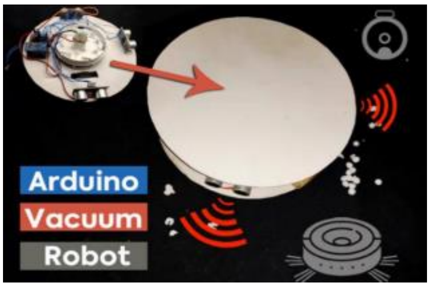
ROBOTICS AND AUTOMATION

ECE - 2008

J COMPONENT

VACCUM CLEANER ROBOT



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CONTENTS:

INTRODUCTION:

- In a present-day scenario, we are all so busy with our work that we don't have the time for cleaning our house properly.
- The solution to the problem is very simple, we just need to buy a domestic vacuum cleaner robot which will clean your house with the press of a button.
- But such commercial products share one common issue, which is cost. So we decided to make a simple Vaccum cleaner robot for Automatic floor cleaning based on Arduino as well as manual controlling which is not only simple to make but costs very less compared to commercial products available in the market.

OBJECTIVE OF THE PROJECT:

- The main objective of this robot is to clean the surface without human involvement and also to avoid the obstacles in the surface while cleaning.

IMPROVISATION:

- Vaccum cleaner robot is a modified form of obstacle detection robot.
- When the robot was automated it can move around the foor automatically and clean the surface with the help of vaccum by detecting the obstacle it can alter the direction and if dust is it can clean it up.
- This prototype is similar to ROOMBA kind of robot but the main advantage in our robot is size and the cost.
- Because of small size it has more advantage as well as the cost it's not cost effective, so that everyone can be benefitted by buying it.

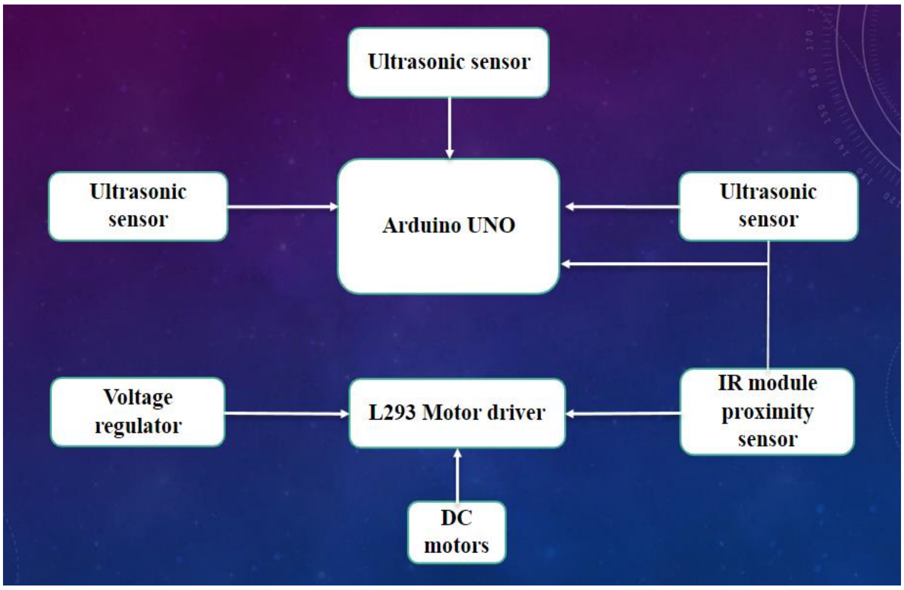
COMPONENTS REQUIRED:

- Arduino UNO
- HC-SR04 Ultrasonic Module
- L293D Motor Driver
- 5Volt N20 Motors
- N20 Motor Wheels
- Switch
- LM7805 Voltage Regulator

- 7.4V (2000 mAH Li-ion battery)
- IR Module
- Perfboard
- Castor Wheel
- 9V battery
- Mount Board
- Generic Portable Vacuum

VACCUM CLEANER USED:

BLOCK DIAGRAM:


Ultrasonic sensor

Ultrasonic sensor

Arduino UNO

Ultrasonic sensor

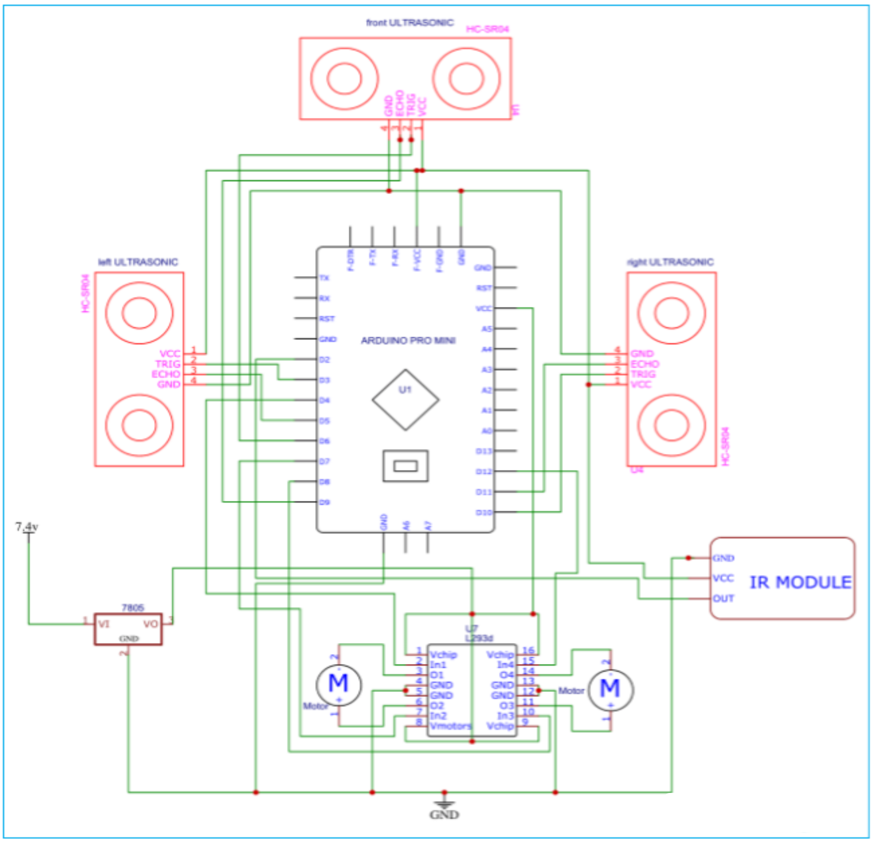
Voltage regulator

L293 Motor driver

IR module proximity sensor

DC motors

CIRCUIT DIAGRAM:



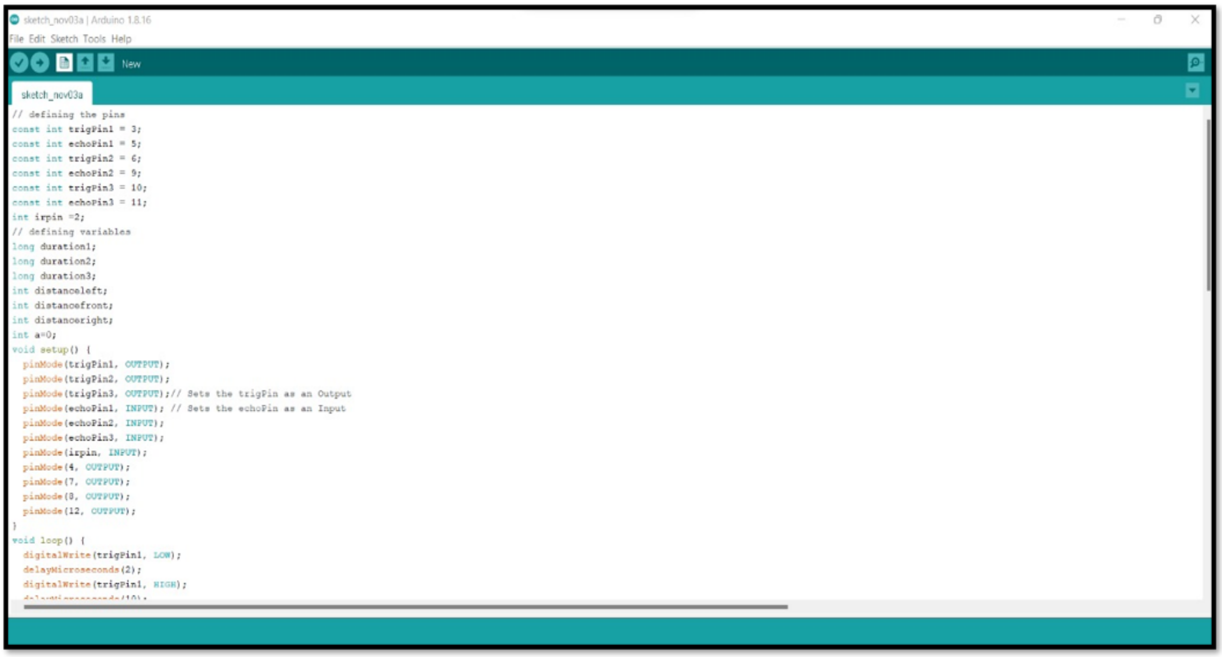
METHODOLOGY:

- A portable vacuum cleaner is used which has three parts in the bottom (a small chamber for storing the dust, the middle portion includes the motor, fan, and the battery socket; on the top there is a cover or cap for the battery).
- It has a DC motor and a fan. This motor is directly connected to 3V (AA battery) via a simple switch.
- As we are powering our robot with a 7.4V rechargeable battery, we will cut the connection from the internal battery and power it from the 5V power supply.

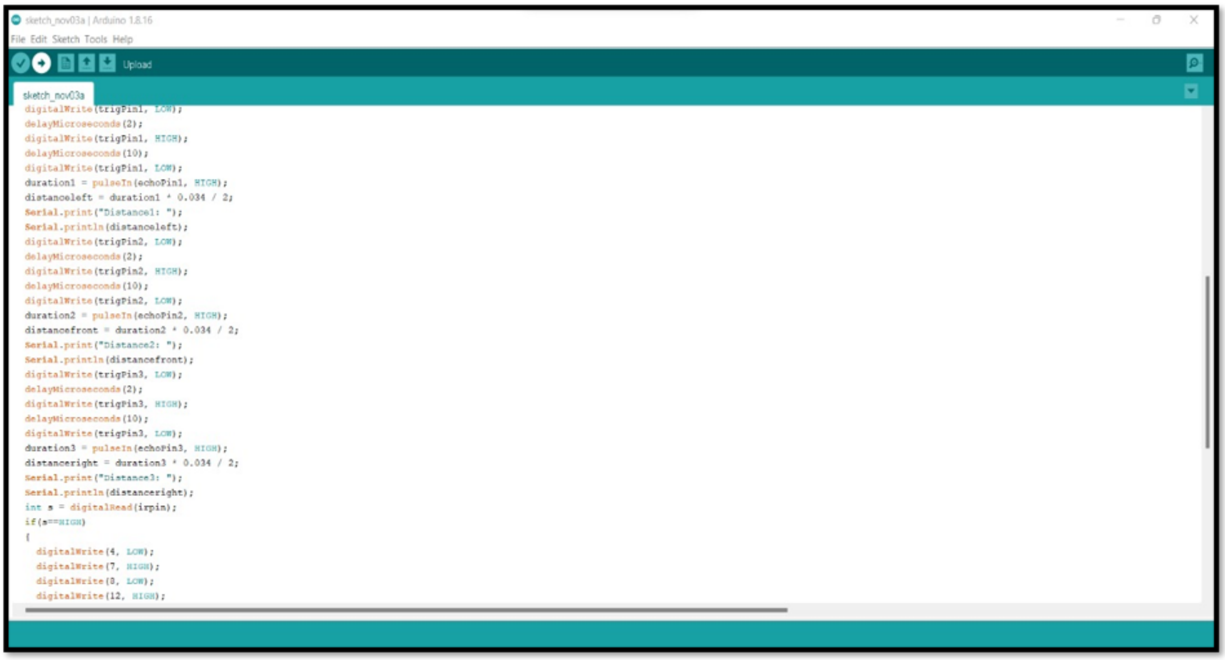
- To detect the obstacles, we are using the popular HC-SR04 ultrasonic distance sensor or obstacle avoidance sensors.
- The working of ultrasonic sensors is very simple, the transmitter module sends an ultrasonic wave which travels through air, hits an obstacle and bounces back and the receiver receives that wave. By calculating the time with Arduino, we can determine the distance.
- IR sensor is used where the robot can detect staircases and can prevent itself from falling. We will make an interface between the IR sensor and Arduino.
- The working of the IR Proximity Sensor is very simple, it has an IR LED and a photodiode, the IR LED emits IR light and if any obstacle comes in front of this emitted light, it will be reflected and the reflected light will be detected by the photodiode.
- The generated voltage from the reflection will be very low. To increase that we can use an op-amp comparator, we can amplify and get output.
- IR module has three pins - Vcc, ground and output. Usually, the output goes low when an obstacle comes in front of the sensor.
- So, we can use this IR module to detect the floor. If for a split second, we detect a high from the sensor, we can stop the robot, turn it back or do anything we want to prevent it from falling from the staircase.
- The Arduino, Ultrasonic modules, motor driver and motors work on 5 Volt, the higher voltage will kill it and we are using the 9- volt battery to convert that into 5 Volt, the LM7805 voltage regulator is used.
- We have three ultrasonic sensors that detect obstacles. So, we need to connect all grounds of ultrasonic sensors and connect them to ground pins.
- We connect all the three Vcc of the sensor and connect that to the common VCC pin.

- Next, we connect the trigger and echo pins to the PWM pins of the Arduino. We also connect the VCC of the IR module to 5V and ground to the ground pin of Arduino, the output pin of the IR sensor module goes to the digital pin D2 of the Arduino.
- For the motor driver, we connect the two enable pins to 5v and also the driver voltage pin to 5V because we are using 5-volt motors.
- Vacuum cleaner is directly connected to the main circuit.

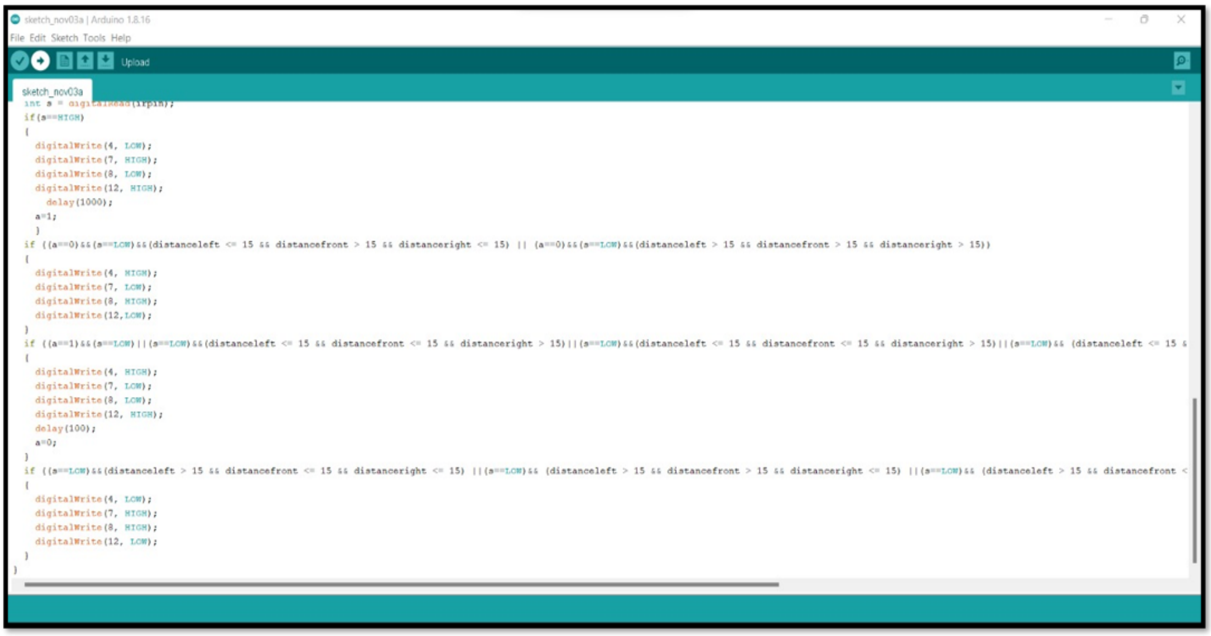
ARDUINO CODING:



```
// defining the pins
const int trigPin1 = 3;
const int echoPin1 = 5;
const int trigPin2 = 6;
const int echoPin2 = 9;
const int trigPin3 = 10;
const int echoPin3 = 11;
int irpin =2;
// defining variables
long duration1;
long duration2;
long duration3;
int distanceleft;
int distancefront;
int distanceright;
int a=0;
void setup() {
  pinMode(trigPin1, OUTPUT);
  pinMode(trigPin2, OUTPUT);
  pinMode(trigPin3, OUTPUT);// Sets the trigPin as an Output
  pinMode(echoPin1, INPUT); // Sets the echoPin as an Input
  pinMode(echoPin2, INPUT);
  pinMode(echoPin3, INPUT);
  pinMode(irpin, INPUT);
  pinMode(4, OUTPUT);
  pinMode(7, OUTPUT);
  pinMode(8, OUTPUT);
  pinMode(12, OUTPUT);
}
void loop() {
  digitalWrite(trigPin1, LOW);
  delayMicroseconds(2);
  digitalWrite(trigPin1, HIGH);
  delayMicroseconds(10);
```

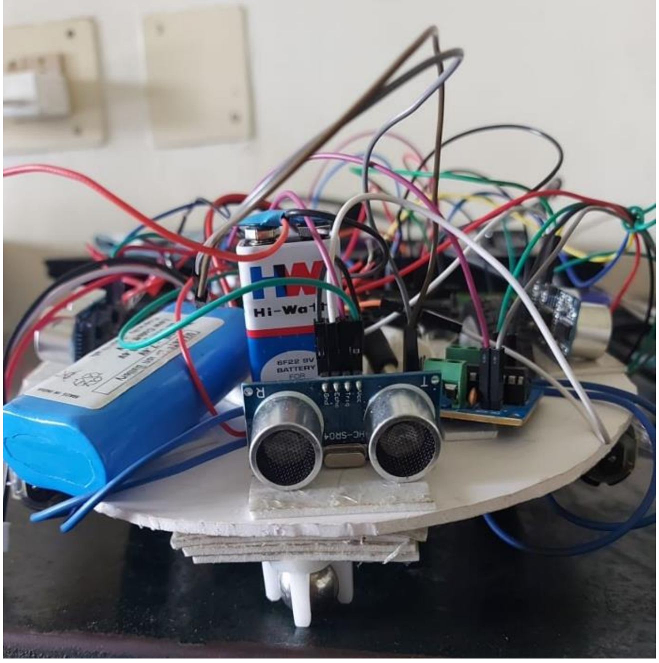


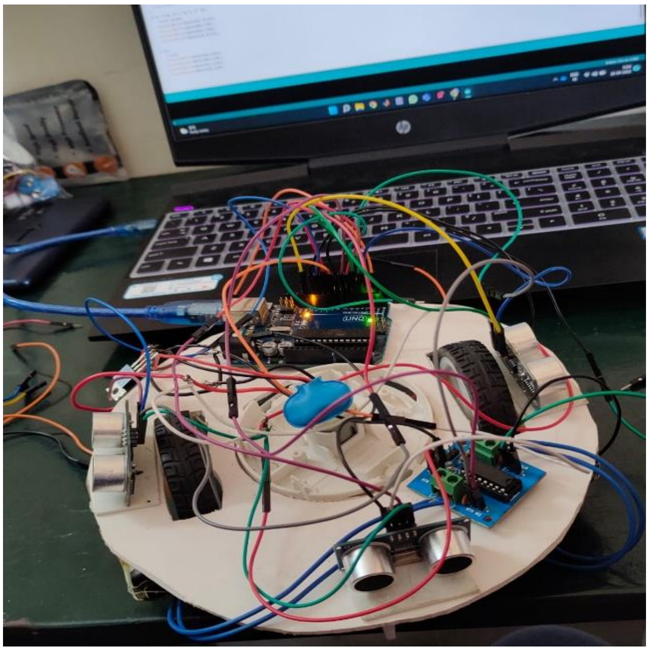
```
digitalWrite(trigPin1, LOW);
delayMicroseconds(2);
digitalWrite(trigPin1, HIGH);
delayMicroseconds(10);
digitalWrite(trigPin1, LOW);
duration1 = pulseIn(echoPin1, HIGH);
distanceleft = duration1 * 0.034 / 2;
Serial.print("Distance1: ");
Serial.println(distanceleft);
digitalWrite(trigPin2, LOW);
delayMicroseconds(2);
digitalWrite(trigPin2, HIGH);
delayMicroseconds(10);
digitalWrite(trigPin2, LOW);
duration2 = pulseIn(echoPin2, HIGH);
distancefront = duration2 * 0.034 / 2;
Serial.print("Distance2: ");
Serial.println(distancefront);
digitalWrite(trigPin3, LOW);
delayMicroseconds(2);
digitalWrite(trigPin3, HIGH);
delayMicroseconds(10);
digitalWrite(trigPin3, LOW);
duration3 = pulseIn(echoPin3, HIGH);
distanceright = duration3 * 0.034 / 2;
Serial.print("Distance3: ");
Serial.println(distanceright);
int s = digitalRead(irpin);
if(s==HIGH)
{
  digitalWrite(4, LOW);
  digitalWrite(7, HIGH);
  digitalWrite(8, LOW);
  digitalWrite(12, HIGH);
```

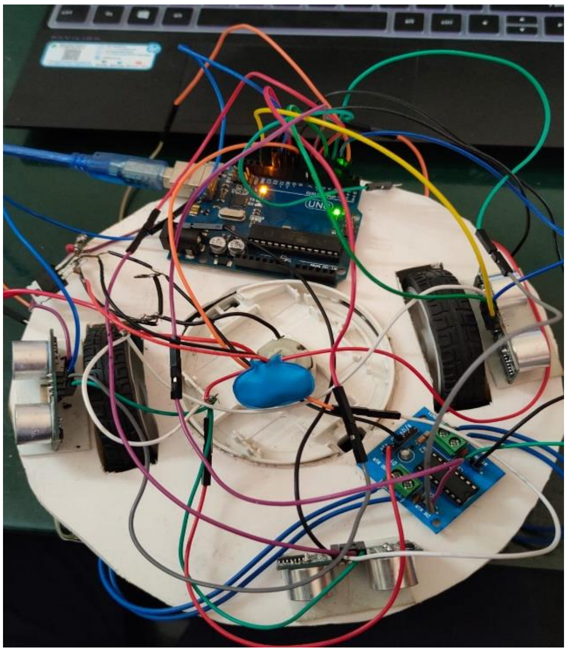


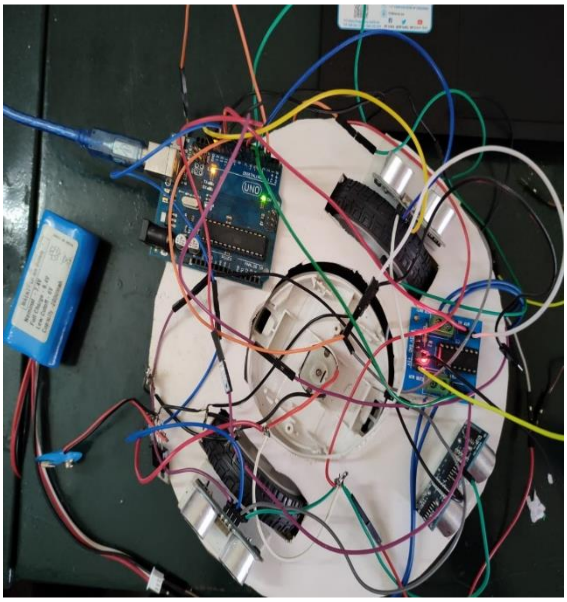
```
int s = digitalRead(irpin);
if(s==HIGH)
{
  digitalWrite(4, LOW);
  digitalWrite(7, HIGH);
  digitalWrite(8, LOW);
  digitalWrite(12, HIGH);
    delay(1000);
  a=1;
  }
if ((a==0)&&(s==LOW)&&(distanceleft <= 15 && distancefront > 15 && distanceright <= 15) || (a==0)&&(s==LOW)&&(distanceleft > 15 && distancefront > 15 && distanceright > 15))
{
  digitalWrite(4, HIGH);
  digitalWrite(7, LOW);
  digitalWrite(8, HIGH);
  digitalWrite(12,LOW);
}
if ((a==1)&&(s==LOW)||(s==LOW)&&(distanceleft <= 15 && distancefront <= 15 && distanceright > 15)||(s==LOW)&&(distanceleft <= 15 && distancefront <= 15 && distanceright > 15)||(s==LOW)&& (distanceleft <= 15 &
{
  digitalWrite(4, HIGH);
  digitalWrite(7, LOW);
  digitalWrite(8, LOW);
  digitalWrite(12, HIGH);
  delay(100);
  a=0;
}
if ((s==LOW)&&(distanceleft > 15 && distancefront <= 15 && distanceright <= 15) ||(s==LOW)&& (distanceleft > 15 && distancefront > 15 && distanceright <= 15) ||(s==LOW)&& (distanceleft > 15 && distancefront <
{
  digitalWrite(4, LOW);
  digitalWrite(7, HIGH);
  digitalWrite(8, HIGH);
  digitalWrite(12, LOW);
}
}
```

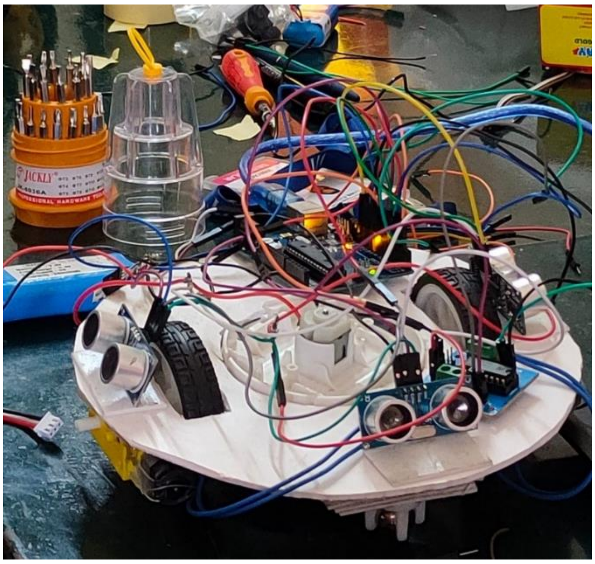
HARDWARE IMAGES:











WORKING OF ROBOT (VIDEO LINKS):

OBSTACLE DETECTION AND WORKING:

- https://drive.google.com/file/d/1E-P68LrJAT_voH5NQuwqjcfv2JxDSBcd/view?usp=sharing

VACCUM CLEANING:

- https://drive.google.com/file/d/1l_UiKeWWc6wqoQExcrmnx8n-vwta3CD7/view?usp=sharing

APPLICATIONS:

- Surface cleaner with wireless control.
- Cost effective robot with wide variety of applications.
- Two ways of using the robot firstly the robot will avoid obstacles so that it can move freely until the room is properly cleaned.
- Another way is we can manually operate the robot for cleaning a specific area.
- IR proximity sensor will be used to avoid robots falling from the stairs.

FUTURE WORK:

- When the robot was completely automated it can’t able to clean a specified area because it will detect the obstacle and if dust is present in that place, it can clean it up.
- To avoid this, we can improvise it by controlling through Remote XY platform from the mobile by using Bluetooth module so that we can place it in areas where we need to clean a specific part of the house or any other places where dust is present.

- Battery efficiency can be improved.
- Range efficiency of robot can be increased for cleaning wide range of area.
- Servo motors can be replaced for the precise control of turning radius and direction of robot.

REFERENCE:

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- https://circuitdigest.com/microcontroller-projects/build-your-own-arduino-based-smart-vacuum-cleaning-robot-for-automatic-floor-cleaning
- https://circuitdigest.com/microcontroller-projects/g-sensor-controlled-robot-car-arduino