A Report on

ARDUINO BASED DRY & WET AUTOMATIC FLOOR CLEANER

Project submitted to the State Board of Technical Education, Hyderabad in Partial fulfillment of the requirements for the award of the degree of Diploma in Electronics and Communication Engineering.

BY

B.NEERAJ	**18248-EC-069**
K.GANESH KUMAR	**18248-EC-080**
K.AJAY KUMAR	**18248-EC-081**
M.SUSHEEL KUMAR	**18248-EC-087**

Under the Esteemed Guidance of

Mrs. V.DEEPA

ASST. PROFESSOR

DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

TEEGALA KRISHNA REDDY ENGINEERING COLLEGE

Medbowli, Meerpet, Saroornagar(M)

HYDERABAD-50009

TEEGALA KRISHNA REDDY ENGG. COLLEGE

2nd Shift Polytechnic College

(Sponsored by TKR Educational Society, Approved by AICTE & SBTET)

dbowli, Meerpet, Saroornagar, Hyderabad-500 097

Phone: 040-65357563, e-mail: tkrec@rediffmail.com, diplomaincharge@gmail.com
Website: www.tkrec.ac.in

ACKNOWLEDGEMENT

We acknowledge and express our gratitude and sincere thanks to our guide **Mrs. V.DEEPA,** for constantly monitoring my progress and suggesting improvements at various stages for preparing the project report.

We would like to express our deepest sense of gratitude towards **Asst. Prof. Mrs. V. DEEPA, Head of the department (ECE)**, for her valuable help during this project report. His guidance has been instrumental and has proved to be of immense help during this project report preparation.

We would like to thank **Mr. P.VENKATRAM REDDY, Principal, TEEGALA KRISHNA REDDY ENGINEERING COLLEGE** for having permitted me to take on this project report.

B. NEERAJ	**(18248-EC-069)**
K. GANESH KUMAR	**(18248-EC-080)**
K. AJAY KUMAR	**(18248-EC-081)**
M. SUSHEEL KUMAR	**(18248-EC-087**

TEEGALA KRISHNA REDDY ENGG. COLLEGE

2nd Shift Polytechnic College

(Sponsored by TKR Educational Society, Approved by AICTE & SBTET)

Medbowli, Meerpet, Saroornagar, Hyderabad-500097

Phone: 040-65357563, e-mail: tkrec@rediffmail.com, diplomaincharge@gmail.com

e: www.tkrec.ac.in

Institute Code: 248

DECLARATION

We, **B.NEERAJ, K.GANESH KUMAR, K.AJAY KUMAR, M.SUSHEEL KUMAR** Here, by declare that the work embodied in this dissertation entitled **"ARDUINO BASED DRY & WET AUTOMATIC FLOOR CLEANER"** Submitted to the State Board of Technical Education, Hyderabad, for partial fulfilment of the degree of **Diploma in Electronics and Communication Engineering** has been carried out by us under the supervision of **Mrs. V.DEEPA, Asst. Professor.** To the best of our knowledge, this work has not been submitted for any other degree in any university.

B.NEERAJ (18248-EC-069)

K.GANESH KUMAR (18248-EC-080)

K.AJAY KUMAR (18248-EC-081)

M.SUSHEEL KUMAR (18248-EC-087)

INDEX

CONTENTS

ABSTRACT

Automatic floor cleaner is a compact robotics system which provides floor cleaning service in room and big offices reducing human labor. Basically as a robot it eliminates human error and provide cleaning activity with much more efficiency. If we clean the floor manually then there is a possibility that the operator will leave some portion of the floor. Also due to manual labor involved this is time consuming and irritating to clean the floor. Also in big offices floor area is very huge and the people involved there for cleaning purpose cannot clean it much more efficiently. This is where the robot comes as an advantage. Also the robot is small and compact in size. So we can carry it and place it wherever we can on the house. Also in industries the robot is very cost effective as compared to manual labor involved. The flexibility, time saving and efficiency make the robot a clean choice for cleaning the floor.

CHAPTER 1

INTRODUCTION

In the recent years, robots have been used for various cleaning purposes. Robots have various cleaning Expertise like mopping, picking up the waste, wet floor cleaning, dry vacuum cleaning etc., Depending on the cleaning mechanism, these robots may have some advantages and disadvantages.Smart floor cleaning robot has been designed for home and office environments. This robot will be using water storage with anti-infection solution which is pumped with water pump motor. This robot on receiving the commands from the android device cleans a area using a cleaning pad by spraying water on the floor. After cleaning the wet floor,it can drain the dirty water into the required container as per the commands given to it. The robotic arm is used for efficient and effective wet floor cleaning purpose. This system can also be used to pick up the objects and carry them within the Bluetooth range. The proposed system is a manual system because it is controlled by android application which is operated by human. The proposed system functioning is entirely depended on the commands that are received from the android app.

CHAPTER 2: MAIN OBJECTIVES

2.1 ROBOT

Robot is an intelligent device having its own brain fed with computer logic so that it can do the work according to the algorithm designed. Autonomous movement of vehicle is guided by the logic controller designed. Robots plays an important role in each every field of life. It is used in industries, in households and in institutes. The robots are just becoming as intelligent as human now a days. Mostly an average human uses 2-3 robots per day in his day to day life. Various robotics parts are:-

- Pneumatic devices
- Actuators
- Sensors
- Mechanical control devices like valve
- Microcontroller - Controlling unit

Mechanical control devices are used to control the flow or movement of materials or any other parts present in the device. Actuators are used for controlling a mechanism which ultimately controls a part of the device.

Sensors are the sensing devices which transmit a signal and receives the signal and accordingly used to accumulate the various environment information which is ultimately fed to microcontroller for deciding the working of machines.

Microcontroller is the brain of robot where program is written and sensors are connected as input and actuators as output. The controlling of the robot is governed by various algorithms like fuzzy controller, machine learning based practices and artificial neural network based algorithms. Basically there are two types of controllers ,one is also known as which is the one continuous controller and another is PID based controller .Continuous controller is more direct and less effective while PID controller is more advanced and varies according to the current state and gives efficient result

2.2 SENSORS

Sensor plays a very important role in every type of robot. Various types of sensors are present. A sensor is a transducer whose intention is to sense (that is, to distinguish) some normal for its environs. It identifies occasions or changes in amounts and gives a relating yield, by and large as an electrical or optical sign; for instance, a thermocouple changes over temperature to a yield voltage. In any case, a mercury-in-glass thermometer is additionally a sensor; it changes over the deliberate temperature into development and construction of a fluid which can be perused on an adjusted glass tube.

Sensors are utilized as a part of ordinary questions, for example, touch-touchy lift catches (material sensor) and lights which diminish or light up by touching the base, other than endless utilizations of which the vast majority are never mindful. With advances in micro machinery and simple to-utilize microcontroller stages, the employments of sensors have extended past the more customary fields of temperature, weight or stream measurement, for instance into MARG T sensors. Besides, simple sensors, for example, potentiometers and power detecting resistors are still generally utilized. Applications incorporate assembling and apparatus, planes and aviation, autos, solution and apply autonomy.

A sensor's affectability shows how much the sensor's yield changes when the data amount being measured changes. Sensor is mainly consists of transducers, operational amplifiers. Transducer converts any physical signal to electrical signal. Basically the electrical signal present in very small range. So we have to use amplifiers which provides very high gain and increases the signal to volt range. Among various types of sensor major sensors are ultrasonic distance measurement sensor, sound sensor, pressure sensor, touch sensor, temperature sensor, and field sensor.

2.3 HELP TO MANKIND

Controlling provides various advantages over human powered work. Following are some of them:-

- It gives accurate results and eliminates possibility of manual error.
- It is very first and efficient and the control system used in industries are 100 times efficient than human work.
- In some part of the work areas it lessens the human efforts. Washing machine comes under this category.
- It also plays the great role in bringing entertainment in human life in different work. Television is the live example of these type of robots.

CHAPTER 3:LITERATURE REVIEW

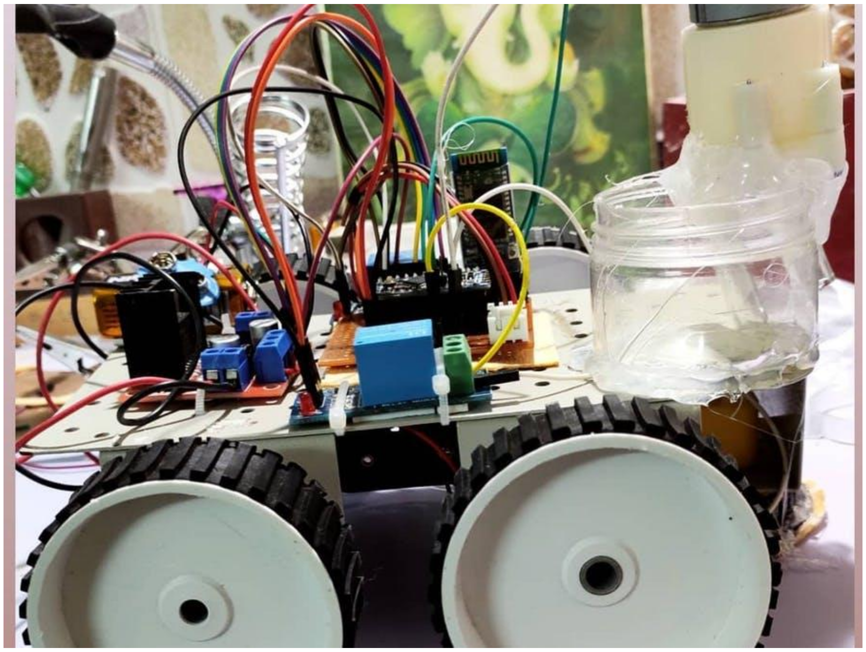
Traditionally floor is cleaned with the help of dry mop or wet mop using the hand as a potential tool. They have to scrub hard on the surface. The cleaning includes cleaning of various surfaces basically cement floors, highly polished wooden or marble floors. Among these floors the rough surface floor such as cement floor, mostly present in semi urban areas are covered with so much dust.

From early human civilization human is increasingly dependent on the machines. Human is trying to reduce the workload upon himself. By the help of machines also we can get huge efficiency because there is no chance of human error there. Now -a -days from 30 years intelligence and robotics growing with a vast pace. Every human is using 2-3 robot at least per day. If we look at past 30 years we will see robotics from large structure going to small and smaller in Nano range. Very complicated sensors have been designed to help the robot in various works .Complicated pneumatic and actuating systems have been designed. One of the best examples is the mobile phone. If we look at the floor cleaning robot we can see iRobot is dominating the market with its 90 sq. cm robot having indoor navigation as its principal controlling system.

Also for many in-house mobile robots indoor navigation is a big issue. Also currently indoor GPS is evolving which uses unsupervised learning and determining its path in its first run. Since now indoor navigation has not been solved completely. Also now-a-days complicated artificial intelligence algorithms like unsupervised and supervised learning, Swarm optimization, ANT algorithm, natural heuristic search are playing a major role in designing control system of the most .

3.1 BODY

The body of the robot has many small components. Like all robots it has sensors, microcontrollers and actuators and other components. It has 2 vacuum pumps connected in backside as well as front side of the robot. A 300 rpm DC motor is connected in the middle of the robot with the scrubber. A bearing is attached to the axle of the scrubber. 2 DC motors of 100 rpm are connected to the wheels. One microcontroller with 4 ultrasonic sensors is attached to it. This has 2 bread boards for circuit connection which ultimately can be replaced after welding.For scrubbing we are using the brushes instead of cloths .The scrubber rotates at very high speed which performs very good mopping action.



3.2 NAVIGATION SYSTEM

Navigation system of the robot is basically dependent on the sensors and microcontroller and algorithm fed to it. Basically the data acquisition system (here sensor) first collects the data from the environment and feeds to microcontroller .The microcontroller uses 2 algorithms. The 2 algorithms are:-

- Spiral motion algorithm
- Random Straight path following

3.2.1 SPIRAL MOTION

Basically after sensing the obstacle distance from outside environment, if the robot has sufficient space on its 4 sides it will move in spiral path at first half of its running. The spiral path can be anti-clockwise and clockwise .The spiral path can be generated by the decreasing ratio of left motor encoder and right motor encoder .

3.2.2 RANDOM STRAIGHT PATH

Basically random straight path searches from one node to another by the help of natural heuristic search. After the spiral motion the robot if detects a collision then it follows the edge of the wall until it gets enough free space for spiral motion again. After some moment if it doesn't get any specific clear area for spiral motion then it will move in random path for some time and the obstacle detection and avoidance system will be carried out by the help of ultrasonic sensors. After that robots stop rotating if the timer is over. In this process we can divide a particular area in the floor as grids and move accordingly so that it will have very confine control over the robot. So it will have grid based search over the floor for movement .

Finally we implemented computer vision by the help of ultrasonic imaging and analyzing the image for the dust particles by the help of supervised learning and clustering the data. We have implemented here A search algorithm for motion planning . The breadth first search implemented here is very effective and provides efficient result for moving .

AUTOMATION AND CONTROL OF MOBILE ROBOT

5.1 AUTOMATION

We have to automate the robot so that it will roam freely on the floor avoiding all the obstacles. We have to also provide a microcontroller in which we have to feed the code so that it will work as a brain of the robot. Also we have to give a proper power source and proper motor for regulating the sprinkling of the robot and motor driver for controlling the direction and speed of motor connected to wheel.

5.1.1 SENSORS

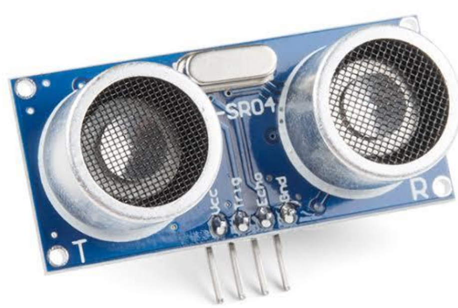


Figure 5.1 Ultrasonic sensor
Company name - HCSR04

This is an ultrasonic sensor of 40 kHz frequency specification. It requires power supply of 5 volt with working current specification as 15 mA .It detects around 13ft of distance. It triggers the pulses in the interval of 10 us. It has 4 terminals namely V_{cc},trig,echo and GND pin

Vcc = 5v

Trig pin =connected to Arduino board PWM pin

Echo pin = connected to Arduino

GND = negative terminal

Through trig pin we set the pulses and emit it to the environment and after emitting square waves the signals are received from the echo pin of this sensor module which ultimately fed to the Arduino board.

Code for Arduino

```
const int trig_pin = 12;
const int echo_pin = 10;
void setup()
{
 Serial.begin(9600);
 }
 void loop()
 {
  log time,cm;
  pinMode(trig_Pin,OUTPUT);
  digitalWrite(trig_Pin,LOW);
  delaymicroseconds(3);
  digitalWrite(trig_pin,HIGH);
  delayMicroseconds(10);
  digitalWrite(trig_Pin,LOW);     // A full square wave is generated with T(on)= 3 and T(off)=10
  pinMode(echopin,OUTPUT);
  time  = pulseIn(echo_Pin,OUTPUT);
  cm = microseconds_to_Centemeter(time);
  Serial.print(cm);
  Serial.print("cm");
  Serial.print();
  delay(1000);
  }
  long      microseconds_to_centimeter(long      micro_sec)
  {
   return micro_sec/29/2;
  }
```

Here above trig pin of sensor is connected to 12 of Arduino and echo pin is connected to 10 of Arduino.

Connected circuit for above:-

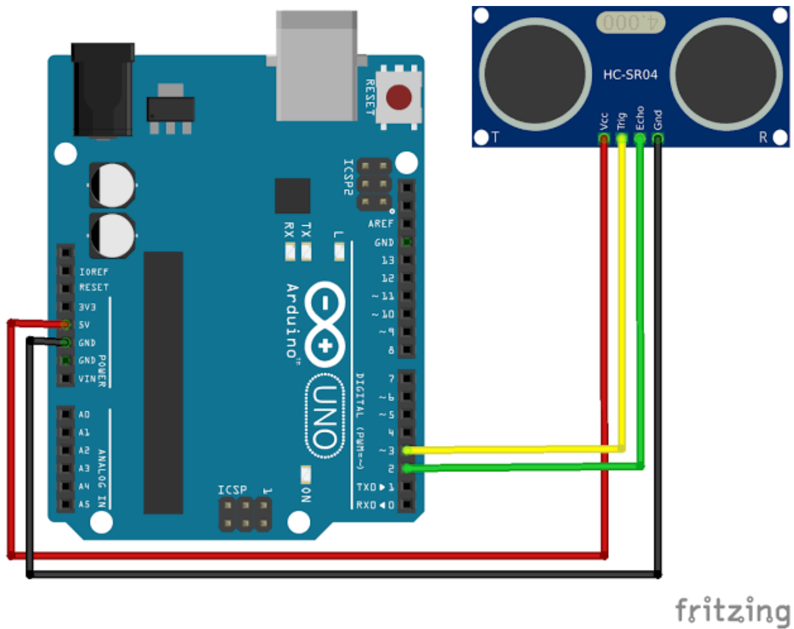


Figure 5.2 Ultrasonic sensor connected with Arduino

ARDUINO BOARD:-

Arduino due board requires at 3.3. Volt. If we give more than 3.3, i.e. 5 volt to i/o pins it will damage the board. It is 32-bit ARM Core. CPU clock rate of this board is 84 MHz. It has SRAM of 92Kb and flash memory of 512 Kb. The microcontroller version of this board is AT91SAM3X8E. It has 54 digital I/O pins from which 12 has PWM output. It has 12 analog output pins from which 2 DAC present. We can give power to it either from the USB or through power jack from batteries.

Pin 2 - 13 are 8 bit PWM output. Pins 0 and 1 are connected to the corresponding pins of the ATmega16U2

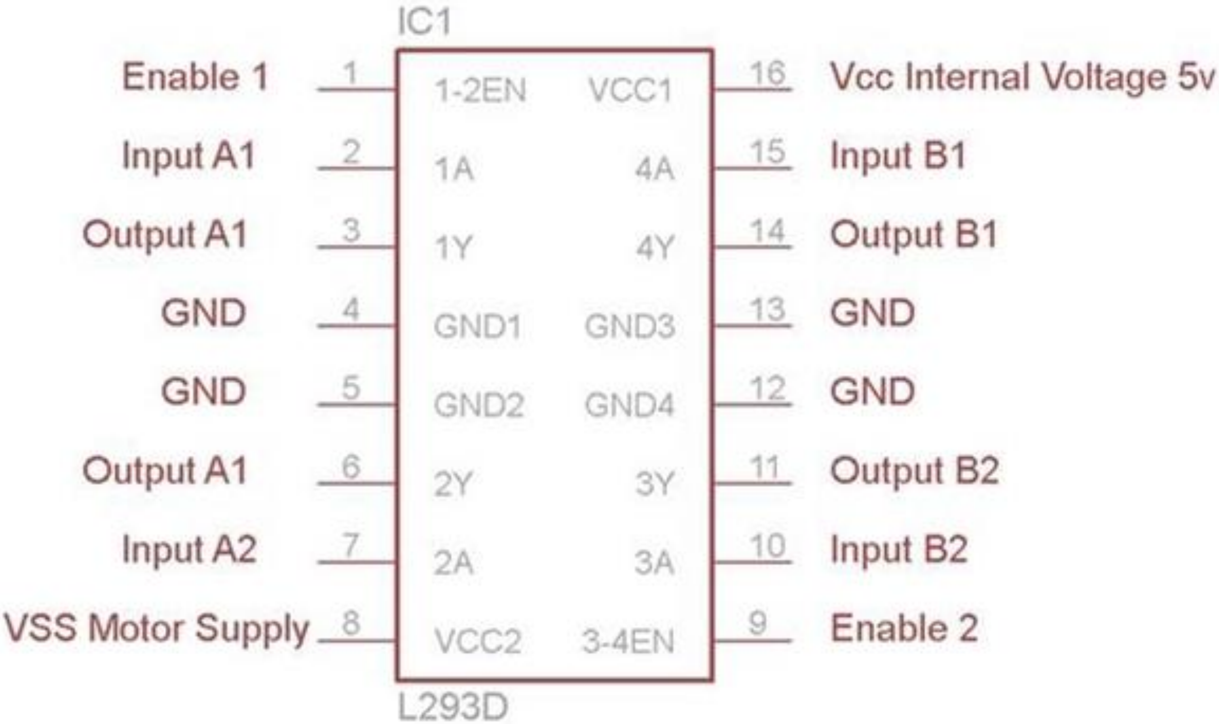
.

2 DAC pins provide analog outputs of 12 bit resolution through analogWrite() function. Reset button on the board is provided for resting the microcontroller board. There are 2 USB ports.one is native USB port and other one is programming USB port. We feed the program written in Arduino IDE to Arduino board through programming usb port through USB cable.

The program written in Arduino IDE consists of two functions basically .One is loop() and other one is setup().

5.1.3 MOTOR DRIVER:-

For this experiment purpose we used L293D motor driver. The schema of L293D is as following.



It is 16 pin structure based IC.This L293D motor driver IC has 4 input pins and 4 output pins and 2 enable pins and motor supply

V_{cc} = 5 volt

V_{ss} = 7 volt

The positive terminal of motor is connected to pin 3 and -ve terminal to pin 6. Following is the criterion for motor rotation:-

- Pin 2 = Logic HIGH and Pin 7 = Logic LOW| Clockwise Direction
- Pin 2 = Logic LOW and Pin 7 = Logic LOW | Idle [No rotation] [Hi-Impedance state]
- Pin 2 = Logic HIGH and Pin 7 = Logic LOW | Idle [No rotation]

By this IC we can control 2 dc motors .This can provide maximum current of 600mA.V_{cc} can be extended upto 36 volt and beyond that it will hamper the board.

[

CONNECTION OF ARDUINO WITH L293D AND MOTOR:-

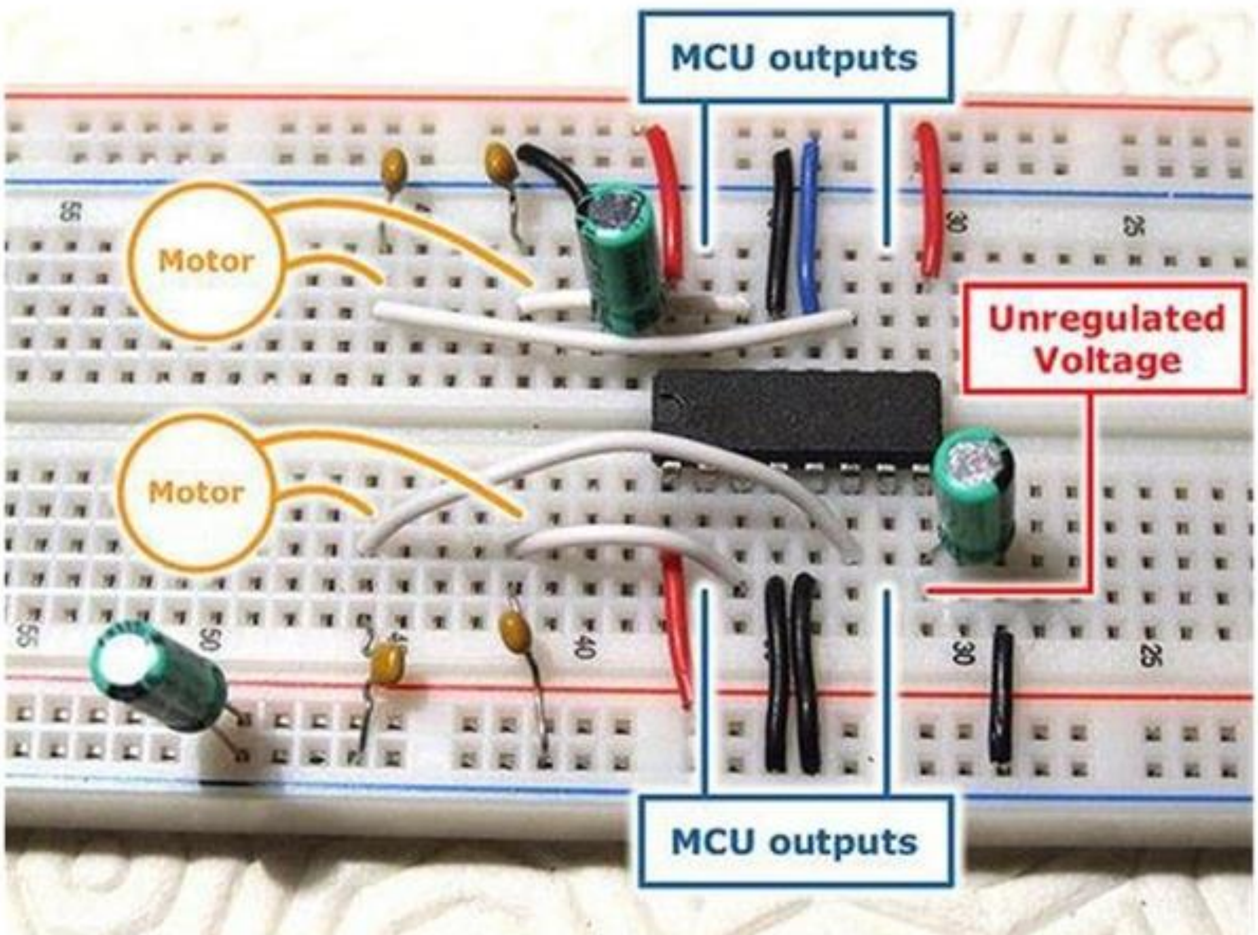


Figure 5.5 L293D Circuit connection

5.1.3.1 Arduino code for DC motor control

```
// ---- Motors’ variable
int motorLeft[] = {2, 3};
int motorRight[] = {7, 8};

// ----Setup function
void setup() {
Serial.begin(9600);

// Setup motors and select the pins
int i;
for(i = 0; i < 2; i++){
pinMode(motorLeft[i], OUTPUT);
pinMode(motorRight[i], OUTPUT);
}

}

// ---- Loop function
void loop() {

driveForward();
delay(1000);
motorStop();
Serial.println("1");

driveBackward();
delay(1000);
motorStop();
Serial.println("2");

turnLeft();
delay(1000);
motorStop();
Serial.println("3");

turnRight();
delay(1000);
motorStop();
Serial.println("4");

motorStop();
delay(1000);
motorStop()
```

```
// -- Driving the bot backward and forward, left and right

void motorStop(){
digitalWrite(motorLeft[0], LOW);
digitalWrite(motorLeft[1], LOW);

digitalWrite(motorRight[0], LOW);
digitalWrite(motorRight[1], LOW);
delay(25);
}

void driveForward(){
digitalWrite(motorLeft[0], HIGH);
digitalWrite(motorLeft[1], LOW);

digitalWrite(motorRight[0], HIGH);
digitalWrite(motorRight[1], LOW);
}

void driveBackward(){
digitalWrite(motorLeft[0], LOW);
digitalWrite(motorLeft[1], HIGH);

digitalWrite(motorRight[0], LOW);
digitalWrite(motorRight[1], HIGH);
}

void turnLeft(){
digitalWrite(motorLeft[0], LOW);
digitalWrite(motorLeft[1], HIGH);

digitalWrite(motorRight[0], HIGH);
digitalWrite(motorRight[1], LOW);
}

void turnRight(){
digitalWrite(motorLeft[0], HIGH);
digitalWrite(motorLeft[1], LOW);

digitalWrite(motorRight[0], LOW);
digitalWrite(motorRight[1], HIGH);
}
```

5.1.4 ALGORITHM

In this bot we are using two algorithms. One is:

- Spiral path following algorithm
- Random Straight motion algorithm

5.1.4.1 Random Straight Path Flow chart

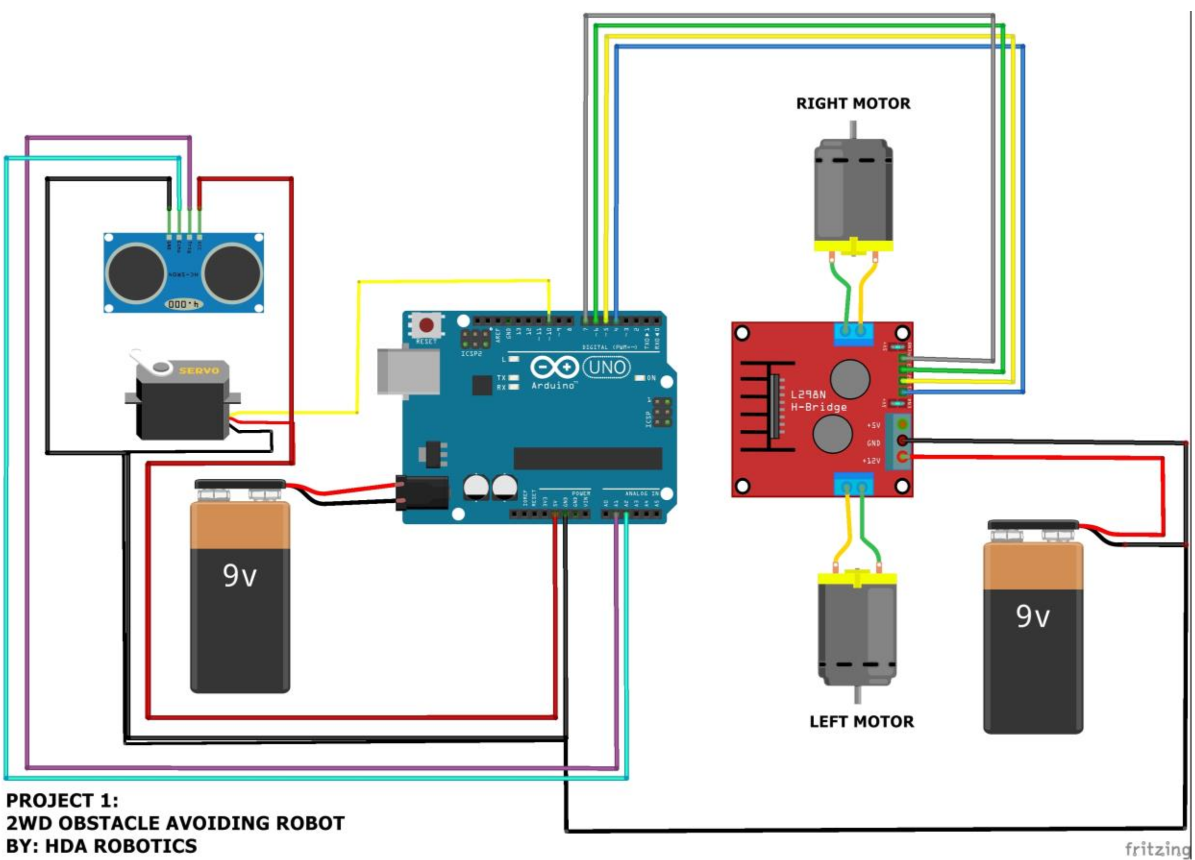


Figure 5.6 Random Straight Path Flow chart

SPIRAL PATH FOLLOWING CHART

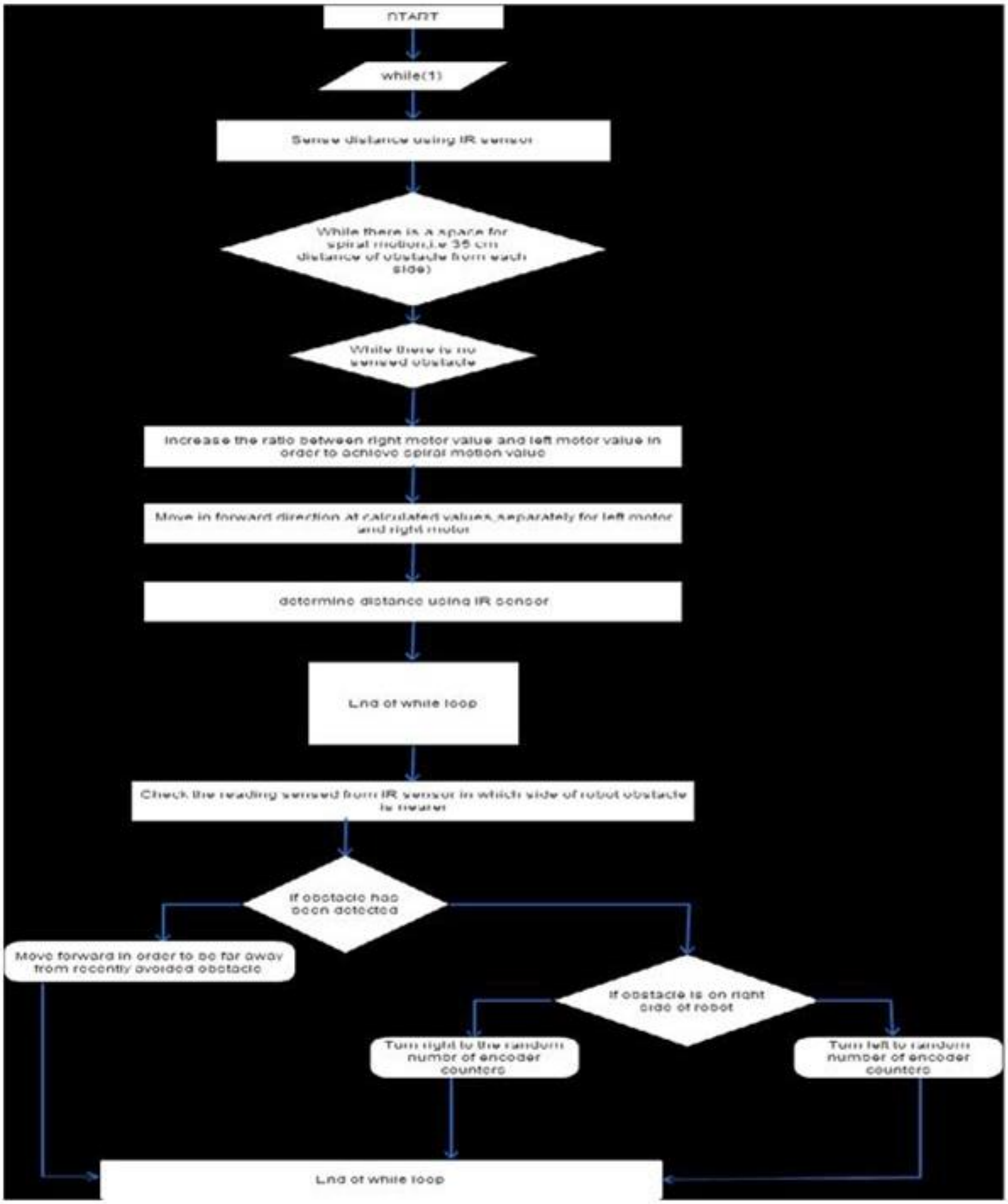


Figure 7 Spiral Path Flow chart

5.1.5 Final Program

//ARDUINO OBSTACLE AVOIDING CAR//

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

#define TRIG_PIN A0
#define ECHO_PIN A1
#define MAX_DISTANCE 200
#define MAX_SPEED 190 // sets speed of DC  motors #define
MAX_SPEED_OFFSET 20

NewPing sonar(TRIG_PIN, ECHO_PIN, MAX_DISTANCE);

AF_DCMotor motor1(1, MOTOR12_1KHZ);
AF_DCMotor motor2(2, MOTOR12_1KHZ);
AF_DCMotor motor3(3, MOTOR34_1KHZ);
AF_DCMotor motor4(4, MOTOR34_1KHZ); Servo
myservo;

boolean goesForward=false;
int distance = 100;
int speedSet = 0;
void setup() {
```

```
  myservo.attach(10);
  myservo.write(115);
  delay(2000);
  distance = readPing();
  delay(100);
  distance = readPing();
  delay(100);
 distance = readPing();
 delay(100);
 distance = readPing();
 delay(100);
  }

 void loop() {
int distanceR = 0;
int distanceL =  0;
delay(40);

if(distance<=15)
{
moveStop();
delay(100);
 moveBackward();
delay(300);
moveStop();
```

```
delay(200);
distanceR = lookRight();
delay(200);
distanceL = lookLeft();
delay(200);
if(distanceR>=distanceL)
{
turnRight();
moveStop();
}else
{
turnLeft();
moveStop();
}
}else
{
moveForward();
}
distance = readPing();
}
int lookRight()
{
myservo.write(50);
delay(500);
```

```
 int distance = readPing();
 delay(100);
 myservo.write(115);
 return distance;
 int lookLeft()
 {
myservo.write(170);
delay(500);
 int distance = readPing();
delay(100);
myservo.write(115);
return distance;
delay(100);
}
int readPing() {
delay(70);
int cm = sonar.ping_cm();
if(cm==0)
{
cm = 250;
}
return cm;
}
```

```
void moveStop() {
 motor1.run(RELEASE);
  motor2.run(RELEASE);
   motor3.run(RELEASE);
   motor4.run(RELEASE);
  }

   void moveForward() {
   if(!goesForward)
   {
  goesForward=true;
  motor1.run(FORWARD);
  motor2.run(FORWARD);
 motor3.run(FORWARD);
 motor4.run(FORWARD);
 for (speedSet = 0; speedSet < MAX_SPEED; speedSet +=2)
// slowly bring the speed up to avoid loading down the batteries too quickly
{
  motor1.setSpeed(speedSet);
   motor2.setSpeed(speedSet);
   motor3.setSpeed(speedSet);
  motor4.setSpeed(speedSet);
delay(5);
}
}
}
```

```
void moveBackward() {
 goesForward=false;
 motor1.run(BACKWARD);
 motor2.run(BACKWARD);
 motor3.run(BACKWARD);
  motor4.run(BACKWARD);

 for (speedSet = 0; speedSet < MAX_SPEED; speedSet +=2)
 // slowly bring the speed up to avoid loading down the batteries too quickly
  {
   motor1.setSpeed(speedSet);
    motor2.setSpeed(speedSet);
    motor3.setSpeed(speedSet);
    motor4.setSpeed(speedSet);
  delay(5);
   }
   }

  void turnRight() {
 motor1.run(FORWARD);
 motor2.run(FORWARD);
   motor3.run(BACKWARD);
   motor4.run(BACKWARD);
 delay(500);
```

```
motor1.run(FORWARD);
motor2.run(FORWARD);
motor3.run(FORWARD);
motor4.run(FORWARD);
 }
void turnLeft() {
motor1.run(BACKWARD);
motor2.run(BACKWARD);
motor3.run(FORWARD);
motor4.run(FORWARD);



  delay(500);
  motor1.run(FORWARD);
  motor2.run(FORWARD);
  motor3.run(FORWARD);
  motor4.run(FORWARD);
   }
```

CONSTRUCTION OF ULTRASONIC SENSOR

Ultrasonic range finder is a circuit for measuring distance by the help of ultrasonic sound. First the ultrasonic bust is transmitted from the transmitter and then receiver receives the ultrasonic burst. The ultrasonic sound velocity is known in the medium as $c = 331,3\ (m/s) * (1+T/273)^{1/2}$

Actually the speed of sonic wave varies with respect to temperature of medium. Overall attenuation in air depends upon: geometric spreading, molecular relaxation, boundaries, and refraction by non-homogeneous atmosphere, and diffraction by turbulence, conduction and shear viscosity losses. Attenuation also varies with respect to distance travelled by the sonic wave. In this experiment we are using two transducers of 40 kHz. Transducer is a device which converts one form of energy to electrical energy and electrical energy to another form of energy. It carries a piezoelectric material which does these energy conversion.

TRANSDUCER PAIR:-

Between the two transducer pair one is transmitter and other is receiver.

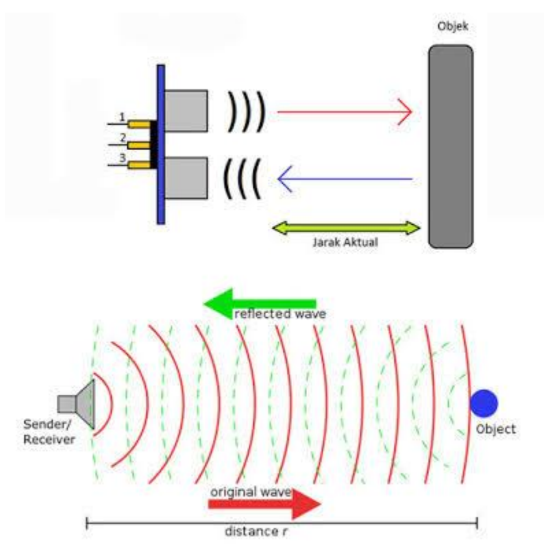


Figure 6.1 Transducer receiver and transmitter

$$Di = 0.5 * C * (T_{initial} - T_{final})$$

(Where:

Di = Distance to Object C =

Speed of Sound

Tinitial = Time at which sonic wave is transmitted

Tfinal = Time at which sonic wave is received)

The main characteristic from which we have to choose ultrasonic transducer from are:-

Resonant frequency

Radiation pattern

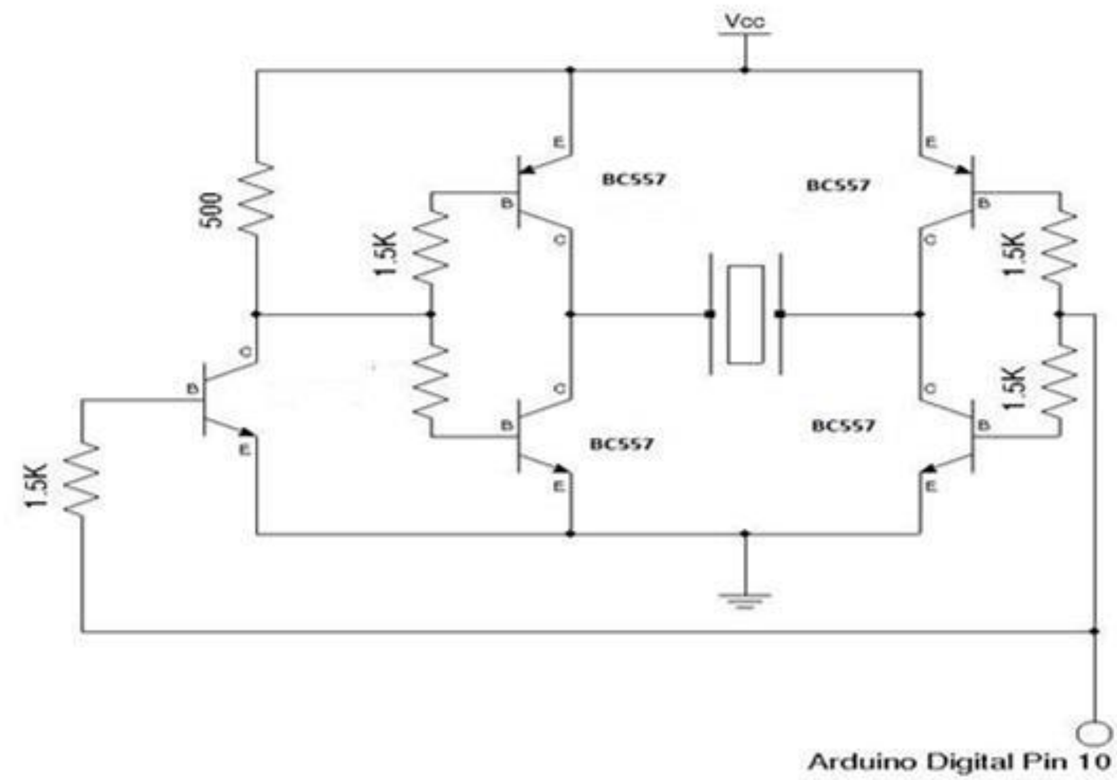
Sensitivity:

The more the resonant frequency the lesser will be the wavelength of transmitted radiation and it will provide good surrounding condition. The more directional the sonic wave the more resolution in the measurement come. Sensitivity helps in decreasing signal to noise ratio.

Here we used two transducers of 40khz.as shown below:

Figure 6.2 Receiver and transmitter transducer pairs HCSR - 04

6.1 Transmitter circuit




```
  void start_Transducer(float freq, float duty_Cycle)
{
  if (duty_Cycle > 0.5) duty_Cycle = 0.5;
  else if (duty_Cycle < 0) dutyCycle = 0;

  cli();
  TCCR1B = _BV(WGM13) | _BV(CS10) | _BV(ICNC1);
  //f0 = fclk / (2 * N * Top)
  long topv = (long) ((float) F_CPU /(freq * 2.0 * 1.0));
  ICR1 = topv;

  OCR1A = (int) ((float) topv * duty_Cycle);
  OCR1B = (int) ((float) topv * (1 - duty_Cycle));
  DDRB |= _BV(PORTB1) | _BV(PORTB2);
  TCCR1A = _BV(COM1A1) | _BV(COM1B1);
  sei();
}

void stop_Transducer()
{
  cli();
  TCCR1B = 0;
  sei();
  digitalWrite(9,LOW);
  digitalWrite(10,LOW);
}
```

6.2 RECIEVER CIRCUIT

Performance of the transmitter is largely influenced by the sensitivity of the receiving signal. Generally the signal reaching on the receiver is very weak (in some millivolt range). So we have to amplify the signal and reduce the noise for optimal performance.

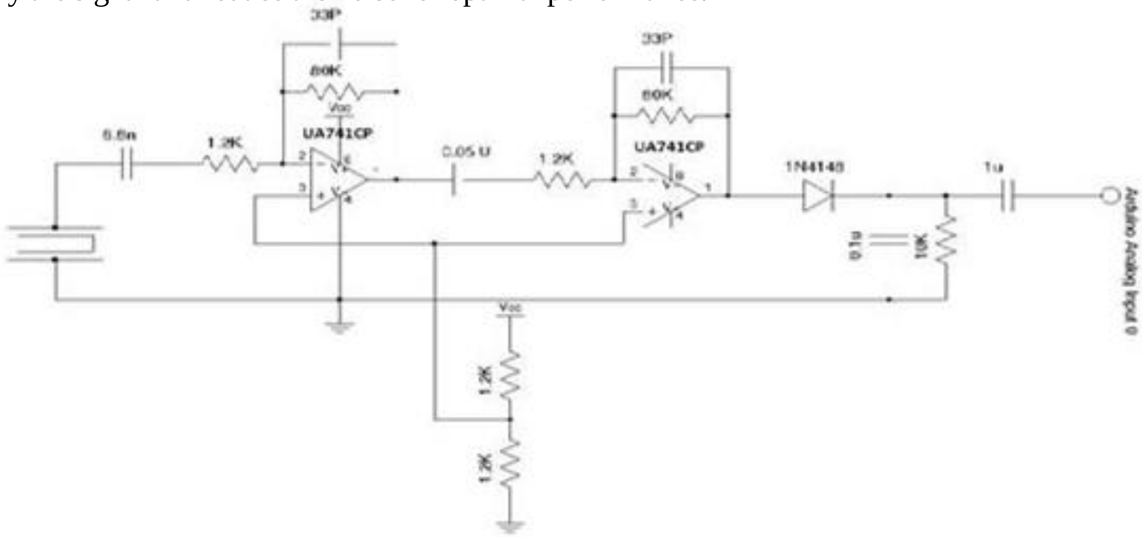


Figure 6.4 Receiver Circuit of ultrasonic sensor

IN4148 - Diode

UA741CP - opamp model

Gain in first stage of amplifier (approx.) = -20 log (R2/R1) = -20 log (80/1.2) = -36.92db

(Here R2 value taken as 80 kΩ approximately whereas real value of R2 is less as 80KΩ is connected to capacitor of value 33pF.So gain will be less. But it will provide frequency stability.)

So approximate gain from two stage = 36.92 + 36.92 = 72 dB

The 0.1 coulomb capacitor passes the signal having medium and high frequency signals.

Here 2 inverting opamps are used and combined stage has a voltage gain of 67 db. So after 2 succesive inversion the phase of signal doesn’t change. Here band pass filters are used with RC circuit where we pass high frequency signal into the circuit input. Band pass filter is centered on the frequency 40 kHz. The output voltage of the opamp is around 2.5 volt (Vcc/2).

For easier processing of the echo, a diode (IN4148), capacitor of 0.05uF and resistor of 10k ohm are used to demodulate the signal. A coupling capacitor (1uF) is used. This helps to get rid of demodulated signal of the DC component.

6.3 RANGE CALCULATION

For finding the range we calculated the time elapsed between the transmitted signal and received signal for range calculation. Here in the below code we specified the initial time as t_start and the final time as t_peak.

CODE to calculate range in Arduino due:-

```
byte a = 0;
unsigned long t_start = 0;
unsigned long t_peak = 0;
unsigned long t = 0;
byte v_peak = 0;
const float SPEED_OF_SOUND_20C = 0.0003432; //meters per micro-second
float d = 0;

void loop()
{
  startTransducer(24000.0, 0.5);
  delayMicroseconds(300);
  stopTransducer();

  v_peak = 0;
  t_start =micros();
  t_peak = t_start;
  delayMilliseconds(1);

  for (int i = 0; i < 256; i++) {
    a = analogRead(0);
    t = micros();

    if (a > v_peak) {
      t_peak = t;
      v_peak = a;
    }
  }

  t = t_peak - t_start;
  d = (float) t * SPEED_OF_SOUND_20C / 2.0;
  Serial.println(d , 2);
}
```

Complete circuit is done combining above two circuits. The duty cycle is set to 0.5 in both the circuit we can increase the duty cycle little bit to get the efficient result.

COMPLETE CODE

(**For making ultrasonic transducer and receiver pair**) for

```
(int k = 0; k < ms; k++) {
delayMicroseconds(1100);
}
}
void stop_Transducer()
{
cli();
TCCR1B = 0;
sei();
digitalWrite(9,LOW);
digitalWrite(10,LOW);
}

void start_Transducer(float freq, float duty_Cycle)
{
if (duty_Cycle > 0.5) duty_Cycle = 0.5;
else if (duty_Cycle < 0) duty_Cycle = 0;

cli();
TCCR1B = _BV(WGM13) | _BV(CS10) | _BV(ICNC1); //f0
= fclk / (2 * N * Top)
long topv = (long) ((float) F_CPU /(freq * 2.0 * 1.0));
OCR1B = (int) ((float) topv * (1 - duty_Cycle));
DDRB |= _BV(PORTB1) | _BV(PORTB2);
TCCR1A = _BV(COM1A1) | _BV(COM1B1);
sei();
void setup()
```

```
{
  Serial.begin(9600);

  pinMode(9, OUTPUT);
pinMode(10, OUTPUT);
}

byte a = 0;
unsigned long t_start = 0;
unsigned long t_peak = 0;
unsigned long t = 0;
byte v_peak = 0;
const  float  SPEED_OF_SOUND_20C  =  0.0003432;  //per  micro-second
float d = 0;

void loop()
{
  start_Transducer(24000.0, 0.5);
  delayMicroseconds(300);
  stop_Transducer();

  v_peak = 0;
  t_start =micros();
  t_peak = t_start;
  delay_Milliseconds(1);

  for (int i = 0; i < 256; i++) {
  a = analogRead(0);
    t = micros();

    if (a > v_peak) {
    t_peak = t;
      v_peak = a;
    }
  }

  t = t_peak - t_start;
  d = (float) t * SPEED_OF_SOUND_20C / 2.0;
  Serial.println(d , 2);
}
```

4.6 Constructing the Chassis

To begin, we start by coupling the chassis of the robot. The robot kit, contains the chassis, two geared DC motors, the wheels, the front wheel, battery holder, some screws, and wires.

Figure 4.14 Chassis Robot Components

Figure 4.15 3D Print chassis plate

Step 1. Connect the motor and wheels to the chassis.

• To complete this step, we start by soldering the thick red and black wires to the positive and negative terminals of the motors as shown below.

Figure 4.16 Soldering the DC Motors

• attach the front wheel as shown in the image below.

Figure 4.17 attach the front wheel

• attach the rear wheels to the chassis

Figure 4.18 attach the rear wheels to the chassis

Step 2. Prepare the Switch and connect the Power Source

we add a switch to the battery holder so that we will be able to turn the robot on or off. The switch is connected according to the schematics shown below and attached to the case using a hot glue. The Battery case is attached to the chassis using a doublesided tape to ensure everything sticks together.

Figure 4.19 schematic circuit diagram of the switch and the power source

Figure 4.20 Soldering the ON/OFF Switch

Step 3. installation the others parts of the robot

This step is to mount other parts of the robot before we start connecting their wires. The motor shield is stacked on the Arduino and it is mounted on the chassis using a double-sided tape. The current require ements of the motors are often higher than what the Arduino can provide, that is why it’s important to use the motor shield as it is equipped with additional circuitry to provide up to 600mA current to each of the motors. This shield provides power to the motors and the servo motor and ultrasonic sensor and makes it much easier. The Ultrasonic sensor is also mounted on the top of the servo motor which is then mounted on the chassis using some screws.

Figure 4.21 The hardware model depicting my project model

Step 4. Wire up the components

To simplify the connections, below is a pin map of how the components connect,

o one to the other. Wire up the components together as shown in the image below.

Figure 4.22 Schematics Block Diagram of wire up the components

Ultrasonic Sensor ▶ Motor Shield

- VCC ▶ 5v
- Gnd ▶ Gnd
- Trig ▶ A4
- Echo ▶ A5

Figure 4.23 connect ultrasonic sensor Pins to the Motor Shield

Figure 4.24 Block Diagram of connect ultrasonic sensor Pins to the Motor Shield

Servo ▶ Motor Shield (Servo_2 port)

• Signal (yellow wire) ▶ S

• Vcc(Red wire) ▶ +

• Gnd(Blow wire) ▶ -

Figure 4.25 Wire up the Servo Motor to Motor Shield (Servo _ port 2)

DC motors ▶ Motor Shield

• Left Motor ▶ M1

• Right Motor ▶ M2

Figure 4.26 Wire up the DC motors to Motor Shield

7. Commercialization possibility

Now in the automatic floor cleaner market iRobot and Scooba are playing major roles. They hold around 80% of the market. Their costs are around 25000 to 35000.Also the algorithms used by them are not most effective. They are using algorithms which approximately provides 70% accuracy. They are not using any image processing algorithms to run their robot. But the robot designed by us is cost efficient which will cost around 15000 .Also we can use camera lens for small dust particle detection, so that it will give more efficient decision in governing the motion of the particle which ultimately save considerable amount of power and reduce the timing with better efficiency and sensitivity. This will act like a pheromone like in ant algorithm.. In ant algorithm when pheromone density of ants in particular direction is denser all other ants follow that direction. Similarly when the robot will find the particular dust size on floor on one side of it and there are less on other 3 sides, it will head towards dusty area if obstacle is not present.

Time redundancy and power saving with low cost provides the best opportunity for marketing this consumer product.

8. CONCLUSION

The Product developed is definitely a very important product in robotics and floor cleaning area .The robots developed uses 2 vacuum pump which ultimately provides lots of vibration and power loss in the system. Also the algorithm implemented is not very effective. So there is definitely current scope for improvement and optimization till the most effective product is being developed. After optimizing the algorithm and taking it to the heuristic based search like bee algorithm it will be a great product and can revolutionize this industry. Definitely it has very huge potential. Also we can use 1 vacuum pump instead two so that it will be cost effective and very energy saving product with less vibration and much control over the robot. The robot having 33*30*8 cm in dimension is very compact in nature and can go beneath any furniture and bed. This is also very handy in portability. The scrubber of the robot now consists of small plastic fibers .But it can be further improved so that the surface area of the scrubber will come 90% in contact with the floor.