A Project Report

On

# "SMART VACUUM CLEANER ROBOT"

Submitted for partial fulfillment of the requirements for the award of the degree

Of

**BACHELOR OF TECHNOLOGY**

**IN**

**ELECTRONICS AND TELECOMMUNICATIONS ENGINEERING**

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# CERTIFICATE

This is to certify that the project work entitled **“SMART VACUUM CLEANER ROBOT”** is a bonafide work carried out by **Ms. Aditee Kulkarni (1921321372070), Ms. Deepti Mangrulkar (1921321372134)** & **Mr. Pranav Dixit (1921321372148)** in partial fulfillment of the requirements for the award of the degree of **BACHELOR OF TECHNOLOGY IN ELECTRONICS AND TELECOMMUNICATION ENGINEERING** by the Dr. **B.A.T. UNIVERSITY**, Lonere under our guidance and supervision.

The results embodied in this report have not been submitted to any other university or institute for the award of any degree or diploma.

| | | |
|---|---|---|
| Prof. V.J. Lipne | Dr. S.N. Pawar | Dr. H.H. Shinde |
| **Guide** | **HOD** | **Principal** |

# DECLARATION

This is to certify that the work reported in the present project entitled **“SMART VACUUM CLEANER ROBOT”** is a record of work done by us in the Department of Electronics and Telecommunications Engineering, JNEC, Dr. B.A.T. University. The reports are based on the project work done entirely by us and not copied from any other source.

**Ms. Aditee Kulkarni**

**Ms. Deepti Mangrulkar**

**Mr. Pranav Dixit**

# ACKNOWLEDGEMENT

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# ABSTRACT

Today household devices are becoming smarter and more automated. Home automation delivers convenience and creates more time for people. Domestic robots are entering homes and people’s daily lives, but it is yet a relatively new and immature market. However, growth is predicted and the adoption of domestic robots is evolving. This work can be very useful in improving the lifestyle of mankind.

We aim to design an automatic vacuum cleaner that will help make household work convenient and much easier. It operates in automatic and manual modes along with additional features like scheduling for a specific time and a dirt container with an auto dirt disposal mechanism. The flexibility, time-saving, and efficiency make the robot a good choice for cleaning the floor.

Automatic vacuum cleaners use open cv (Image based processing), raspberry pi camera, dc motor and control driver and node MCU, and ultrasonic sensor. It also contains a mop for wet cleaning, autonomously vacuuming, and wet-mopping a floor in one pass (sweep and mop combo). By using image processing techniques our vacuum cleaner can detect obstacles and able to find the correct path for proper cleaning of the floor. The vacuum cleaner is in a truncated shape. It uses image processing which has several criteria that make it user-friendly.

# CHAPTER I

# INTRODUCTION

In today's life, time management is considered one of the most important factors. A very notable household chore is floor cleaning which is often considered a difficult and boring job. In most cases, cleaners are hired to do the task rather than the household residents doing it. The discomfort posed by this recurrent chore necessitated the development of a vacuum cleaner that could assist humans with such a task. A vacuum cleaner is an electromechanical appliance commonly used for cleaning floors, furniture, rugs, and carpets by suction. An electric motor inside the appliance turns a fan which creates a partial vacuum and causes outside air to rush into the evacuated space. This forces any dirt or dust near the nozzle into a bag inside the machine or attached to the outside. The demand to reduce manpower level has led to the design and development of automatic control systems, which enables unattended operations of the machinery.

Current vacuum cleaners, although efficient, are rather bulky and therefore require large manpower for proper functioning. The former vacuum cleaners use to generate suction and gathered dust with a rotating brush, the latter worked with a belt driven by a hand-cranked fan making it awkward to operate. In the late 1990s and early 2000s, more efficient sweepers equipped with limited suction power were developed. Depending on the design target, robotics vacuum cleaners are appropriate for offices, hotels, hospitals, and homes. However, most cheap cleaners need a better cleaning pattern algorithm for efficient functioning while the smart ones are rather costly, and thus beyond the reach of most homes. These challenges were carefully considered while designing the vacuum cleaner.

Marketing materials for robotic vacuums frequently cite low noise, ease of use, and autonomous cleaning as main advantages. The perception that these devices are set-and-forget solutions is widespread but not always correct. Robotic vacuums are usually smaller than traditional upright vacuums, and weigh significantly less than even the lightest canister models. However, a downside to a robotic vacuum cleaner is that it takes an extended amount of time to vacuum an area due to its size. They are also relatively expensive, and replacement parts and batteries can contribute significantly to their operating cost.

The Automatic vacuum fig.1

Fig 1: The Automatic Vacuum

## 1.1 OBJECTIVE

The objective of this project is to design and develop a smart vacuum cleaner, that will help to make household work convenient and much easier. In this project new type of home intelligent cleaner adopted the ultrasonic sensor, which has the function of real-time environment perception, is introduced, and this cleaner driven by a dc motor has the ability of autonomous working by itself and functions for automatic detection and obstacle avoidance. This project adopts a floor coverage task and designs a synthesis detection system based on sensor arrays finding method technology according to algorithm characteristics, experimental results for obstacle detection by static finding indicate that the design detection systems improve cleaning robot’s environment perception and path search ability greatly.

In recent years, robotic cleaners have taken major attention in robotics research due to their effectiveness in assisting humans in floor cleaning applications at homes, hotels, restaurants, offices, hospitals, workshops, warehouses, and universities, etc. basically, robotic cleaners are distinguished on their cleaning expertise like floor mopping, dry vacuum cleaning, etc. Some products are based on simple obstacle avoidance using infrared sensors while some utilize laser mapping techniques. Each cleaning and operating mechanism of robotic floor cleaners has its advantages and disadvantages. For example, robots utilizing laser mapping are relatively faster, less time-consuming, and energy efficient but costly, while obstacle avoidance-based robots are relatively time-consuming and less energy efficient due to random cleaning but less costly

## 1.2 AIM OF STUDY

The aim of this project is to design and build a low cost vacuum cleaner that can automatically clean the room when left on in the room. Additionally, it must automatically shut down after a specific time after the operation.

## 1.3 SCOPE OF WORK

The robot is designed keeping in mind the following modules of operation:

- Cleaning mechanism
- Automatic obstacle avoidance
- Less space consuming

## 1.4 LAYOUT OF THE THESIS

The project is divided into five main chapters. In the Chapter I, an introduction which includes background study, problem statement, objectives and scope is presented. Chapter II gives a literature review of past related works that have been conducted. Brief introduction of the proposed work and details of relevant theory are also presented in the Chapter II. Chapter III talks about the system design of the SMART VACUUM CLEANER ROBOT block diagram, circuit design and the system circuit diagram with its description. In Chapter IV, the construction, testing and demonstration of the system is presented. Finally, the conclusion and recommendation of this project is done in Chapter V which includes the summary of the results and directions for future research.

# CHAPTER II

# LITERATURE SURVEY

We have done a comprehensive study of the latest technological trends and efficient systems. We have undertaken an extensive literature survey to study automatic vacuum cleaner parameters, such as sensor, Arduino, and Motor shield A well-planned literature survey has ensured the availability of information for efficient system performance, technology usage, specialization, and management of available resources. IOT-based systems are also studied for an automatic vacuum cleaner system.

Our study includes the current knowledge, findings, as well as theoretical and methodological contributions for the development of automatic vacuum cleaners using image processing. It involves concept development, which is a set of activities carried out in system engineering to collect parameters of operational needs and develop a suitable system for implementation. Design of smart vacuum cleaners which are available in the market are using Arduino Uno, Motor, Ultrasonic Sensor, and IR Sensor to achieve the goal of the cleaning process. Vacuum cleaner Robots have several criteria that are user-friendly.

An autonomous vacuum cleaner robot can randomly navigate through a room or a house with the minimum human assistance, the following specifications are found:

- Obstacle avoidance
- Collision Detection
- Dry cleaning
- Automatic system

Nowadays, the robot operates in autonomous and manual modes along with additional features like scheduling for a specific time and bagless dirt container with auto-dirt disposal mechanism. This work can be very useful in improving lifestyle of mankind. The proposed design is being operated in dual modes. In one of the modes, the robot is fully autonomous and makes decisions on the basis of the outputs of infrared proximity sensors, ultrasonic sensors, and tactile sensors after being processed by Arduino (mega) controller and controlling the actuators (2 DC encoder motors) by the H-bridge driving circuitry.

In manual mode, the robot can also be used to clean a specific area of a room by controlling it manually from a laptop with a Graphical User Interface (GUI) in Visual Studio (C# programming language) via Bluetooth connectivity.

In some of the vacuum cleaners, all hardware and software operations are controlled by the AT89S52 micro-controller. RF modules have been used for wireless communication between remote (manual mode) and robot and have range 50m. This robot is incorporated with an IR sensor for obstacle detection and an automatic water sprayer pump. Four motors are used, two for cleaning, one for the water pump, and one for the wheels. Dual relay circuit is used to drive the motors one for the water pump and another for the cleaner. In the automatic mode, robot control all the operations itself and change lane in case of hurdle detection and moves back. In the manual mode, the keypad is used to perform the expected task and to operate the robot. RF module has been used to transmit and receive the information between remote and robot and display the information related to the hurdle detection on LCD. The whole circuitry is connected with a 12V battery. Unlike other floor cleaner robots, this is not a vacuum cleaner robot; it performs sweeping and mopping operation. The detachable mop is used for mopping. In the automatic the mode, robot performs all operations itself. Firstly, it starts, it moves forward and perform cleaning action.

For user convenience automatic water sprayer is attached which automatically sprays water for mopping, therefore is no need to attach wet cloth again and again for mopping. Four motors have been used to perform operations moving to move the robot, for water pump, and for cleaner. Relays are used to drive the water pump and cleaner motor. LM293D IC is used to drive the wheel motor.

All the information are displayed on LCD. In the manual mode, user itself operates the robot. RF module have been used to transmit and receive the signal to operate the robot through remote. All the information displayed on LCD. In the manual mode, user itself operates the robot. RF module have been used to transmit and receive the signal to operate the robot through remote. In the manual mode, if any hurdle detected, then signal of hurdle detection is displayed on the LCD of the remote via the RF module. The following research paper which we have studied for reference and help for our project uses the following sensors:

- OBSTACLE SENSOR
- CLIFF SENSORS
- WALL SENSORS
- WHEEL SENSORS

| *Sr. No.* | *YEAR* | *TITLE* | *BY* | *PUBLISHER* | *KEY-POINTS* |
|---|---|---|---|---|---|
| 1 | Dec 2021 | **“Arduino Based Floor Cleaning Robot Using Ultrasonic Sensor”** | Dadasaheb Shaik | International Research Journal of Modernization in Engineering Technology and Science | • Use of Arduino Uno Microcontroller<br>• Use of Ultrasonic Sensor for obstacle detection<br>• L293D Motor Shield to drive DC motors |
| 2 | April 2018 | **"Robotic Vacuum Cleaner Using Arduino with Wi-Fi"** | P. B. Jarande, &et.al | International Conference on Inventive Communication and Computational Technologies (ICICCT) | • Use of Arduino Uno<br>• Use of Wi-Fi module (ESP8266EX)<br>• Could be controlled from afar via Wi-Fi. |
| 3 | Jan 2016 | **"Cleaning Robot Based On PIC Controller"** | Swati Pawar, &et.al | IJSRD - International Journal for Scientific Research & Development | • Use of PIC18F4550<br>• Use of C programming language to control the system |
| 4 | Oct 2014 | **"A Robust Obstacle Detection Method for Robotic Vacuum Cleaners"** | Mun-Cheon Kang &et.al | IOSR Journal of Engineering (IOSRJEN) | • Wide angle camera captures an image with the IR line reflected via the floor or a barrier<br>• Obstacles obtain with the help of the coordinates of image in the pixel’s format |

# CHAPTER III

# SYSTEM DESIGN

## 3.1 INTRODUCTION

In this chapter, a systemic approach showing the SMART VACUUM CLEANER ROBOT is designed. The entire design of the system is complex hence it is important to consider it as a subdivided into functional components. The various components and the block diagram is elaborated in the subsequent sections of this chapter.

## 3.2 BLOCK DIAGRAM

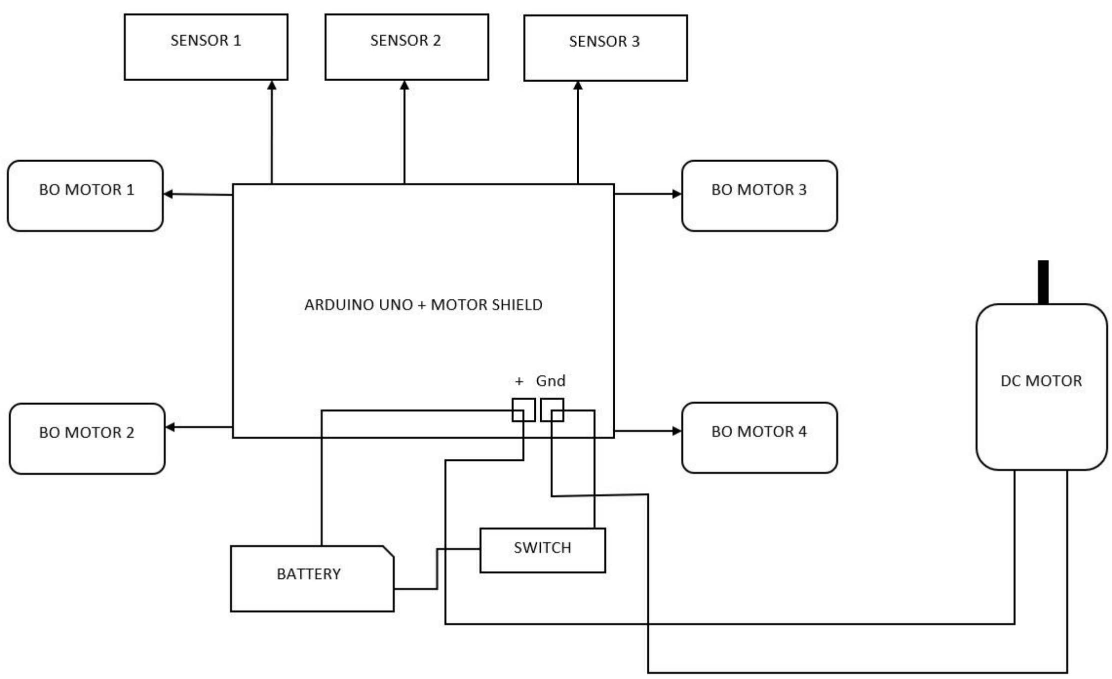


Fig 3.2: Block Diagram

### 3.3 PROJECT HARDWARE

#### 3.3.1 ARDUINO UNO

The 74HC/HCT595 are high-speed Si-gate CMOS devices and are pin compatible with low power Schottky TTL (LSTTL). They are specified in compliance with JEDEC standard no. 7A. The “595” is an 8-stage serial shift register with a storage register and 3-state outputs. The shift register and storage register have separate clocks. Data is shifted on the positive-going transitions of the SHCP input. The data in each register is transferred to the storage register on a positive-going transition of the STCP input. If both clocks are connected together, the shift register will always be one clock pulse ahead of the storage register. The shift register has a serial input (DS) and a serial standard output (Q7’) for cascading. It is also provided with asynchronous reset (active LOW) for all 8 shift register stages. The storage register has 8 parallel 3-state bus driver outputs. Data in the storage register appears at the output whenever the output enable input (OE) is LOW.

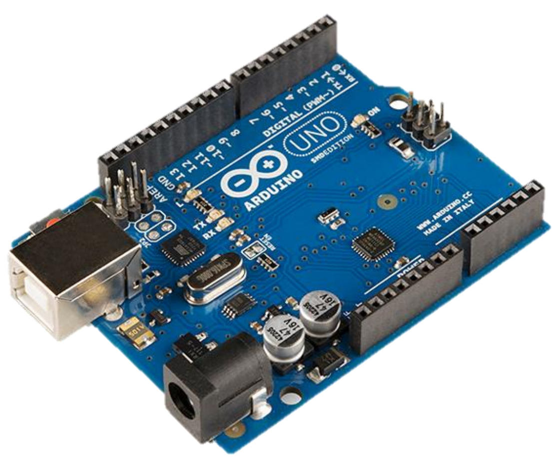


Fig 3.3.1: Arduino UNO

FEATURES

- 8-bit serial input
- 8-bit serial or parallel output
- Storage register with 3-state outputs
- Shift register with direct clear
- 100 MHz (Typ) shift out frequency
- Output capability: – parallel outputs; bus driver – serial output; standard
- ICC category: MSI.

APPLICATIONS

- Serial-to-parallel data conversion
- Remote control holding register.

### 3.3.2 L293D Based Arduino Motor Shield

The L293D is a dedicated module to fit in Arduino UNO R3 Board, and Arduino MEGA. It is actually a motor driver shield that has full featured Arduino Shield can be used to drive 2 to 6 DC motor and 4 wire Stepper motor and it has 2 set of pins to drive a SERVO.

L293D is a monolithic integrated that has a feature to adopt high voltage, high current at four channel motor driver designed to accept load such as relays solenoids, DC Motors and Stepper Motors and switching power transistor. To simplify to used as two bridges on each pair of channels and equipped with an enable input. A separate supply input is provided for the logic, allowing operation at a lower voltage and internal clamp diodes are included. The device is suitable for use in switching applications at frequencies up to 5kHz. The L293D is assembled in a 16 lead plastic package which has 4 centre pins connected together and used for heat sinking. The L293D is assembled in a 20 lead surface mount which has 8 centre pins connected together and used for heat shrinking.

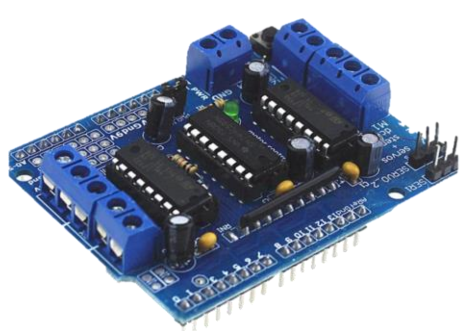

Fig 3.3.2: Motor Shield (L293D)

SPECIFICATIONS

- Control 2 Servos
- Logic Control Voltage VSS: 4.5 ~ 5.5 V
- Motor Supply Voltage VSS: 15v
- Drive operating current IO: 1.2A
- 8 Stage Serial Shift Registers

FEATURES

- Up to 4 bi-directional DC motors with individual 8-bit speed selection (so, about 0.5% resolution)
- Up to 2 stepper motors (unipolar or bipolar) with single coil, double coil, interleaved or micro-stepping.
- H-Bridges: L293D chipset provides 0.6A per bridge (1.2A peak) with thermal shutdown protection, 4.5V to12V
- Pull down resistors keep motors disabled during power-up
- Big terminal block connectors to easily hook up wires (10-22AWG) and power
- Arduino reset button brought up top
- 2-pin terminal block to connect external power, for separate logic/motor supplies
- Dimensions: 69mm x 53mm x 14.3mm (2.7in x 2.1in x 0.6in)

### 3.3.3 Ultrasonic Ranging Module HC - SR04

Ultrasonic ranging module HC - SR04 provides 2cm - 400cm non-contact measurement function, the ranging accuracy can reach to 3mm. The modules includes ultrasonic transmitters, receiver and control circuit. The basic principle of work:

(1) Using IO trigger for at least 10us high level signal

(2) The Module automatically sends eight 40 kHz and detect whether there is a pulse signal back.

(3) IF the signal back, through high level , time of high output IO duration is the time from sending ultrasonic to returning. Test distance = (high level time×velocity of sound (340M/S) / 2,

Wire connecting direct as following:

- 5V Supply
- Trigger Pulse Input
- Echo Pulse Output
- 0V Ground

Fig 3.3.3: Ultrasonic Sensor (HC SR04)

SPECIFICATIONS

- Working Current 15 mA
- Working Frequency 40Hz
- Max Range 4 m
- Min Range 2 cm
- Measuring Angle 15 degree
- Trigger Input Signal 10Us TTL pulse
- Echo Output Signal Input TTL lever signal and the range in proportion
- Dimension 45*20*15mm

### 3.3.4 60 RPM BO Motor

The BO Series 60RPM DC Motor Plastic Gear Motor – BO series straight motor gives good torque and rpm at lower operating voltages, which is the biggest advantage of these motors.

A small shaft with matching wheels gives an optimized design for your application or robot. Mounting holes on the body & light weight makes it suitable for in-circuit placement. This motor can be used with 69mm Diameter Wheel for Plastic Gear Motors and 87mm Diameter Multipurpose Wheel for Plastic Gear Motors.

Fig 3.3.4: BO Motor

FEATURES

- Cost-effectiveness of the injection-molding process.
- Elimination of machining operations.
- Low density: lightweight, low inertia.
- Capability to absorb shock and vibration as a result of elastic compliance.
- Ability to operate with minimum or no lubrication, due to inherent lubricity.
- The relatively low coefficient of friction.
- Corrosion-resistance; elimination of plating, or protective coatings.
- The quietness of operation
- Tolerances often less critical than for metal gears, due in part to their greater resilience.

Consistency with the trend to greater use of plastic housings and other components.

### 3.3.5 DC Motor 6V

DC motors come in all sorts of shapes, sizes, voltages, etc. This motor is classified as a “260 Motor” and works with 3 – 6V DC. The shaft diameter is 2mm and works well with many of the gears in our assorted gear sets, most propellers, and other accessories we carry**.**

SPECIFICATION

- Rated Voltage 6V DC
- No load speed 12000±15% rpm
- No load current ≤280mA
- Operating voltage 1.5-6.5V DC
- Starting Torque ≥250g.cm(according to ourself developed blade)
- Starting current ≤5A
- Insulation Resistance above 10Ω between the case and the terminal DV 100V

Fig 3.3.5: DC Motor

**3.4 CIRCUIT DIAGRAM**

**3.4.1 OBSTACLE AVOIDING ROBOT**

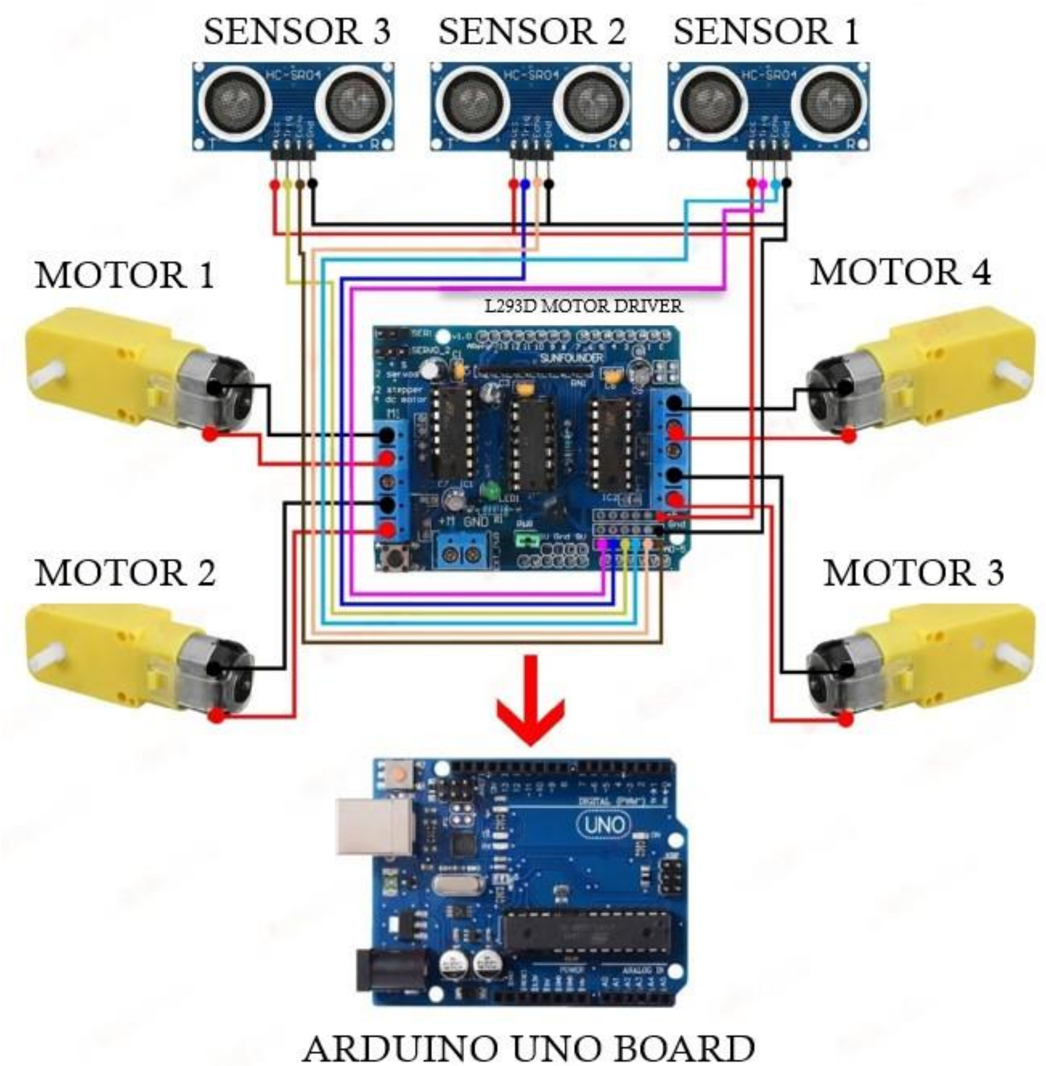


Fig 3.4.1: Obstacle Avoiding Robot

The Arduino UNO is directly mounted on the L293D Motor Shield. The 4 BO motors are connected to the PWM pins to control and maintain the speed of the motors. The ultrasonic sensors are connected to the analog pins which are brought up by the Motor Shield. The above connection only creates an obstacle-avoiding robot. The next step involves the making of a vacuum cleaner which will be powered by the same power source as the obstacle-avoiding robot.

The making of a vacuum cleaner circuit is discussed below.

### 3.4.2 VACUUM CLEANER CIRCUIT

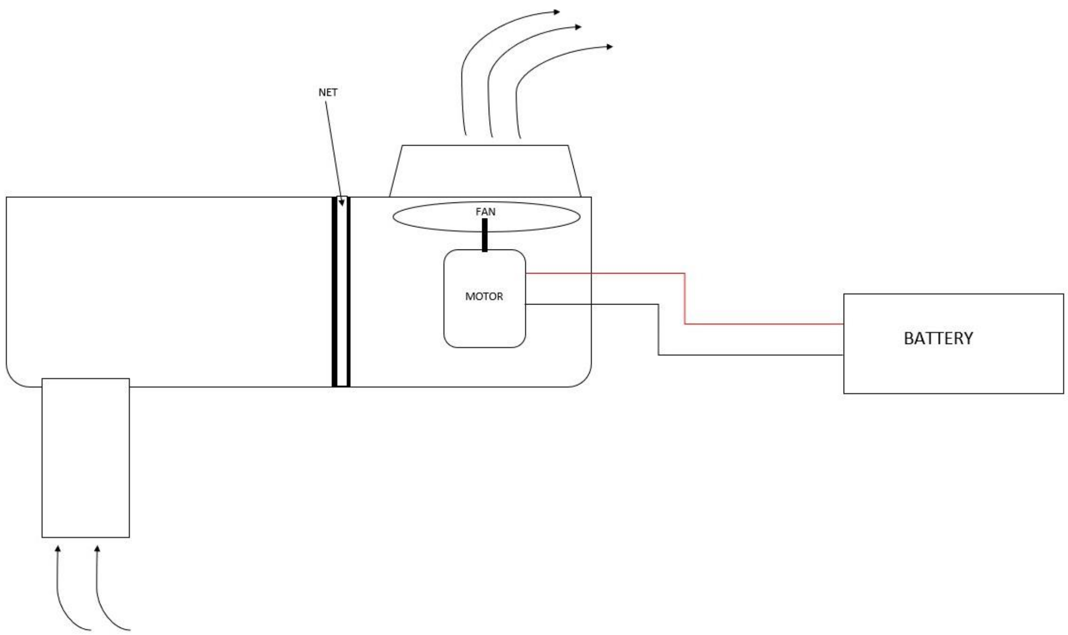


Fig 3.4.1: Vacuum Cleaner Circuit

The vacuum cleaner circuit is made by using a tiffin box. The air-tight tiffin box is taken and drilled a hole at its top according to the diameter of the fan used. Another hole is made at the bottom for the suction purpose. A net is attached at the centered for the dust to stick and doesn't come out of the fan. The fan is attached to the motor which is attached to the top of tiffin facing outwards. This will create vacuum inside the tiffin box which will suck the dust and garbage and will be collected in the 1st compartment.

## 3.5 SOFTWARE METHODOLOGY

### 3.5.1 INTRODUCTION

**ARDUINO IDE:** The Arduino Integrated Development Environment - or Arduino Software (IDE) - contains a text editor for writing code, a message area, a text console, a toolbar with buttons for common functions and a series of menus. It connects to the Arduino hardware to upload programs and communicate with them.

Programs written using Arduino Software (IDE) are called sketches. These sketches are written in the text editor and are saved with the file extension .ino. The editor has features for cutting/pasting and for searching/replacing text. The message area gives feedback while saving and exporting and also displays errors. The console displays text output by the Arduino Software (IDE), including complete error messages and other information. The bottom righthand corner of the window displays the configured board and serial port. The toolbar buttons allow you to verify and upload programs, create, open, and save sketches, and open the serial monitor.

### 3.5.2 CODE LOGIC

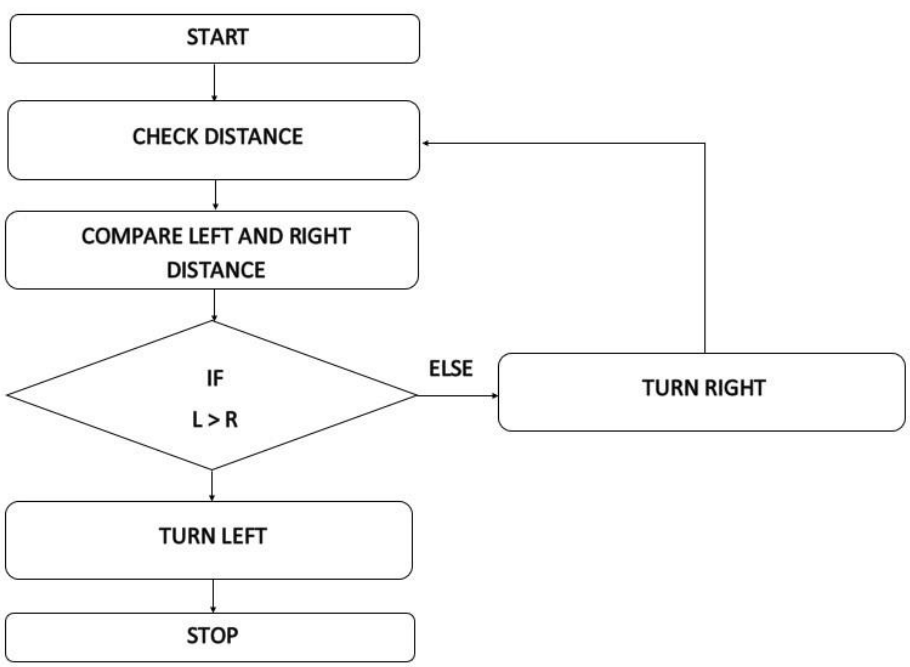


Fig 3.5.2: Code Logic

The program starts by simply checking the distance using the center sensor. If the center sensor distance is less than 8cm then the left and right sensors sense the distance. If the distance from the left sensor is found to be more then the left function is executed else the right function is executed. This process keeps on going a complete loop until the whole ground is clean.

### 3.5.3 LIBRARIES USED

The only library used in the code is the ADAFRUIT MOTOR Library. This library is specially used for the driving of motors and for controlling and managing the speeds of the motors.

```
#include <AFMotor.h>
```

### 3.5.4 COMPLETE CODE

```
//Include the motor driver library
#include <AFMotor.h>
//Define the sensor pins
#define S1Trig A0
#define S2Trig A1
#define S3Trig A2
#define S1Echo A3
#define S2Echo A4
#define S3Echo A5
//Set the speed of the motors
#define Speed 160

//Create objects for the motors
AF_DCMotor motor1(1);
AF_DCMotor motor2(2);
AF_DCMotor motor3(3);
AF_DCMotor motor4(4);

void setup() {
  Serial.begin(9600);
  //Set the Trig pins as output pins
  pinMode(S1Trig, OUTPUT);
  pinMode(S2Trig, OUTPUT);
  pinMode(S3Trig, OUTPUT);
  //Set the Echo pins as input pins
  pinMode(S1Echo, INPUT);
  pinMode(S2Echo, INPUT);
  pinMode(S3Echo, INPUT);
  //Set the speed of the motors
  motor1.setSpeed(Speed);
  motor2.setSpeed(Speed);
  motor3.setSpeed(Speed);
  motor4.setSpeed(Speed);
}

void loop() {
  int centerSensor = sensorTwo();
  int leftSensor = sensorOne();
  int rightSensor = sensorThree();
// Check the distance using the IF condition
  if (8 >= centerSensor) {
    Stop();
    Serial.println("Stop");
    delay(1000);
    if (leftSensor > rightSensor) {
      left();
      Serial.println("Left");
      delay(500);
    } else {
      right();
      Serial.println("Right");
      delay(500);
    }
  }
  Serial.println("Forward");
  forward();
}

//Get the sensor values
int sensorOne() {
  //pulse output
```

```
  digitalWrite(S1Trig, LOW);
  delayMicroseconds(4);
  digitalWrite(S1Trig, HIGH);
  delayMicroseconds(10);
  digitalWrite(S1Trig, LOW);

  long t = pulseIn(S1Echo, HIGH);//Get the pulse
  int cm = t / 29 / 2; //Convert time to the distance
  return cm; // Return the values from the sensor
}

//Get the sensor values
int sensorTwo() {
  //pulse output
  digitalWrite(S2Trig, LOW);
  delayMicroseconds(4);
  digitalWrite(S2Trig, HIGH);
  delayMicroseconds(10);
  digitalWrite(S2Trig, LOW);

  long t = pulseIn(S2Echo, HIGH);//Get the pulse
  int cm = t / 29 / 2; //Convert time to the distance
  return cm; // Return the values from the sensor
}

//Get the sensor values
int sensorThree() {
  //pulse output
  digitalWrite(S3Trig, LOW);
  delayMicroseconds(4);
  digitalWrite(S3Trig, HIGH);
  delayMicroseconds(10);
  digitalWrite(S3Trig, LOW);

  long t = pulseIn(S3Echo, HIGH);//Get the pulse
  int cm = t / 29 / 2; //Convert time to the distance
  return cm; // Return the values from the sensor
}

/*******************Motor functions**********************/
void forward() {
  motor1.run(FORWARD);
  motor2.run(FORWARD);
  motor3.run(FORWARD);
  motor4.run(FORWARD);
}
void left() {
  motor1.run(BACKWARD);
  motor2.run(BACKWARD);
  motor3.run(FORWARD);
  motor4.run(FORWARD);
}
void right() {
  motor1.run(FORWARD);
  motor2.run(FORWARD);
  motor3.run(BACKWARD);
  motor4.run(BACKWARD);
}
void Stop() {
  motor1.run(RELEASE);
  motor2.run(RELEASE);
  motor3.run(RELEASE);
  motor4.run(RELEASE);
}
```

### 3.6 ROBOT ASSEMBLY

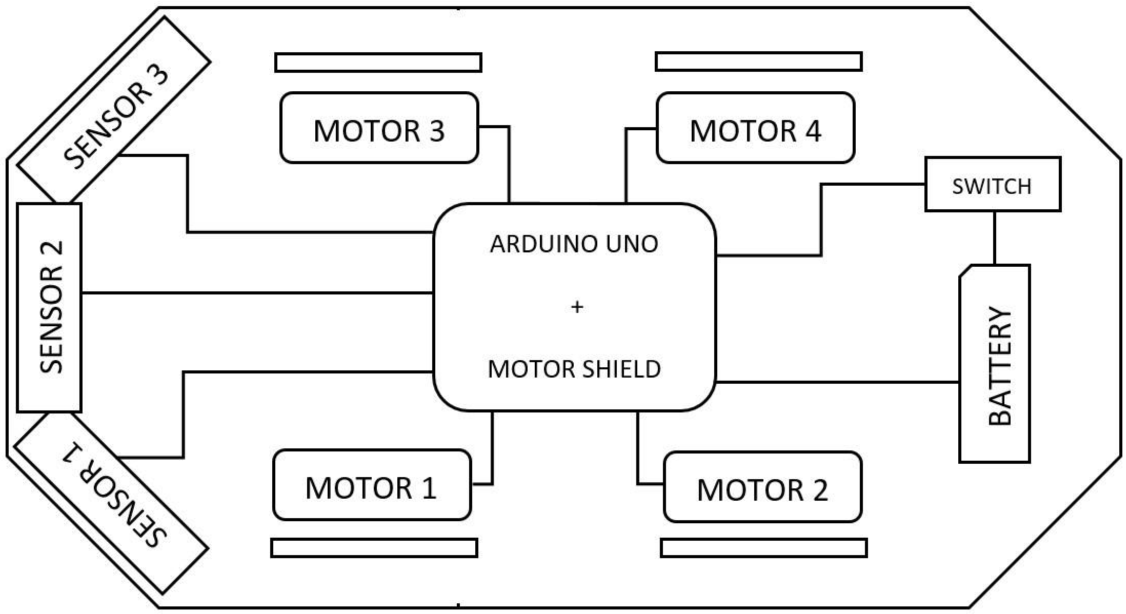


Fig 3.6: Robot Assembly

A robot will always require a chassis. The chassis that we made was using a foam sheet. It was cut in the shape shown above. The corners were cut at 45 degrees for the ultrasonic sensors to fit in. This enabled the robot to get a more field of vision for obstacle avoidance.

The slits were cut in the bottom of the chassis according to the wheel diameter for the robot to move. 60 RPM BO motors were connected to the Arduino + Motor Shield system for driving purposes.

The battery was mounted at the top along with a switch to turn off and on the robot.

# CHAPTER IV

# IMPLEMENTATION ISSUES

There were many issues that were faced while the implementation of the project. Some of these include:

- One-Sensor Implementation
- Voltage Deficiency

## 4.1 ONE-SENSOR IMPLEMENTATION

The initial implementation of the project was to use a single ultrasonic sensor for obstacle detection. In this project, a servo motor was used to rotate the ultrasonic sensor in both directions to check the distance on both sides and act accordingly.

The major drawback was that whenever the robot used to confront a slanted wall or an obstacle at an angle it used to collide with the obstacle. It contradicted the obstacle-avoiding purpose. To solve the problem, we came up with the implementation of the project which included three ultrasonic sensors.

## 4.2 VOLTAGE DEFICIENCY

It was observed that when connected with the standard supply the speeds of motors weren’t enough to even move the robot. Thus, it was decided to make use of the 18650 3.7 V battery. This provided enough voltage to the system to make it drive by it.

# CHAPTER V

## 5.1 RESULT

- The robot which we design will facilitate efficient floor cleaning.
- It will work only in automatic mode.
- It will also provide hurdle detection in case of any obstacles that come in its way, hurdle is detected using an ultrasonic sensor.
- Our design will be helpful in overcoming the limitation of the existing technology, i.e. instead of the zigzag movement of the robot, our system will follow a straight path (edge detection).
- Along with the sensor the robot also consists of a vacuum pump.
- Vacuum pump help in sucking dust, and this suction of dust will take place from the front side of the model.

## 5.2 CONCLUSION

The autonomous vacuum cleaner is not yet ready for commercialization, which was never the goal of the project. Many of the achieved results are very promising. The shape of the robot is well suited for the application, especially for tasks like cleaning along the ball, long legs, and corners. The ultrasonic sensor is able to identify obstacles. The combination of the robot shape and ultrasonic sensor system and its algorithm play well together and make the task of cleaning an unknown and unstructured environment feasible.

## 5.3 LIMITATIONS

The limitations of the project include:

- No signal or warning for collision detection
- No alert if the dust filled is full
- No manual control

### 5.4 FUTURE SCOPE

- Image/video captured of a objects can be fed to the controller so that the robot can clean the entire house according to the input fed.
- Currently image is captured only for edge detection for movement in proper path, not for object detection.
- The cleaning mechanism on the robot can be replaced by a handlike structure so that it can lift things from one place to another.
- Voice controlled locomotion of robot instead of remote control.
- Automatic charging

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