering Evaluation, Innovative Systems Design and Engineering, Vol.3, No.4, pp.41-44.

[9]] Manya Jain (2017) 'Ergonomies considerations in the design and use of single disc floor cleaning machines', Applied Ergonomics, pp. 112-116.

[10] Sandeep J. Meshram and Mehta G.D (2016) Design and Development of Tricycle Operated Street Cleaning Machine', Journal of Information, Knowledge And Research In Mechanical Engineering. Vol.4, No.1,pp.0975-0981.

[11] Shubham Antapurkar,"Arduino Based Dry & Wet Automatic Floor Cleaner", International Journal of Engineering Technologies and Management Research, ISSN: 2454-1907, Volume 5 Issue2, February, 2018,14-18.

[12] Aadil Arshad, Muhammad Kashif, Nandkishor S. Kale et al, "Design & Development of Floor Cleaning Machine", International Journal for Scientific Research & Development, ISSN (online): 2321-0613, Volume 6, Issue 01, 2018,278-280.

[13] Ms. R. Abarna, S.Devadharshini, S.Dhileep et al,"Design And Fabrication Of Automatic Floor Cleaning Machine", International Journal of Science and Engineering Research, (p)-2230-235, 3221 5687, (P) 3221 568X, Volume 6 Issue 4 April -2018

[14] A. Saleem, A. Sabir, A. Iqbal, A. Hussain Design and implementation of an intelligent dust cleaner robot for uneven and nonstructural environment International Conference on Computing, Mathematics and Engineering Technologies – iCoMET (2019)

[15] A.P. Murdan, P.K. Ramkissoon A smart autonomous floor cleaner with an Android-based controller 2020 3rd International Conference on Emerging Trends in Electrical, Electronic and Communications Engineering (ELECOM) (2020).

[16] Himani Patel and Mahima Patel, "Wireless Multi -Purpose Floor Cleaning Machine", International Journal of Latest Technology in Engineering, Management Applied Science, ISSN 2278-2540, Volume 8, Issue 4, April 2019 ,16-19.

[17] Arjun V Murali, Amal Raj, Anandhu Jayaram et al, "Floor Cleaning Machine", International Journal of Advanced Engineering and Global Technology, ISSN No: 2309-4893, Volume 5, Issue-03, May 2017,1824-1826

[18] Mr. S. Rameshkumar, M. Selvakumar, S. Senthilkumar et al, “Design and Fabrication of Multipurpose Floor Cleaning Machine”, International Journal of Advanced Science and Engineering Research, ISSN: 2455-9288, Volume 3, Issue: 1, 2018, 1012-1019.

[19] S Monika, k Aruna, S V S Prasad, B Naresh “Design and implementation of smart floor cleaning robot using Android App” by Inernational Journal of Innovative Technology and Exploring Engineering(IJITEE), March 2019.

[20] J Frolizzi C.Disalvo. Service robots in the domestic environment: A “study of Roomba vacuum in the home”. In international conference on human robot interaction HRI.

[21] A Technical Analysis of Autonomous Floor Cleaning Robots Based on US Granted Patents, European International Journal of Science and Technology Vol. 2 No. 7 September 2013. Liu, Kuotsan1, Wang, Chulun.

[22] V.Prabakaran, M.Rajesh Elara, T.Pathmakumar and S. Nansai ”HTetro: A Tetris inspired shape shifting floor cleaning robot”, IEEE International Conference on Robotics and Automation (ICRA), May 29 to June 3, 2017, Singapore.

[23] V. P.H., L. V., M. K., R. P.S. and S. R. (2018). Sweepy The Smart Floor Cleaner. International Conference on Design Innovations for 3Cs Compute Communicate Control (ICDI3C), 124-126.

[24] Jens-Steffen Gutmann , Kristen Culp , Mario E. Munich and Paolo Pirjanian. The Social Impact of a Systematic Floor Cleaner . In IEEE international workshop on advance robotics an its social impacts ,Technische University munchen, Germany May 21-23,2012.

[25] Harvey Koselka, Bret A.Wallach, David Gollaher, ”Autonomous floor mapping apparatus,” U.S.Patent 6741054 B2, May 25, 2004.

Research Paper Published

Appendix