# Smart Multipurpose Floor Cleaning Robot


*A BS Final Year Project by*

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**May, 2023**

# Certificate of Approval

It is certified that we have checked the project presented and demonstrated by **Aneesa Riaz 547-FET/BSEE/F19, Dua Fatima 577-FET/BSEE/F19, Zahra Saeed Khan 560-FET/BSEE/F19** and approved it.

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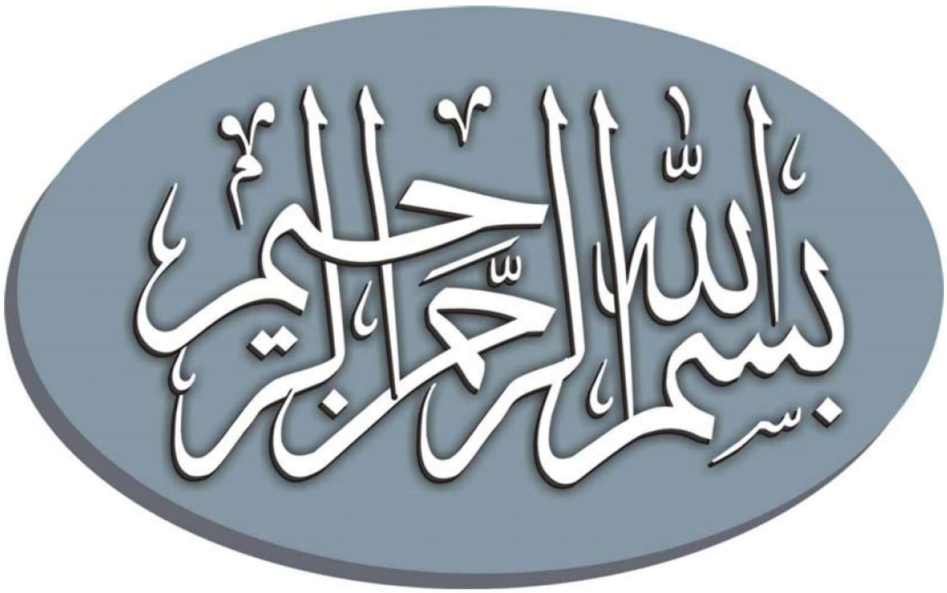


*In the name of Allah (SWT), the most beneficent and the most merciful*

A BS Final Year Project submitted to the

Department of Electrical and Computer Engineering

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In partial fulfillment of the requirements

For the award of the degree of

Bachelor of Science in Electrical Engineering

# Declaration

We hereby declare that this work, neither as a whole nor as a part thereof has been copied out from any source. No portion of the work presented in this report has been submitted in support of any application for any other degree or qualification of this or any other university or institute of learning. We further declare that the referred text is properly cited in the references.

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**Tools Used:**

- Auto Cad
- Arduino
- Proteus

# Abstract

In this day and age, people lead very busy lives. People living in cities work irregular and for long hours. In such cases, people will always find ways to save time. Maids are in trend in recent year for cleaning houses. Simple vacuum cleaner does not work in an effective way as it consumes large electricity and have costly maintenance. To remove such problems, we proposed a solution of multipurpose autonomous cleaning robot. Robot is an electromechanical system used to perform a variety of functions in commercial and home environments. It starts by having a sensor detect each object and send input to the Arduino, which controls robot's movement. It can perform the functions of vacuuming, mopping and sanitizing very effectively. Robot is also programmed to move in a zig-zag movement to clean every corner of the house and avoid obstacles autonomously.

## Contents

# LIST OF FIGURES:

# List of Abbreviations

| | |
|---|---|
| SoC | System on Chip |
| FYDP | Final Year Design Project |
| OBE | Outcome Based Education |
| IoT | Internet of Things |

# *CHAPTER 1*

## 1.1 INTRODUCTION:

Cleanliness plays an important role in daily routine. Cleanliness is more effective way to protect ourselves and society from diseases and keep the surrounding dust free. Healthy environment is a need of mankind to ensure healthy lifestyle. Dust causes a major risk to human health in any hospital, school, colleges, household, and hotel room. Dusting and sweeping are the daily household task that must be done every day to maintain cleanliness. Maids are in trend in recent year for cleaning the houses. Several cleaning solutions are available in recent years to keep your surrounding free of dust. Machine controlled vacuum cleaner were available for the interest of mankind.

Simple vacuum cleaner does not work in effective way. They consume large electricity and have costly maintenance. Maids work in different houses at a same time so they get germs and bacteria with them which can be very harmful for house owner and their family members. some maids have a habit of stealing things from the house, but all the maids are not dishonest, but due to these maid's house owner must suffer a lot. Handicap person are not able clean their house by himself they need someone help. But now we live in modern age we can resolve such problems with the help of technology and engineering techniques.

Today's hectic life demand smart way for enhancing lifestyle through improving cleaning process. To remove such problems, we proposed a solution of multipurpose autonomous floor cleaner robot. Robot will be an electromechanical system used to perform a variety of functions in commercial and home environments. Robot harvesters contain low-power electronic and mechanical components, can operate during a full power outage**,** and no longer require human control. The robot will have electrical components that power and control the equipment. This energy will be provided in the form of electricity received from the battery. The basic electrical circuit plays a decisive role here. The robot's electrical elements will be used to move it through a motor. Robot therefore requires different levels of power provided to vehicles and sensors to enable and perform simple operations. First, the robot will be turned on manually and it'll start moving forward and performs a cleaning action. Sensors will be used to detect obstacles. When an obstacle is detected, the robot automatically will change the lane, stops

interfering and starts a cleaning action. There will be a bin collecting the debris and alarm will go off once it achieves the limit. The controller is programmed to simply accept input, sense its surroundings, and control the robot to avoid collisions. This robot vacuum cleaner is an electric household appliance that can be operated manually according to human convenience.

## 1.2 MOTIVATION:

Cleanliness is essential for a healthful and smooth environment. The motivation behind autonomous cleaning robots is to improve hygiene standards through cleaning technology. Cleaning is considered a tedious and repetitive task that many people want to avoid. This robot offers a simple solution that requires minimal effort and human intervention. Features such as self-management, programming options, and the ability to control the system via an app give users the flexibility to delegate cleaning tasks to a reliable and powerful system Today, however, such problems can be solved with the help of technology and engineering.

Additionally, traditional cleaning tools are often specialized for specific tasks, requiring users to switch between different tools as needed. This versatility gets rid of the want for more than one equipment and simplifies the cleansing process. Our goal is to provide a solution that allows one device to handle many cleaning tasks. By combining different cleaning methods, surfaces can be vacuumed, wiped, and disinfected at the same time. Through this robot, we ensure greater efficiency, versatility, accessibility and promote hygiene and wellness.

## 1.3 PROBLEM STATEMENT:

Cleaning the floors and premises of our residence or work is mandatory and provides a decent atmosphere. The process of cleaning usually involves human beings. Cleaning the floors in a multi storied mall, hospitals, and even large home needs large human resources to perform cleaning which may take time and needs separate person monitoring the work too. In the residential places, cleaning process may be cumbersome for the elderly people, also the cleaning workers are not affordable these days. People with disabilities cannot clean their homes by themselves and need someone's help. Also, maids work in different households at the same time, they introduce germs and bacteria that can be harmful to the homeowners and their families. Some maids have a habit of stealing things, but not all maids are dishonest, but at the hands of these maids, the owner of the house suffers greatly.

In such scenario, technology can help in reducing the efforts being put by the human beings and ultimately can save the time, budget, and resources. We have designed and fabricated a multi-purpose cleaning robot that can perform cleaning operations inside the residential as well as commercial environment.

## 1.4 RESEARCH OBJECTIVES:

- Design and Development of Prototype robot.
- Design and Development of Motor drive circuits for the robot.
- Design and Development of sensor-based Movement mechanism of robot.
- Design and Development of floor wiping unit.
- Design and Development of vacuum cleaning unit
- Design and Development of sanitizing unit
- Design and Development of remote end for the robot

## 1.5 BRIEF PROJECT METHODOLOGY:

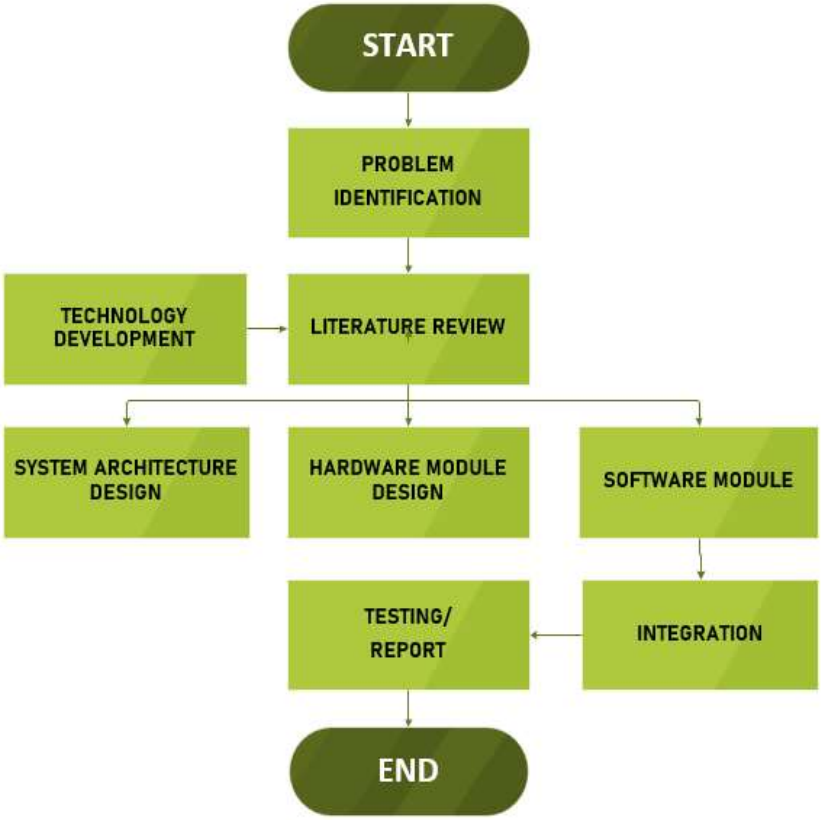


***Figure 1 Project Methodology***

## 1.6 PROJECT COMPOSITION:

- **CHAPTER 1** present our projects, problems, project motivations and objectives. This sets the context for the entire report and forms the basis for subsequent chapters.

- **CHAPTER 2** is a comprehensive review of existing literature and research relevant to our project. We analyze past research to identify key findings, knowledge gaps and areas that require further investigation.

- **CHAPTER 3** focuses on providing detailed information about the electronic modules used in this project. A detailed description of each module and its specifications and features are included. This chapter will serve as a foundation for understanding the hardware components used in your project.

- **CHAPTER 4** covers the circuit design aspects of the project. It describes the schematics and circuits of the modules and highlights the connections and interactions between them. This chapter also describes hardware tests that are performed to verify robot functionality.

- **CHAPTER 5** covers IOT i.e., ability of these connected objects to communicate and interact with one another without human intervention is the main concept behind IoT. They can collect information from their environment, communicate it with other devices or centralized systems, and then react or initiate activities in response to the information.

- **CHAPTER 6** is about Prototype which involves creating a working model or a preliminary version of the IoT product or system. It allows developers to test and validate their ideas, functionalities, and user experience before moving forward with full-scale production. Integration refers to the process of combining and connecting various components, subsystems, or modules to create a unified and functional whole.

It is to ensure that the individual parts of a project work together harmoniously and achieve the desired objectives.

- **CHAPTER 7** explores significant advancements in the field, including groundbreaking discoveries and innovative technologies, pushing the boundaries of knowledge. In conclusion, the advancements discussed in this chapter highlight the remarkable progress, paving the way for a future full of possibilities.

# *Chapter 2*

# LITERATURE REVIEW

It compares the current work to the prior one for evaluation.
It highlights the future work that would be carried out based on the current work in progress and illustrates the current implementations that address the project's past issues and constraint that must be understandable and transparent.

## 2.1 BACKGROUND OF PROJECT:

Conventional cleaning methods often involve manual labor, repetitive tasks, and the use of multiple cleaning tools. As technology advances, interest in developing automated solutions to simplify and improve cleaning operations has increased. The emergence of robots and artificial intelligence has made it possible to design and develop multi-purpose cleaning robots. These robots can perform a variety of cleaning tasks independently or with minimal human intervention. It is equipped with advanced sensors and cleaning mechanisms to effectively and efficiently clean various surfaces and environments. With busy lifestyles and limited time for home or commercial cleaning, people are looking for ways to optimize their cleaning routine.

In addition, the convergence of smart home systems and the Internet of Things (IoT) has opened huge avenues for connectivity and automation. The multi-purpose cleaning robot is integrated into the smart home ecosystem, allowing users to control and schedule cleaning tasks remotely or through voice commands. This integration enables seamless collaboration between the cleaning robot and other smart devices, improving the cleaning experience and convenience. In general, the background of the multi-purpose cleaning robot is the need for cleaning solutions, advances in robotics and AI technology, the importance of cleanliness and integration with smart home systems. Taking advantage of these factors, multi-purpose cleaning robots offer promising solutions to improve cleanliness, comfort, and productivity in domestic and commercial environments.

*Figure 2:Multipurpose Floor Cleaning Robot*

## 2.2: RELATED WORK:

### 2.2.1 Automatic Floor Cleaning Robot Using Arduino and Ultrasonic Sensor:

Different components namely the ultrasonic sensor, the L298 motor shield, the Arduino Uno microcontroller, the servo, and the DC motor have been used. This tool works when Arduino Uno microcontroller treats ultrasonic sensor as distance sensor and DC motor as robot driver, then DC motor is controlled by Motor Shield L298. When the ultrasonic sensor detects an obstacle ahead, the robot will automatically find a non-obstruction direction towards the floor cleaning robot. The distance value on the sensor has been determined, i.e., when the distance read by the ultrasonic sensor is less than 15 cm. The ultrasonic sensor's distance value test results show that different conditions occur. At a distance of >15cm, the state of the prototype street-cleaning robot is obtained, while at a distance of <15cm, the state of the prototype street-cleaning robot is obtained.

### 2.2.2 Design and Manufacturing of Automatic Classroom Vacuum Cleaning Robot:

A prototype is designed for a classroom vacuum cleaner robot that uses user interface elements to control the power supply of electronic devices used in an office environment. Various types of wheels were tested in the design of the robot. Lopper wheels are used in robot's manufacturing by the company on demand. Lopper wheels have been observed to be easier and more economical to manufacture. Wheels with three lobes have continuous vibration problems A 5-turn wheel was tested to solve this problem. The 7 track wheels were chosen because the results of this wheel test showed a significant reduction in vibration. Vacuum cleaner selection is based on Bernoulli's principle.

### 2.2.3 Floor Cleaning Machine by Remote Control:

Floor cleaner is developed for mopping and sweeping. Operation works both manual and automatic fashion. The machine can detect any obstacle within 1 foot of its path. The wireless development robot based on radio frequency communication between machine and remote control with a range of 50m. Obstacle detection information will be sent to the remote control and received displayed on the remote-control screen. The machine is developed performing all the operations autonomous and can be used in multi-use environment that allows access to limited space.

### 2.2.4 Development of a Vacuum Cleaner Robot:

The design of the model, its limitations and cleaning areas as well. as the interaction between circuit design and layout have been discussed. The basics of building an automatic robot for cleaning have several blocks, namely navigation, collision detection, suction and many others, each block type and their interaction must be synchronized so that the robot works well without any errors. Chassis, circuit design for confined spaces, navigation and vacuum made easy, along with challenges encountered, suggested changes and improvements, estimated costs and code expectations through the detailed explanation of the report.

### 2.2.5 Fabrication of Floor Scrubber Machine:

Floor cleaning machine consists of AC motor, belt brush, conveyor belt, wiper, conveyor roller, dustbin, waste bin and frame. The belt roller receives input from the AC motor through the belt. Along the entire length of the belt, a brush is mounted connecting two rollers. Conveyor roller arrangement and internal rotary conveyor follow clockwise. The dustbin is kept at a low distance from the floor to sweep dust off the floor through a brush and into the dustbin mounted on the back of the chassis. All parts are mounted on the frame.

### 2.2.6 Automatic Floor Cleaner with UV Disinfection System:

Developed a floor cleaning machine that has three functions in one, namely vacuuming, mopping and UV disinfection. Cleaning is done using relative motion between the brush and the floor surface and cleaning bacteria with UV LED strips.

### 2.2.7 Auto Floor Mopping and Cleaning Bot:

An Arduino-controlled floor cleaner is designed to perform the necessary cleaning operation. When designing this device, focus was on developing low cost, flexibility and low maintenance. The floor cleaning machine is suitable for dry and wet floor cleaning. It can also act as a vacuum cleaner and UV sterilizer for floors.

### 2.2.8 Wireless Multi - Purpose Floor Cleaning Machine:

A prototype is designed to clean floors in hospitals, homes, auditoriums, shops, computer centers etc. The machine includes a wet cotton brush to clean the floor and is dried by a small fan. Development machine works sweeping and cleaning operations. The machine provided is an efficient floor cleaner, even in the corners of the floor. In addition, the machine has a semi-automatic spray mode and dry as well as wet mode electric cleaning tools. They used a DC motor and a vacuum pump instead of using two vacuums to save energy. In the literature it is stated that the cleaning time of the developed machine is very little and the machine is cost effective and low in maintenance.

### 2.2.9 Semi-Automatic Track Cleaning Machine:

A robot-based mechanism for cleaning between train tracks. The design is to overcome all the disadvantages of the current machine to have super clean rails. In this machine, vacuum technology was used, in which all kinds of waste such as empty plastic water bottles, human waste, shredded paper, etc. will be collected. This machine is suitable for all weather conditions and can be attached to an existing ship hold and this compartment can be built independently and designed with low-cost communication techniques. The article also mentioned that the machine was developed to save time, destroy dirt, save costs and be environmentally friendly.

### 2.2.10 Design & Development of Floor Cleaning Machine:

Developed an easy-to-use and simple floor cleaner. This machine has wipers, brush, cotton mop and vacuum cleaner to reduce cleaning time. In this article, they claim that their machine meets the cleaning needs.

### 2.2.11 Solar Operated Floor Cleaning Machine:

It is a solar-based cleaning system. For this, photovoltaic panels have been used that convert energetic particles (photons) into electricity. This clean energy is used to power cleaning machine.

### 2.2.12 Autonomous Floor Cleaning Robots:

This microcontroller automatic floor cleaner module is implemented for floor mopping and dusting. In this module of a remote-control car having a transmission motor attached to the front axle between the front wheels, which is attached to a cleaning brush in the front and gear motor connected to a 12-volt battery and the remote-control car attached to a 9-volt battery. The remote car controlled by microcontroller.

### 2.2.13 Design and Fabrication of Manually Operated Floor Cleaning Machine:

Proposed a manual floor washer with modern processes for cleaning both wet and floors. It comes with a storage box that can store garbage. The basic considerations of ease of use, reduced labor and environmental friendliness were taken into account when designing the floor of the machine. It is an electric machine that does not require training. The paper also mentions future possibilities for reducing the vacuum cleaner footprint and mitigating the vibrations caused by high RPM.

### 2.2.14 Robotic Vacuum Cleaners Entering in the Home Ecosystem:

The mistakes of previous robot vacuums, learn from them, and make the necessary changes to your robot design to effectively overcome these mistakes have been discussed. The report analyzes the energy crises that may arise in future generations and documents the efficient use and management of energy through optimized power distribution within the system. This article describes various navigation techniques that vacuum robots can use to efficiently use the energy in the system. Best navigation method can be chosen to use based on the performance values of your design.

## 2.3 ALGORITHM:

Algorithms used by the robot to decipher sensor data and decide how to proceed with the task at hand. These algorithms incorporate obstacle avoidance and object recognition.
To interface with other devices or systems for remote control, data exchange, or integration with smart home or office environments, the robot possesses wireless communication module s like Wi-Fi.

# *Chapter 3*

# System Design and Implementation

## 3.1 SYSTEM DESIGN:

Our work focused on developing an intelligent IoT based multipurpose smart cleaning Robot where the robot is equipped with various sensors such as ultrasonic sensors, or other specialized sensors depending on the application. These sensors provide the robot with information about its environment. The robot employs algorithms to interpret sensor data and make decisions based on the task at hand. These algorithms include object recognition and obstacle avoidance. The robot incorporates wireless communication modules, such as Wi-Fi to communicate with other devices or systems for remote control, data exchange, or integration with smart home/office environments. The robot requires a power source, which can be batteries or a combination of batteries and external power supply for charging or prolonged operation.

### 3.1.1 SYSTEM ARCHITECTURE:

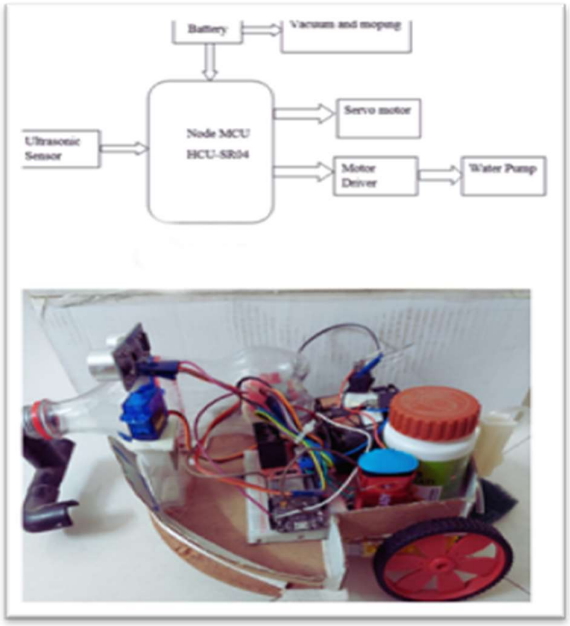


***Figure 3 Architecture of the system***

## 3.1.2 SYSTEM BLOCK DIAGRAM:

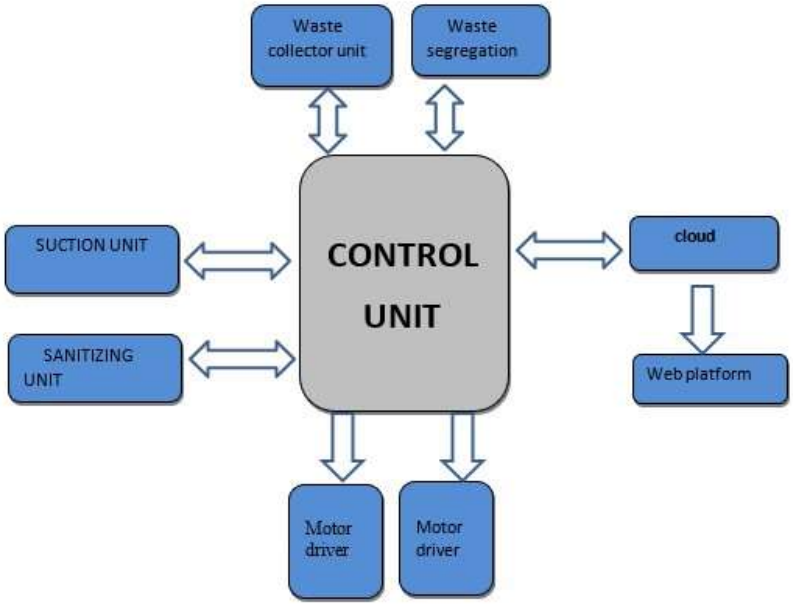


***Figure 4 Block diagram***

## 3.1.3 REQUIREMENT ANALYSIS:

There are multiple approaches to design a robot, but the basic requirements remain the same. The basic requirements of multipurpose floor cleaning robot are:

- **Cleaning Efficiency:**

The robot should be able to effectively clean different types of floors, such as hardwood, tiles, carpets, etc.

It should have efficient cleaning mechanisms, such as brushes, vacuum, and mop, to handle various types of dirt and debris.

- **Navigation:**

The robot should be capable of navigating autonomously within the cleaning area.

Localization capabilities are required to ensure accurate positioning within the cleaning area.

- **Obstacle Detection and Avoidance:**

The robot should be equipped with sensors to detect obstacles, furniture, and other objects in its path.

It should have the ability to navigate around obstacles or safely move them if possible**.**

- **User Interaction and Control:**

The robot should provide a user-friendly interface, such as buttons, smartphone app, for easy control and interaction with the user.

It should offer various cleaning modes, customizable settings.

- **Battery Life and Charging:**

The robot should have a sufficient battery capacity to clean a given area without frequent recharging.

It should provide a reliable and convenient charging system.

- **Maintenance and Durability:**

The robot should be designed for easy maintenance, including filter replacement, brush cleaning/replacement, and general upkeep.

It should be constructed with durable materials to withstand regular usage and potential collisions.

- **Safety Features:**

It should comply with safety standards and regulations to ensure user and property safety.

- **Connectivity and Integration:**

The robot may offer connectivity options, such as Wi-Fi, for remote control, scheduling, or integration with smart home systems.

- **Size and Design:**

The robot's physical dimensions should be suitable for maneuvering in different environments, including tight spaces and under furniture.

The design is aesthetically pleasing, compact, and lightweight for easy handling.

## 3.2 SOFTWARE DETAILS:

- **Arduino IDE:**

  Arduino is a free platform that allows users to upload and write code in real time. Any Arduino-based software board is fully compatible with the Arduino IDE. Any Linux, Mac, or Windows operating system can readily implement the software. For smooth compilation and editing, most of its components are written in JavaScript. Although the tool's primary focus is on creating code, it also offers several significant functionalities. For instance, the Arduino IDE enables users to communicate crucial project details with corporate stakeholders. Users have the option to change internal layouts and schematics as necessary. Main features of Arduino software are:

  - **Simple, clear programming environment**
  - **Open source and extensible software**
  - **It can work on Windows, Macintosh OSX, and Linux operating systems.**
  - **Board Module Options**

- **Proteus:**

  Proteus is an all-inclusive software for product development, from idea to final project. Proteus is a simulation software used to simulate components and can draw desired circuit. It is utilized for quick code validation of microcontroller-written code. Proteus has many accessible libraries that can be added to include more components. Its benefits include automatic PCB layout and wiring; intelligent principal layout; hybrid circuit simulation; precise analysis; single-chip software testing; and single-chip and peripheral circuit co-simulation.

- **AutoCAD:**

  It can develop and edit 2D and 3D designs and drawings using the tools and functionality offered by AutoCAD. Drafting, annotation, dimensioning, and rendering are just a few of the many features it provides. It can include different design elements including lines, arcs, circles, and polygons as well as make exact, intricate designs. Users of AutoCAD may see and communicate their designs in three dimensions by supporting the production of 3D models.

## 3.3 HARDWARE DETAILS:

- **Arduino:**

The Arduino Mega 2560 is a microcontroller board and can be named as ATMEGA 2560. The memory space of the Arduino Mega is much larger compared to the Arduino Uno board. It consists of 54-digital pins. Within 54-digital pins, mostly 15 pins are used because of the pulse width modulation (PWM). On the analog side, it has 16 input pins. The main elements of Arduino Mega are listed below:

- 16MHz oscillator
- USB cable port
- Reset button.
- Voltage regulator
- Power jack indicator
- Power semiconductor diode

The facility is connected through DC supply and AC supply from the battery or the adapter. It has a supply of three 3V and 5V. The Arduino mega 2560 can have the memory of 256KB. The size of SRAM is 8KB. Memory space of EEPROM is 4KB. The Arduino mega also used the Arduino software of the IDE. In that we will supply the program and alter the board within the Arduino mega 2560.

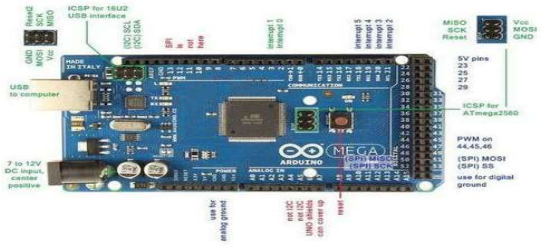

*Figure 5 Mega2560*

- **Ultrasonic sensor:**

An ultrasonic sensor is a piece of technology that uses ultrasonic sound waves to detect the distance to a target item and then turns the reflected sound into an electrical signal. The speed of audible sound is slower than that of ultrasonic waves (i.e., the sound that humans can hear). The transmitter uses piezoelectric crystals to create sound, and the receiver is the two primary parts of an ultrasonic sensor.


***Figure 6 Ultrasonic Sensor***

- **Node MCU:**

It is an open source IoT platform, also known as ESP-8266 Wi-Fi module because it's an on-board Wi-Fi chip which helps in connecting things/devices together.

The specifications of Node MCU are listed below:

- Open source
- Programmable
- It runs at 3.3V
- WIFI enabled

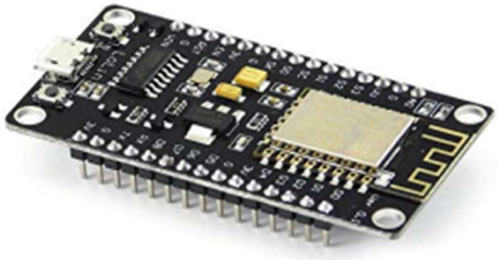

***Figure 7 Node MCU***

- **DC Water Pump Motor:**

DC motor is any of a category of rotary electrical machines that converts electricity power into energy. The DC motor is used in water and flow water in whole system with pressure.

***Figure 8 Water Pump***

- **DC Fan:**

Direct current, which only flows in one direction, is used by DC fans.

***Figure 9 DC Fan***

- **Jumper Wires and Connecting Wires**

Jumper wires area unit merely wires that have connective pins at every finish, permitting them to be used to connect 2 points to each different while not attachment. Jumper wires area unit usually used with breadboards and different prototyping tools thus on type it straightforward to vary.

***Figure 10 Jumper and connecting wires***

Connecting wires are used to travel electric current from one purpose on a circuit to a unique because of electricity wants a medium through that it will move. Most of the connecting wires are made up of copper or metallic element. Copper is cheap and sensible conduction. Instead of the copper, we'll additionally use silver that has high conduction however it's too pricey to use.

- **DC Air Pump:**

An air pump can be a pump to push air. All air pumps have a moving neighborhood that directs air flow (piston, impeller, diaphragm, etc.). When the air moves, less neighborhood is formed, which fills more air.

**Figure 11** ***DC Air Pump***

# *CHAPTER 4*

## Electronic Circuit Diagram

In this chapter there are details about the project's verification, testing, and validation procedures as well as statistical analysis, calculations, results, and supporting evidence. The verification of the hardware and algorithm tests' specification has been done. The data used and application verification. In terms of the project's requirements and objectives, the test cases at each level of design and the integration of the design models into the following level. Validation and evaluation of the intended outcomes.

## 4.1 Simulation Details

## 4.1.1 SUCTION UNIT:

In this unit, the motor is attached to the fan. When air particles are propelled forward, their density rises in front of the fan and falls behind it, causing the pressure level behind the fan to fall. This creates suction, a partial vacuum and the ambient air pushes itself into the bin through the intake port.

### SIMULATION:

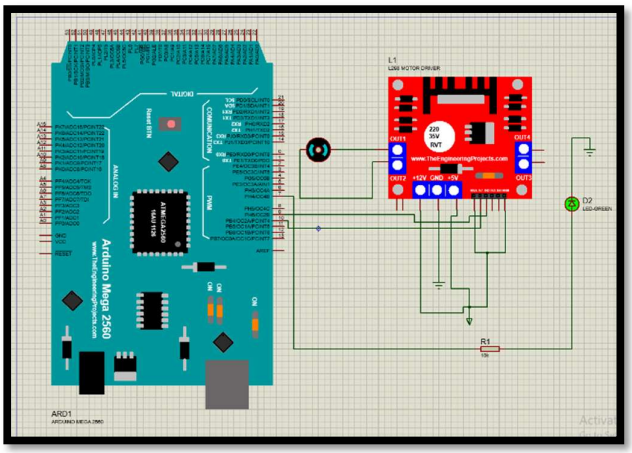


*Figure 12 Simulation of suction unit*

## TESTING:

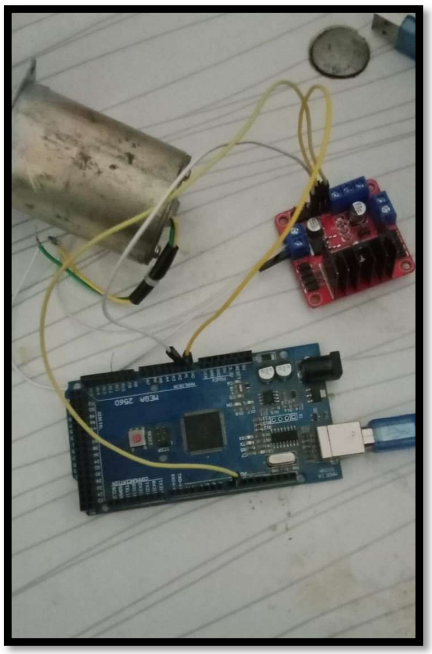

*Figure 13 Circuit of Suction Unit*

### 4.1.2 SANITIZING UNIT:

A pump in the sanitizing unit is run by a relay that is managed by Arduino. Disinfecting liquid pours into the buffing disc while the pump operates, sanitizing the floor.

### Simulation:

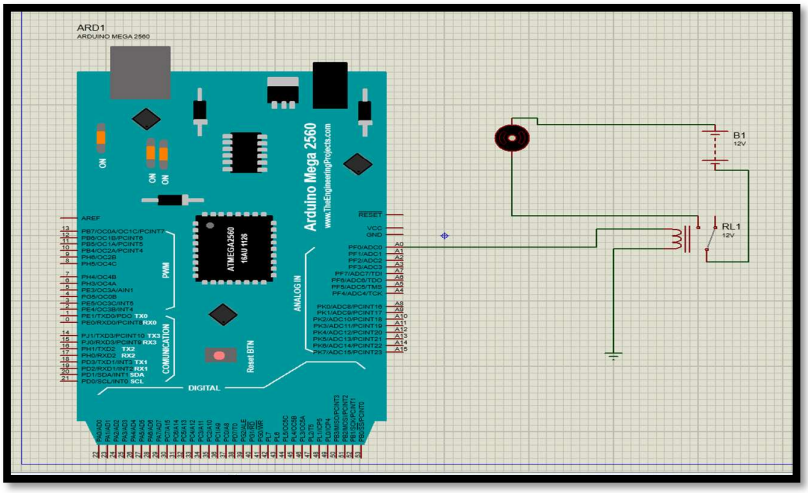


*Figure 14 Simulation of Sanitizing Unit*

## TESTING:

Testing of sanitizing unit by interfacing arduino mega 2560 with relay and motor pump

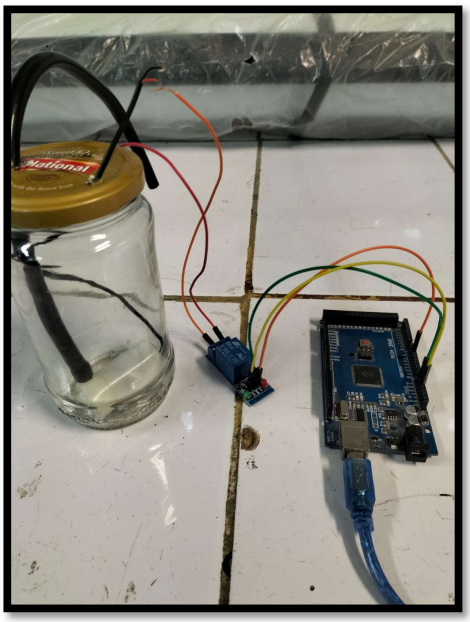


*Figure 15 circuit of Sanitizing Unit 1*


*Figure 16 Circuit of Sanitizing Unit 2*

## 4.1.3 MOTOR INTERFACE WITH ARDUINO:

Arduino mega 2560 is used to interact with a motor driver LM298, which controls the motor's forward and reverse motion.

### Simulation:

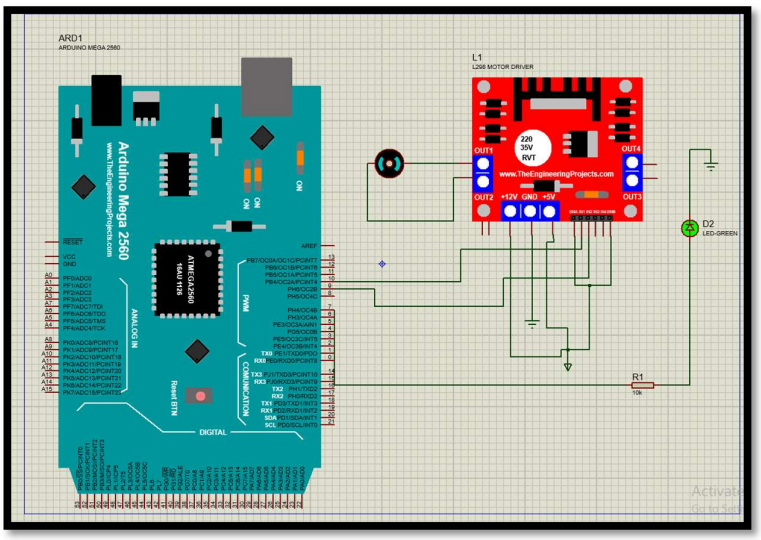


*Figure 17 Simulation of Motor Interface*

### TESTING:

Testing the working of motor driver LM298 by Interfacing it with Arduino mega 2560.

*Figure 18 Circuit of Motor Interface*

## 4.1.4 Interfacing of Arduino & NodeMCU:

Interfacing Arduino and NodeMCU involves connecting the two devices to establish communication and data exchange between them.

## OUTPUT:

Random values on thingspeak channel.

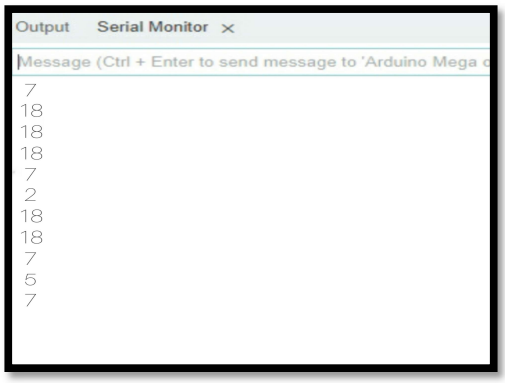


***Figure 19 Values on screen***

## TESTING:

Interfacing of nodemcu with arduino to send random values on thingspeak channel

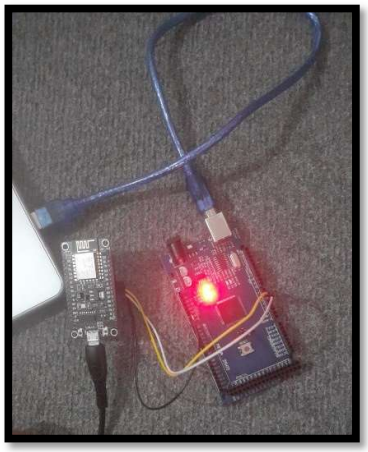

***Figure 20 Connections***

# *CHAPTER 5*

# IOT IMPLEMENTATION

IoT is the idea of linking common objects to the internet and allowing them to communicate with one another and with people. The network of actual machines, automobiles, home appliances, and other items that are equipped with sensors, software, and connectivity to gather and share data via the internet is known as the Internet of Things (IoT).

## 5.1 CHANNEL CREATION:

Output of the thingspeak when it gets the command of start/stop

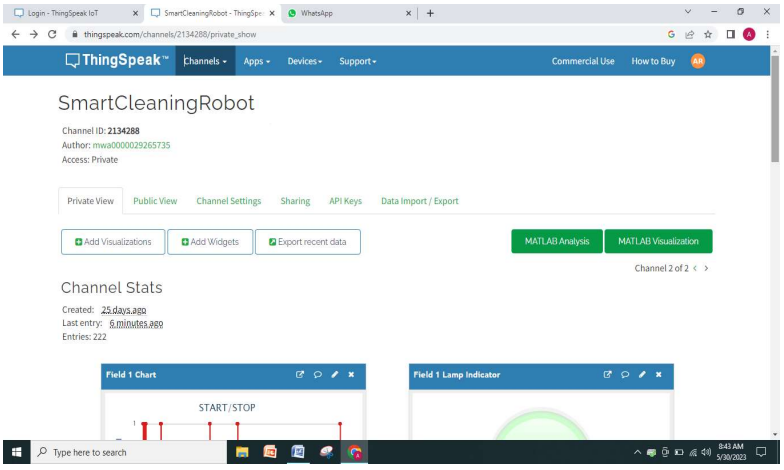


**Figure 21 Data Output 1**

## 5.2 SUCTION UNIT WITH IOT CONTROL:

Control of the suction unit's on/off switch by Thingspeak. We utilize an esp WiFi module in this circuit.

### TESTING:

Interfacing of nodemcu with arduino, motordriver and suction unit. Nodemcu will take updated data from the thingspeak and send it to arduino then arduino mega 2560 will turn on/off the suction unit.

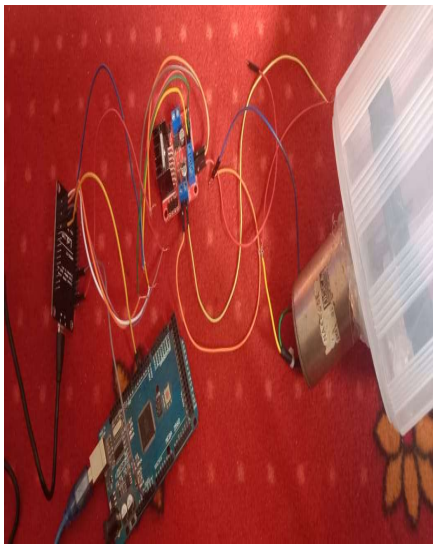

***Figure 22 Circuit***

# OUTPUT:

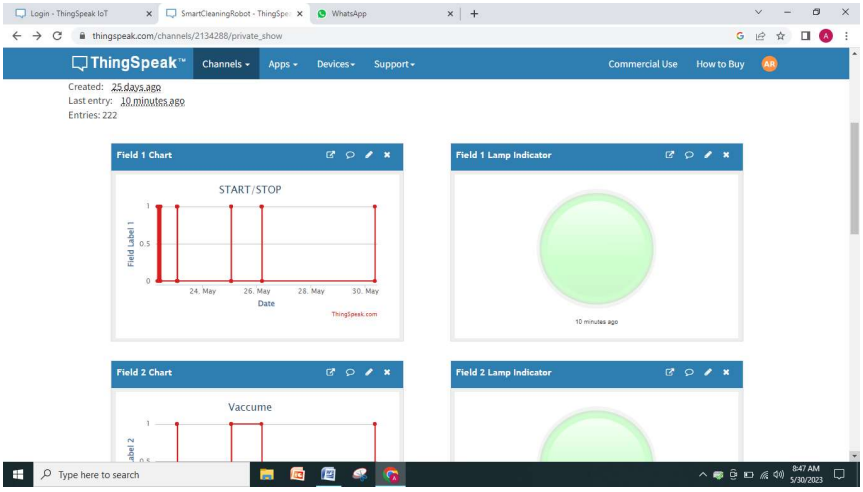


*Figure 23 Data Output 2*

Thingspeak output when it gets command to turn on/off the suction unit

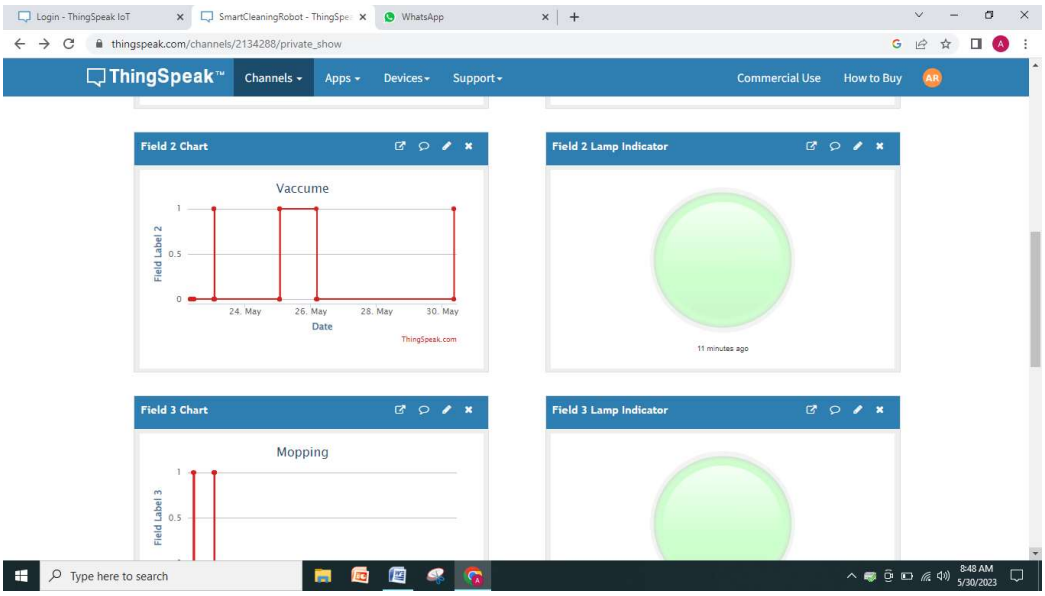


*Figure 24 Data Output 3*

## 5.3 SANITIZING/MOPPING UNIT WITH IOT CONTROL:

Control of the sanitizing unit's on/off switch by Thingspeak. We utilise an esp WiFi module in this circuit.

## TESTING:

Interfacing nodemcu with arduino and sanitizing unit.

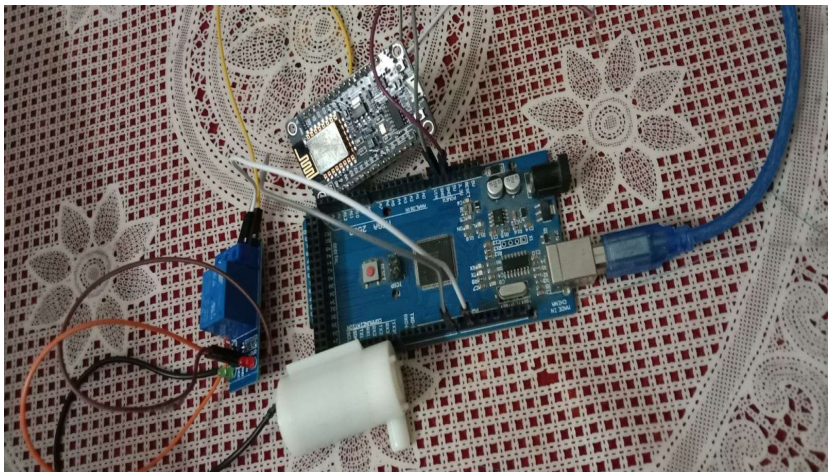

***Figure 25 Circuit***

# OUTPUT:

Output of thingspeak channel when nodemcu connected with mopping and sanitizing unit.

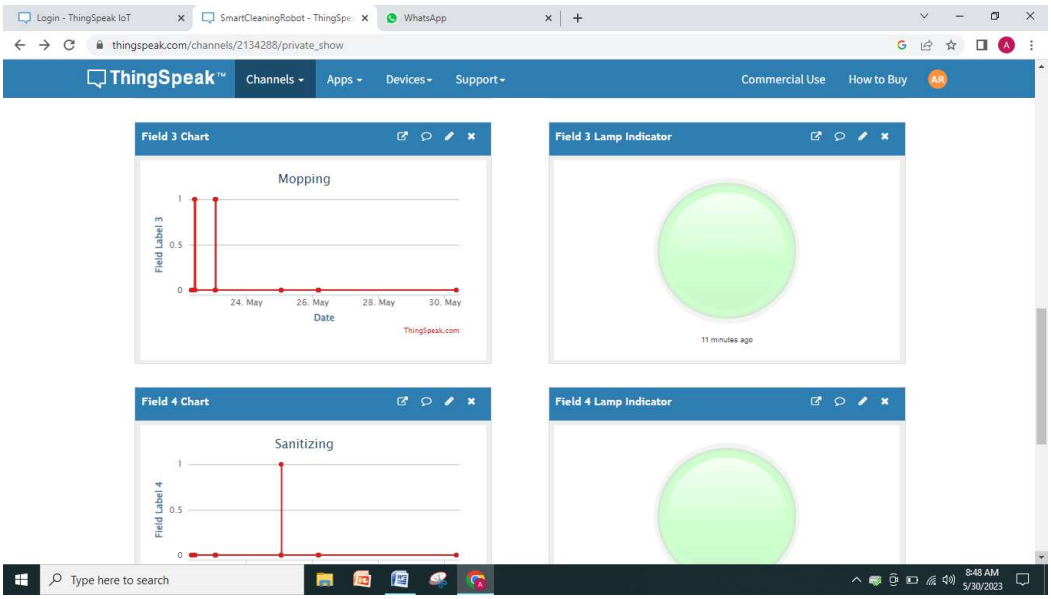


*Figure 26 Data Output 4*

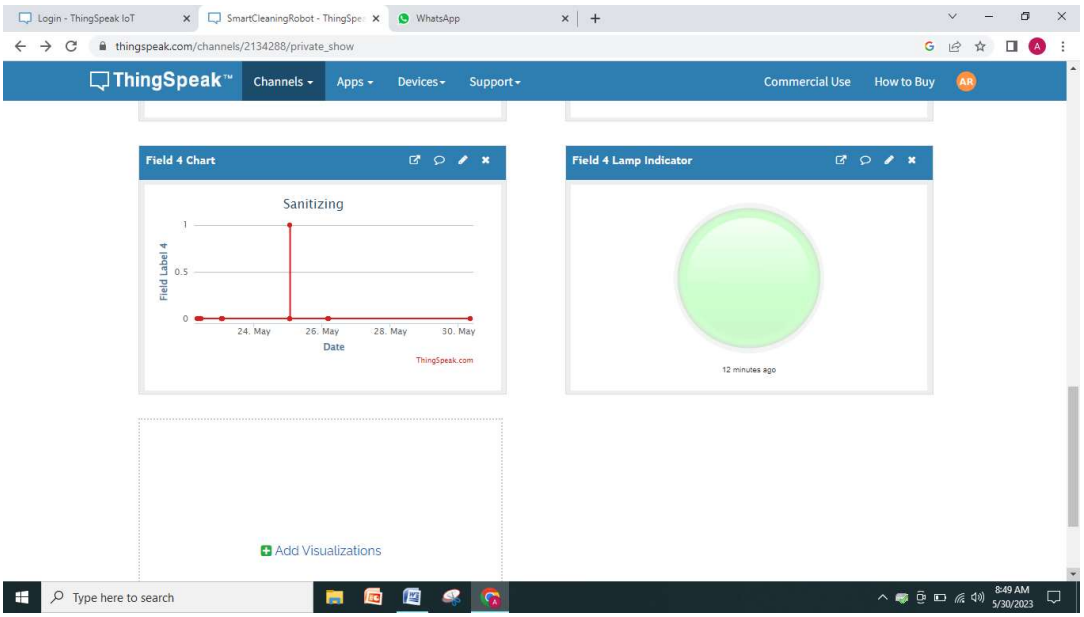


*Figure 27 Data*

# *CHAPTER 6*

# PROTOTYPE AND INTEGRATION

## 6.1 PROTOTYPE SPECIFICATION:

Design and development of multipurpose cleaning robot prototype was based on commonly available and low-cost components. Its base is made of acrylic sheet, and it is in round shape. Its dimension is 3 mm thickness and 12-inch diameter. It is consisting of two driving wheels which is controlled by two motors and L298 motor driver. It also has one supporting wheel. This robot has a feature of obstacle detection. It has an ultrasonic sensor which detects the obstacle from 1 foot. It has a battery pack of 12 volts. It also has charging port through which we can charge robot easily.

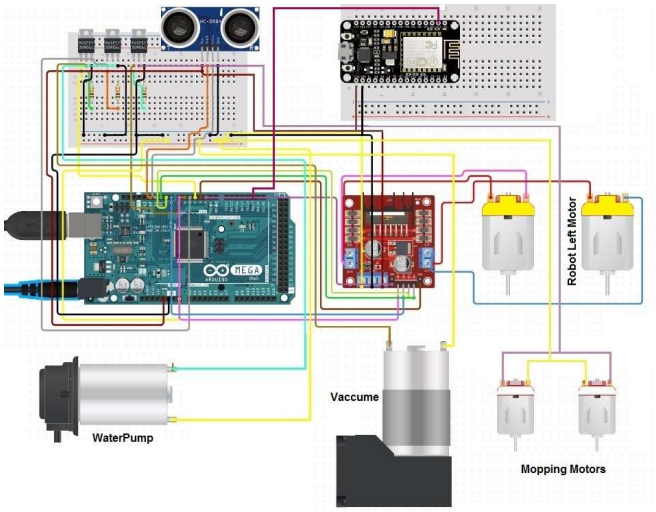


***Figure 28 Prototype circuit***

# PROTOTYPE:

*Figure 29 Prototype bottom view*

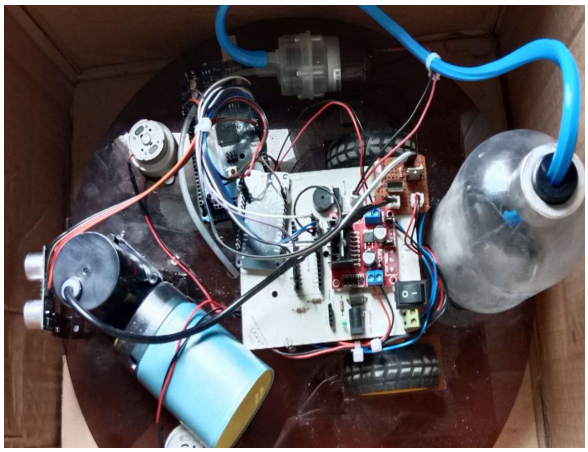

*Figure 30 Prototype Top view*

There are three units inside the robot:

## 6.1.1 VACUUM UNIT:

Vacuum unit consist of suction pump and a dc motor which sucks all the debris and dust from the floor. Vacuum unit also have a bin which can easily be removed and install.

## SIMULATION:

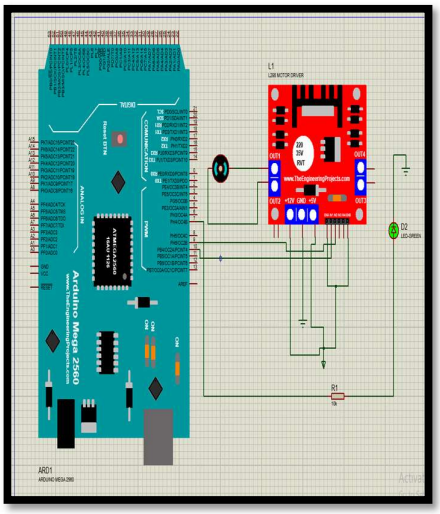


*Figure 31 Simulation*

## TESTING:

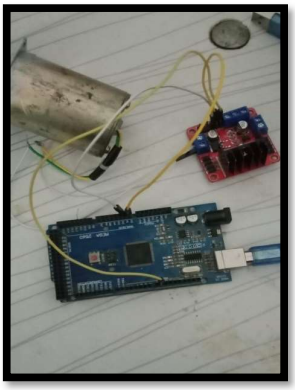

*Figure 32 Circuit*

## 6.1.2 MOPPING UNIT:

Mopping unit consists of dc motors and two brushes. Brushes are used for mopping functions.

## SIMULATION:

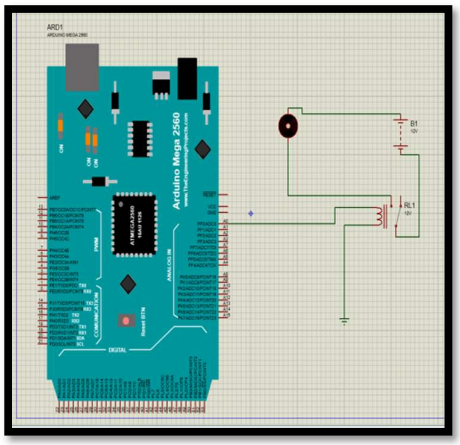


*Figure 33 Simulation*

## TESTING:

*Figure 34 Actual Picture*

## 6.1.3 SANITIZING UNIT:

Sanitizing unit consist of water pump and a container which is filled with a sanitizer liquid.

### SIMULATION:

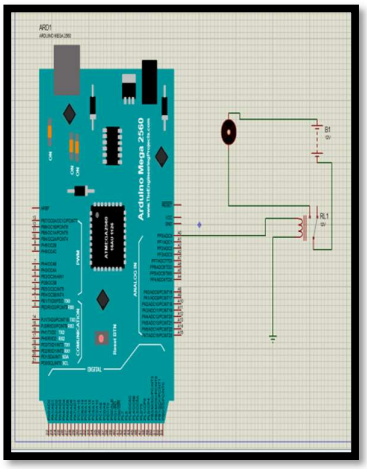


*Figure 35 Simulation*

### TESTING:


*Figure 36 Circuit*

All these three units switch on and off is controlled with mobile application.

## 6.1.4 COMPONENTS:

The complete hardware prototype of smart multipurpose cleaning robot involved various components:

- Ultrasonic senor
- Arduino at mega 2560,
- Esp 8266 Wifi module
- Transistor
- Five Dc motors
- Water pump
- L298 Motor driver
- Wheels

## 6.2 INTEGRATION WITH IOT:

Smart multipurpose cleaning robot with the Internet of Things (IoT) can provide several advantages, such as remote control, automation, and enhanced monitoring capabilities. Benefits of integrating a cleaning robot with IoT:

**Remote Control:** IoT integration allows you to remotely control and monitor the cleaning robot from anywhere using a mobile. You can start or stop robot, switch on and off all the three units and receive real-time updates on the cleaning progress.

**Smart Sensors and Data Collection**: IoT integration enables the cleaning robot to gather and transmit data from its on board sensors. These sensors can include, ultrasonic sensors.

All these three units switch on and off is controlled with mobile application.

## 6.2.1 COMPONENTS:

The complete hardware prototype of smart multipurpose cleaning robot involved various components:

- Ultrasonic senor
- Arduino at mega 2560,
- Esp 8266 Wifi module
- Transistor
- Five Dc motors
- Water pump
- L298 Motor driver
- Wheels

# *Chapter 7*

## 7.1 CONCLUSION:

In conclusion the prototype of smart multipurpose cleaning robot prototype is successfully developed, and objective of this project is achieved. Smart multipurpose cleaning robots offer numerous benefits and are a significant advancement in the field of household cleaning. These robots are designed to automate various cleaning tasks and provide convenience and efficiency to users. The smart cleaning robot capable to vacuum dust, small papers, and small sand from flat surface. It also has a function of mopping and sanitizing. It has a capability to be controlled remotely through mobile apps or voice commands. Smart cleaning robots are programmed to perform cleaning tasks effectively and efficiently. It uses ultrasonic sensor, artificial intelligence and also detect obstacles. By automating cleaning tasks, smart cleaning robot save valuable time for users. Smart cleaning robot clean autonomously, effectively and saves time . Although the initial investment may be higher compared to traditional cleaning tools, smart multipurpose cleaning robot can provide long-term cost savings. They reduce the need for manual labor, minimize the use of disposable cleaning supplies, and contribute to preserving the lifespan of flooring.

## 7.2 RECOMMENDATIONS:

Multipurpose cleaning robot has a capability to perform vacuum, mopping and sanitizing over a wide range. It has a capability to add more features to enhance the cleaning more effectively. Advancements in smart multipurpose cleaning robots have been driven by technological innovations and user demands. Smart cleaning robot become smart but it can become more smarter with AI integration. These technologies enable robot to adapt different techniques and method to perform their task effectively over a time. Smart multipurpose cleaning robot can be enhanced by adding a navigation system. Navigation system having laser sensor cameras and mapping algorithm. In future Multi-Surface Modern cleaning robots are designed in such a way that it can handle various surfaces, including carpets, hardwood floors, tiles, and even windows. They incorporate specialized brushes, suction systems, or mopping attachments to adapt to different cleaning requirements.

# *Appendix:*

## Code:

```
#include <ArduinoJson.h> // Include the ArduinoJson library


#include <EEPROM.h> // Include the EEPROM library


//#include <WiFi.h>  // This line is commented out


char *ssid = "mobilewifi"; // Define the Wi-Fi SSID


char *password = "12345678"; // Define the Wi-Fi password
```

[10:03 PM, 6/22/2023] Aneesa F-19: //#include <WiFi.h>  // This line is commented out

```
char *ssid = "mobilewifi"; // Define the Wi-Fi SSID


char *password = "12345678"; // Define the Wi-Fi password


static const char *host = "api.thingspeak.com"; // Define the ThingSpeak API host


static const char *channelID = "2134288"; // Define the ThingSpeak channel ID


static const char *apiKeyWrite = "4RZ9Y29XW1VXTHX4"; // Define the ThingSpeak write API key
```

```
static const char *apiKeyRead = "RZ8TP0J9QF67TL19"; // Define the ThingSpeak read API key

const int httpPort = 80; // Define the HTTP port

int ledPin = 2; // Define the GPIO pin for the LED

#define relay1 14 // Define the GPIO pin for relay1

#define relay2 12 // Define the GPIO pin for relay2

#define relay3 13 // Define the GPIO pin for relay3

#define relay4 4 // Define the GPIO pin for relay4

int r1 = 0; // Initialize the state of relay1

int r2 = 0; // Initialize the state of relay2

int r3 = 0; // Initialize the state of relay3

int r4 = 0; // Initialize the state of relay4

int ssidLength, passwordLength; // Variables for storing the length of SSID and password
```

```
unsigned long previousMillis = 0; // Variable for storing the previous time

const long interval = 10000; // Interval for checking the connection status

String strData; // String variable for storing received data

String url; // String variable for storing the URL

int cF = 1; // Flag for indicating connection status

WiFiServer server(httpPort); // Create a WiFiServer object on the specified port

void setup()
{
  //ssid += '\0'; // This line is commented out
  //password += '\0'; // This line is commented out
  Serial.begin(9600); // Initialize the serial communication
  pinMode(ledPin, OUTPUT); // Set the LED pin as output
  pinMode(relay1, OUTPUT); // Set the relay1 pin as output
  pinMode(relay2, OUTPUT); // Set the relay2 pin as output
  pinMode(relay3, OUTPUT); // Set the relay3 pin as output
  pinMode(relay4, OUTPUT); // Set the relay4 pin as output
```

```
digitalWrite(relay1, HIGH); // Turn off relay1
digitalWrite(relay2, HIGH); // Turn off relay2
digitalWrite(relay3, HIGH); // Turn off relay3
digitalWrite(relay4, HIGH); // Turn off relay4

EEPROM.begin(100); // Initialize EEPROM
delay(100);

r1 = EEPROM.read(81); // Read the state of relay1 from EEPROM
delay(10);
r2 = EEPROM.read(82); // Read the state of relay2 from EEPROM
delay(10);
r3 = EEPROM.read(83); // Read the state of relay3 from EEPROM
delay(10);
r4 = EEPROM.read(84); // Read the state of relay4 from EEPROM
delay(10);
EEPROM.commit(); // Save changes to EEPROM

if (r1 == 1)
  digitalWrite(relay1, LOW); // Turn on relay1 if the state is 1
else
{
  r1 = 0;
  digitalWrite(relay1, HIGH); // Turn off relay1 if the state is not 1
```

```
}
delay(500);

if (r2 == 1)
  digitalWrite(relay2, LOW); // Turn on relay2 if the state is 1
else
{
  r2 = 0;
  digitalWrite(relay2, HIGH); // Turn off relay2 if the state is not 1
}
delay(500);

if (r3 == 1)
  digitalWrite(relay3, LOW); // Turn on relay3 if the state is 1
else
{
  digitalWrite(relay3, HIGH); // Turn off relay3 if the state is not 1
  r3 = 0;
}
delay(500);

if (r4 == 1)
  digitalWrite(relay4, LOW); // Turn on relay4 if the state is 1
else
```

```
  {
    digitalWrite(relay4, HIGH); // Turn off relay4 if the state is not 1
    r4 = 0;
  }
  delay(500);

  WiFi.begin(ssid, password); // Connect to the Wi-Fi network
  Serial.println("\nConnecting to.... ");
  Serial.println(ssid);
  Serial.println(password);
  delay(1000);
  digitalWrite(ledPin, HIGH); // Turn on the LED
  server.begin(); // Start the HTTP server
  Serial.println("HTTP server started");
  delay(1000);
}

void loop()
{
  WiFiClient client = server.available(); // Check if a client is available

  if (WiFi.status() != WL_CONNECTED)
  {
    digitalWrite(ledPin, LOW); // Turn off the LED
```

```
  delay(100);
  Serial.print(".");
  digitalWrite(ledPin, HIGH); // Turn on the LED
  delay(900);
  cF = 1; // Set the connection flag to 1
}

if (WiFi.status() == WL_CONNECTED && cF == 1)
{
  Serial.print("\nConnected to ");
  Serial.println(ssid);
  Serial.print("IP Address:");
  Serial.println(WiFi.localIP());
  cF = 0; // Set the connection flag to 0
}

if (client)
{
  // Code for handling client requests can be added here
}

unsigned long currentMillis = millis();
if (currentMillis - previousMillis >= interval)
{
```

```
previousMillis = currentMillis;


// Use WiFiClient class to create TCP connections
if (!client.connect(host, httpPort))
{
  Serial.println("Internet Connection failed");
  digitalWrite(ledPin, LOW); // Turn off the LED
  delay(100);
  digitalWrite(ledPin, HIGH); // Turn on the LED
  delay(900);
  return;
}


url = "/channels/";
url += channelID;
url += "/feeds/last.json?api_key=";
url += apiKeyRead;
url += "&results=2";


client.println(String("GET ") + url + " HTTP/1.1\r\n" +
               "Host: " + host + "\r\n" +
               "Connection: close\r\n\r\n");
delay(1000);
```

```
while (client.available())
{
 strData = client.readStringUntil('\n');
 if (strData != "" || strData != "-1")
 {
  String jsonReq = strData;
  int size = jsonReq.length() + 1;
  char json[size];
  jsonReq.toCharArray(json, size);
  StaticJsonBuffer<200> jsonBuffer;
  JsonObject &json_parsed = jsonBuffer.parseObject(json);

  if (json_parsed.containsKey("field1"))
  {
   String field1 = json_parsed["field1"];
   if (field1 == "1")
   {
    if (r1 == 0)
    {
     r1 = 1;
     digitalWrite(relay1, LOW); // Turn on relay1
     EEPROM.write(81, r1);
     Serial.println(" ON1");
     EEPROM.commit();
```

```
    }
  }
  else if (field1 == "0")
  {
    if (r1 == 1)
    {
      r1 = 0;
      digitalWrite(relay1, HIGH); // Turn off relay1
      EEPROM.write(81, r1);
      Serial.println(" OFF1");
      EEPROM.commit();
    }
  }
  else
  {
    Serial.println("UNKNOWN");
  }
  delay(500);
}


if (json_parsed.containsKey("field2"))
{
  String field2 = json_parsed["field2"];
  if (field2 == "1")
```

```
{
 if (r2 == 0)
 {
  r2 = 1;
  EEPROM.write(82, r2);
  digitalWrite(relay2, LOW); // Turn on relay2
  Serial.println(" ON2");
  EEPROM.commit();
 }
}
else if (field2 == "0")
{
 if (r2 == 1)
 {
  r2 = 0;
  EEPROM.write(82, r2);
  digitalWrite(relay2, HIGH); // Turn off relay2
  Serial.println(" OFF2");
  EEPROM.commit();
 }
}
else
{
 Serial.println("UNKNOWN");
```

```
  }
  delay(500);
}

if (json_parsed.containsKey("field3"))
{
  String field3 = json_parsed["field3"];
  if (field3 == "1")
  {
    if (r3 == 0)
    {
      r3 = 1;
      EEPROM.write(83, r3);
      digitalWrite(relay3, LOW); // Turn on relay3
      Serial.println(" ON3");
      EEPROM.commit();
    }
  }
  else if (field3 == "0")
  {
    if (r3 == 1)
    {
      r3 = 0;
      EEPROM.write(83, r3);
```

```
      digitalWrite(relay3, HIGH); // Turn off relay3
      Serial.println(" OFF3");
      EEPROM.commit();
    }
  }
  else
  {
    Serial.println("UNKNOWN");
  }
  delay(500);
}

if (json_parsed.containsKey("field4"))
{
  String field4 = json_parsed["field4"];
  if (field4 == "1")
  {
    if (r4 == 0)
    {
      r4 = 1;
      EEPROM.write(84, r4);
      digitalWrite(relay4, LOW); // Turn on relay4
      Serial.println(" ON4");
      EEPROM.commit();
```

```
      }
    }
    else if (field4 == "0")
    {
     if (r4 == 1)
     {
      r4 = 0;
      EEPROM.write(84, r4);
      digitalWrite(relay4, HIGH); // Turn off relay4
      Serial.println(" OFF4");
      EEPROM.commit();
     }
    }
    else
    {
     Serial.println("UNKNOWN");
    }
    delay(500);
   }
  }
}


Serial.print("Field1:");
Serial.print(r1);
```

```
    Serial.print(" Field2:");
    Serial.print(r2);
    Serial.print(" Field3:");
    Serial.print(r3);
    Serial.print(" Field4:");
    Serial.print(r4);
    Serial.println();

    client.stop(); // Disconnect from the server
  }
}
```

# *References:*


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**4- Design and Development of an Automated Floor Cleaning Robot for Domestic Application:**

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