AUTOMATIC VEHICLE COLLISION AVOIDANCE SYSTEM

A Thesis
Submitted to the Department of Electrical and Electronics Engineering
of
BRAC University
By

Ashikul Islam
Sohana Salim Oyshi
Faisal Mahmud Sohan
Syed Ahmed Usama

In Partial Fulfillment of the
Requirements for the Degree
of
Bachelor of Science in Electrical and Electronics Engineering
Spring2015

DECLARATION

We hereby declare that this thesis is based on the results found by ourselves. Materials of work found by other researcher are mentioned by references. This thesis, neither in whole nor in part, has been previously submitted for any degree.

Signature of

Supervisor

Dr. Mosaddequr Rahman

Signature of Authors

Ashikul Islam
Student ID: 11121051

Sohana Salim Oyshi
Student ID: 11121010

Faisal Mahmud Sohan
Student ID: 11121033

Syed Ahmed Usama
Student ID: 09110011

ACKNOWLEDGMENTS

We present our sincere gratitude to our Supervisor Dr. Mosaddequr Rhaman, Professor, Department of Electrical and Engineering, BRAC University for his motivation, support and directions. He has stimulated a deep sense of critical thinking and relating knowledge to practical fields within us through manifold suggestions and directions.

We would also like to thank Research Assistant, Imran Bin Zafar for helping us with some of the critical portions of the thesis work.

We are thankful to our Co-Supervisor Avijit Das, Department of Electrical and Engineering, BRAC University and our friend Pritom Chowdhury (ID-11121092) for helping us in learning Arduino and Microcontroller and also with their academic knowledge.

ABSTRACT

Vehicle accident has become very acute now a day. When investigated, it has been found that many of the accidents happen due to drivers' failure to stop the car at the right time. In some cases it is the pedestrians who cannot cross a road at the right time. Researchers have found that nearly 35% people die from accident of which 98% die due to fatal road accidents. Many vehicle industries have introduced artificial intelligence system in the vehicles to reduce such accidents. But, this system is complicated and cost requirement is high. As a result, mass people still remain in the risk of accidents. This limitation has drawn the concentration of this research. This research describes how a cheap intelligent system design can be implemented to avoid sudden accidents. The design includes such system that the vehicle speed automatically reduces whenever there is a possible threat of accident.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

CHAPTER I

INTRODUCTION

1.1 An Overview

Intelligent Accident Protection System is a new topic in the area of research. According to the National Sleep Foundation 2005 report, 60% of adult drivers – about 168 million people – say they have driven a vehicle while feeling drowsy in the past year, and more than one-third, (37% or 103 million people), have actually fallen asleep at the wheel! In fact, of those who have nodded off, 13% say they have done so at least once a month. Four percent – approximately eleven million drivers – admit they have had an accident or near accident because they dozed off or were too tired to drive. The National Highway Traffic Safety Administration conservatively estimates that 100,000 police-reported crashes are the direct result of driver fatigue each year. This results in an estimated 1,550 deaths, 71,000 injuries, and $12.5 billion in monetary losses. These figures may be the tip of the iceberg, since currently it is difficult to attribute crashes to sleepiness [1]. This is one of biggest reason that causes accident because driver due to drowsiness cannot cope up with a changed situation and hence causes accident.

Researchers are always trying to find out a cheap solution to avoid accident automatically. Current researches are mainly based on Artificial Intelligence System. This process is vigorous and the cost is way too high. So to prepare a low cost intelligent system has become a new demand. It is possible to use different sensors and to make a cheap intelligent accident system with which accident can be minimized to a certain extent.

In this research a prototype robot vehicle has been built which can sense obstacle around it and reduce its speed to the necessary limit. The robot takes data from its surroundings and finally makes a decision based on all of the data. The robot also provides an emergency signal and displays necessary emergency messages in the screen. The following block diagram shows the whole process:

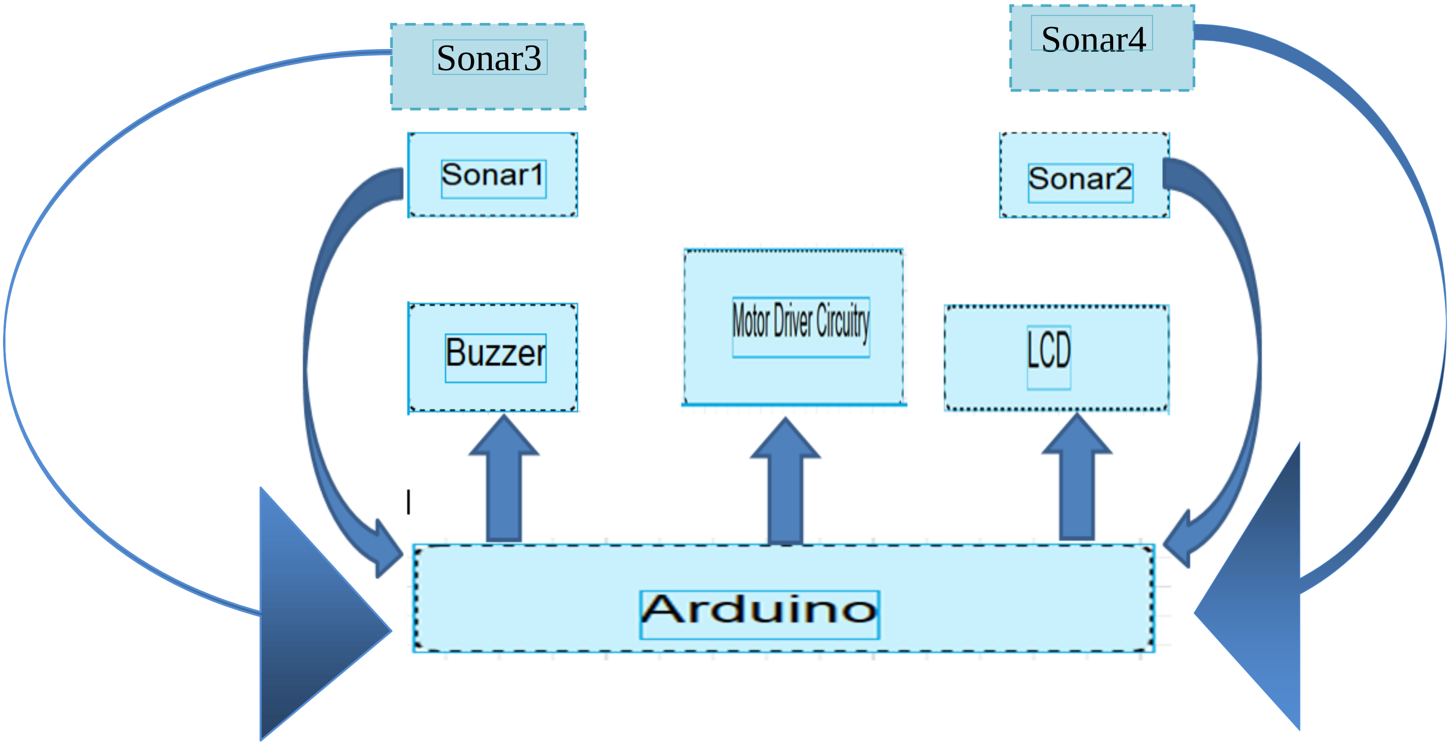


Fig. 1.1 Simple block diagram

1.2 Motivation

To reduce accidents with censored technology is not new. The design and alignment of the sensor matters because if the sensors are not aligned correctly, the whole system becomes less intelligent to avoid sudden accidents. Thus the motto of reducing accidents tends to fail. This research finds its motivation from the factor that designing a cheap sensor-ed accidence avoidance system has always been a tonic for further research. This research suggests such a unique and distinguished design which if implemented commercially can prove itself worthy of controlling sudden accidents. This technology will somewhat reduce the dependency on the artificial intelligence based systems and will suitable for common people because of its cost reduction.

1.3 Architecture

Figure 1.2 shows the complete architecture of the whole system. Primarily two ultrasonic sensors are mounted on top of the robot vehicle in two opposite side. When the robot moves in a particular direction it continuously searches for obstacle and their distances. A buzzer is attached with the robot which raises alarm at the time of emergency situation. It keeps beeping based on the different levels of emergencies. There is a LCD screen which is attached with the robot. In case of emergencies the screen projects a particular message to alert the driver. The main feature of the design is that the distances are sensed nearly at the same time and the decision is made so quickly based on the situation where all the distances and risks are taken as parameters.

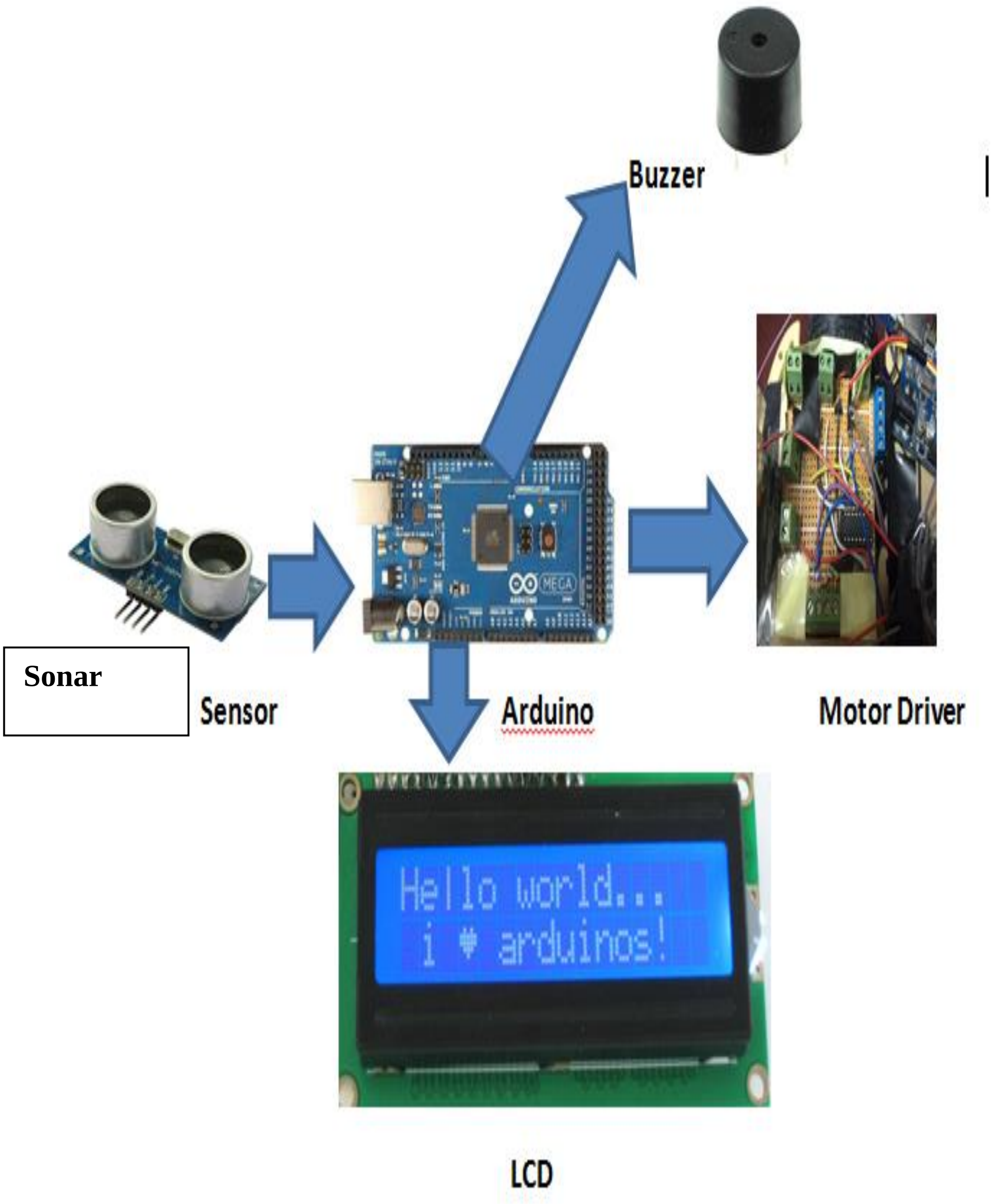


Fig.1.2 Overall System Diagram

CHAPTER II

IMPLEMENTATION

2.1 Sonar Sensor:

The sonar sensor is usually known as Ultrasonic Sonar Sensor. It has four pins. The pins are named VCC, Trig-pin, Echo-pin and ground-pin. The VCC pin stands for power. This is used to power up the sensor. The Trig and Echo pins are connected to the micro-controller. Actually the sensor emits an ultrasonic sound and searches instantaneously to receive the sound back. It records the time between sending and receiving signals. Then a calculation is made to convert the time duration to distance in the program.

These are used to achieve optimal positioning for accurate spatial resolution. Small low-cost ultrasonic distance measurement modules like this: It has an effective way to sense the presence of nearby objects and the distance to them. Often robots use these to sense objects or collisions and take appropriate action.

Here's how these modules work:

They have two transducers, basically a speaker and a microphone.

Ultrasound is a high frequency sound (typically 40 KHz is used). A short burst of sound waves (often only 8 cycles) is sent out the "Transmit" transducer (left, above). Then the "Receive" transducer listens for an echo. Thus, the principle of ultrasonic distance measurement is as the same as with Radio-based radar.

Distance is calculated as: $L = C \times T/2$, where L is the length, C is the speed of sound in air; T is the time difference from the transmission from the transmitter to the receiver. This is divided by 2 for the two-directions the sound travels. Speed of sound is about: $C = 344m / s$ (20 degrees C room temperature).

Speed of sound in air velocity is affected by the air density, and for high accuracy the temperature must be taken into account, either within the module electronics (In the SRF-06 module we have) or in the Arduino software.

The module in our example has 4 pins:

- VCC Operating voltage: 5.0V
- Trig the transmit signal pin
- Echo the received echo pin
- GND Ground
-

  Software does the following
- Turn the Trig pin on and off to send out a sound pulse
- Monitor and time how long until the Echo pin sees the echo
- Calculate the distance as shown above, possibly correcting for temperature

The channel names are: AF3, AF4, F3, F4, F7, F8, FC5, FC6, P3 (CMS), P4 (DRL), P7, P8, T7, T8, 01, 02 of these channels AF3, AF4, F3, F4, F7and F8 are used for taking frontal EEG data from the part of the brain which is involved in planning, organizing, problem solving, selective attention and personality [14]. FC5 and FC6 are used for taking EEG from the part of the brain which works on the processes that are engaged in preparing a response of front-central EEG [23], [24].

To take EEG from the region in the back of the brain which processes visual information and which is mainly responsible for visual processing O1 and O2 channels are used. In case for partial area which controls sensation FC5 and FC6 are used. There are two temporal lobes, one on each side of the brain located at about the level of the ears. These lobes allow a person to differentiate one smell from another and one sound from another. They also help in sorting new information. T7, T8 are used for taking data from temporal sites. Fig. 1.3 shows different connections of the sensors around the scalp and Table 1.1 is showing the Emotive Headset configuration

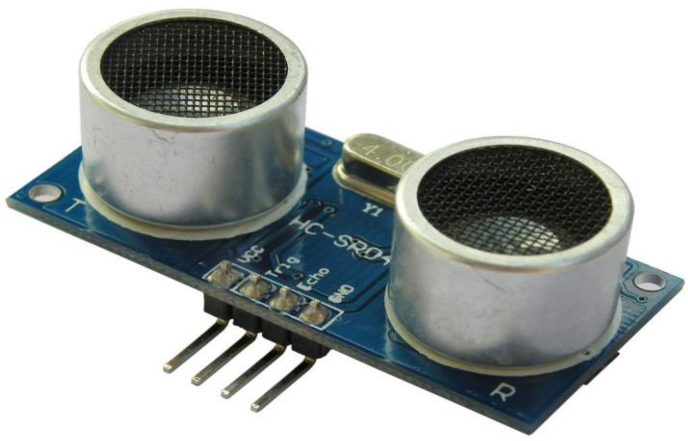


Fig. 1.3 Sonar Sensor

2.2 Buzzer:

The Buzzer has two pins. One pin is bigger than the other. The bigger is usually connected to the microcontroller. The smaller pin is connected to ground. Whenever the microcontroller pin which is connected to the bigger pin of the buzzer becomes high the buzzer starts beeping.

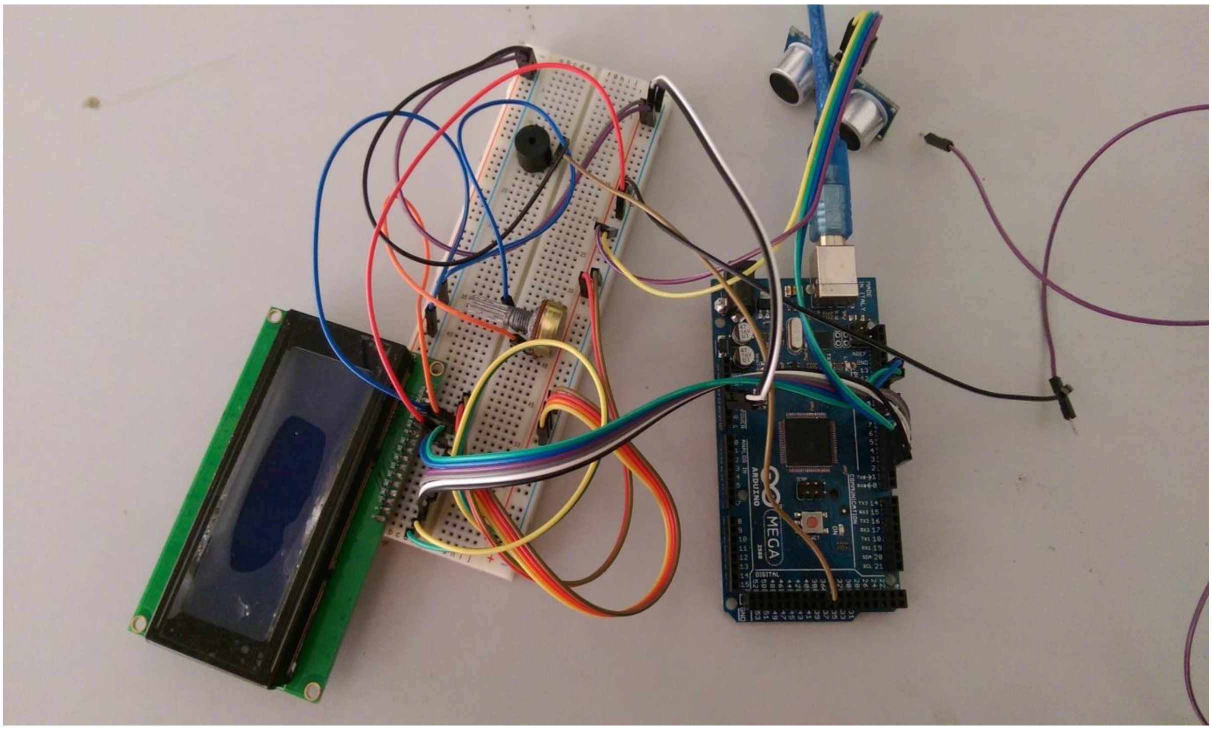


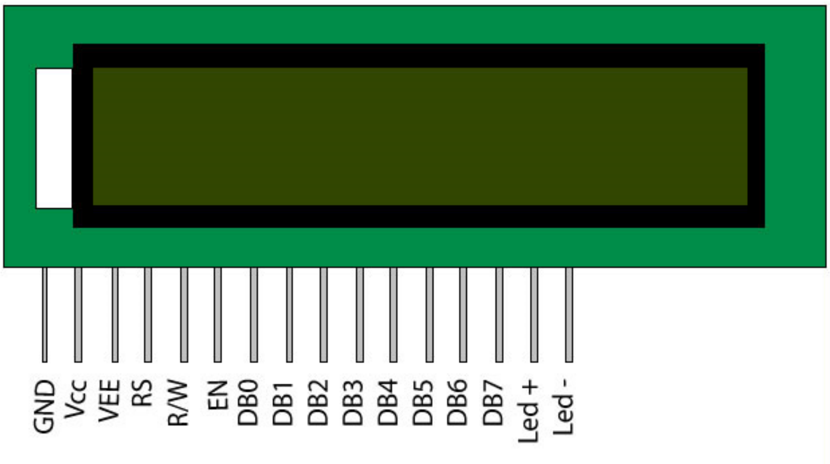
FIG 1.4: ARDUINO WITH LCD AND BUZZER

2.3 LCD:

There are twelve pins. The pins functions are described below:

Pin No.	Function	Name
1	Ground (0V)	Ground
2	Supply voltage; 5V (4.7V – 5.3V	VCC
3	Contrast adjustment; through a variable resistor	V_{EE}
4	Selects command register when low; and data register when high	Register Select
5	Low to write to the register; High to read from the register	Read/write
6	Sends data to data pins when a high to low pulse is given	Enable
7	8- bit data pins	DB0
8		DB1
9		DB2
10		DB3
11		DB4
12		DB5
13		DB6
14		DB7
15	Backlight VCC (5V)	Led+
16	Backlight Ground(0V)	Led-

The following figure shows the connection diagram:



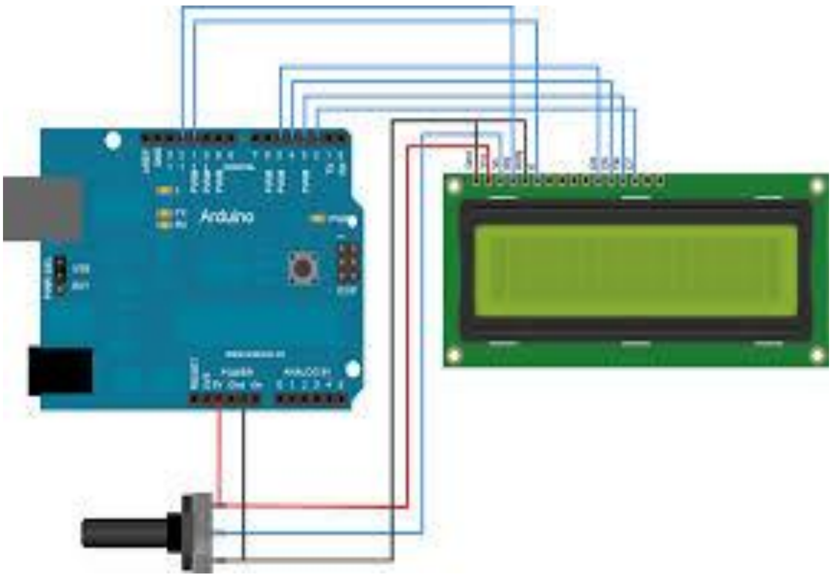


Fig 1.5 : Arduino pins connected with LCD

2.4 Motor Driver:

L293D is an H-bridge motor IC which can run two bi-directional motors at a time. The microcontroller produces a very low current when it provides signal to the motor driver. With this low current motor is unable to run. So, motor drivers act as current amplifiers and they provide a higher-current signal. This higher current signal is used to drive the motors.

L293D contains two inbuilt H-bridge driver circuits. In its common mode of operation, two DC motors can be driven simultaneously, both in forward and reverse direction. The motor operations of two motors can be controlled by input logic at pins 2 & 7 and 10 & 15. Input logic 00 or 11 will stop the corresponding motor. Logic 01 and 10 will rotate it in clockwise and anticlockwise directions, respectively.

Enable pins 1 and 9 (corresponding to the two motors) must be high for motors to start operating. When an enable input is high, the associated driver gets enabled. As a result, the outputs become active and work in phase with their inputs. Similarly, when the enable input is low, that driver is disabled, and their outputs are off and in the high-impedance state [3].

The following table shows the connection diagram:

Pin No	Function	Name
1	Enable pin for Motor 1; active high	Enable 1,2
2	Input 1 for Motor 1	Input 1
3	Output 1 for Motor 1	Output 1
4	Ground (0V)	Ground
5	Ground (0V)	Ground
6	Output 2 for Motor 1	Output 2
7	Input 2 for Motor 1	Input 2
8	Supply voltage for Motors; 9-12V (up to 36V)	$V_{cc\ 2}$
9	Enable pin for Motor 2; active high	Enable 3,4
10	Input 1 for Motor 1	Input 3
11	Output 1 for Motor 1	Output 3
12	Ground (0V)	Ground
13	Ground (0V)	Ground
14	Output 2 for Motor 1	Output 4
15	Input2 for Motor 1	Input 4
16	Supply voltage; 5V (up to 36V)	$V_{cc\ 1}$

The connection diagram of the Motor driver is can be seen from the following figure:

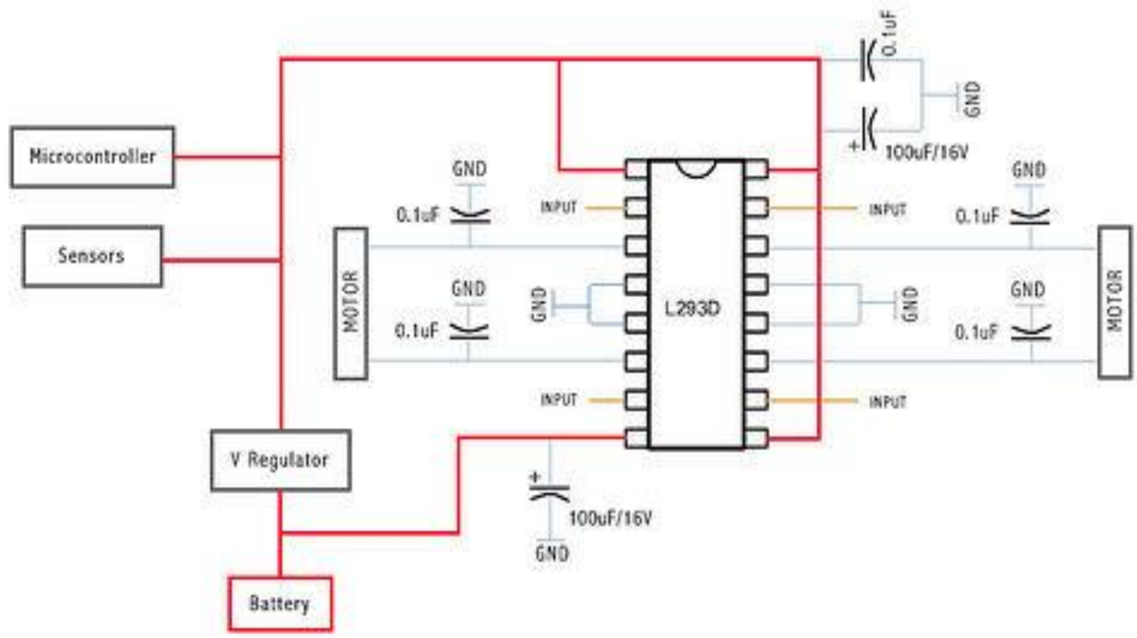


Fig 1.6: Circuit Diagram of motor driver

Base on the above connection diagram we have prepared an efficient motor driver: The following figure shows the driver:

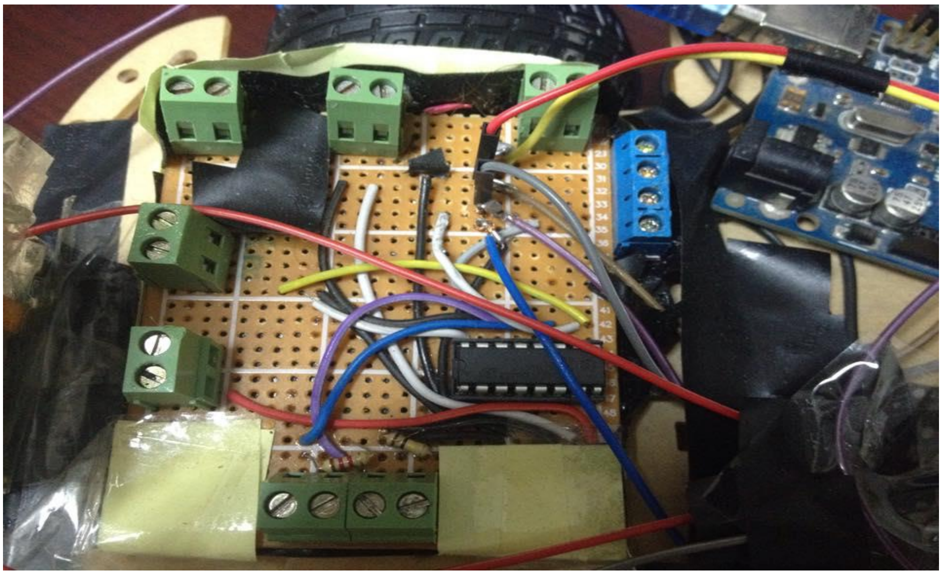


FIG 1.7 : PCB CIRCUIT WITH MOTOR DRIVER

2.5 INSTALLING the sonar sensors:

In this prototype two Sensors are installed in the two opposite sides of it. As described above the Trig and Echo pins are connected to the microcontroller and the VCC and ground pins are connected to 5v and ground respectively. The microcontroller is programmed to learn the between sending and coming back of the sound signal due to obstacle that makes the reflection happen. When the microcontroller knows the duration, it can convert the duration into distance. Picture below shows that--

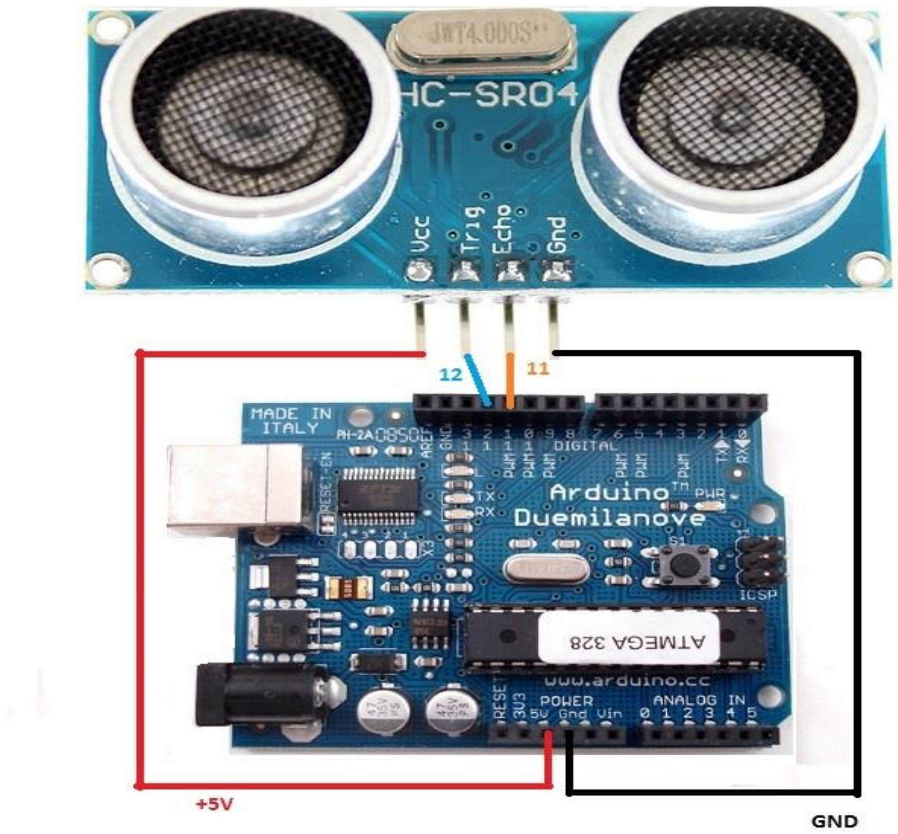


FIG 1.8: SENSOR PINS CONNECTED TO ARDUINO

2.6 MOUNTING the buzzer:

The buzzer is mounted on top of the prototype. On if its pin connected to the microcontroller. Whenever the pin is high the Buzzer beeps to alert the driver of a possible accident.

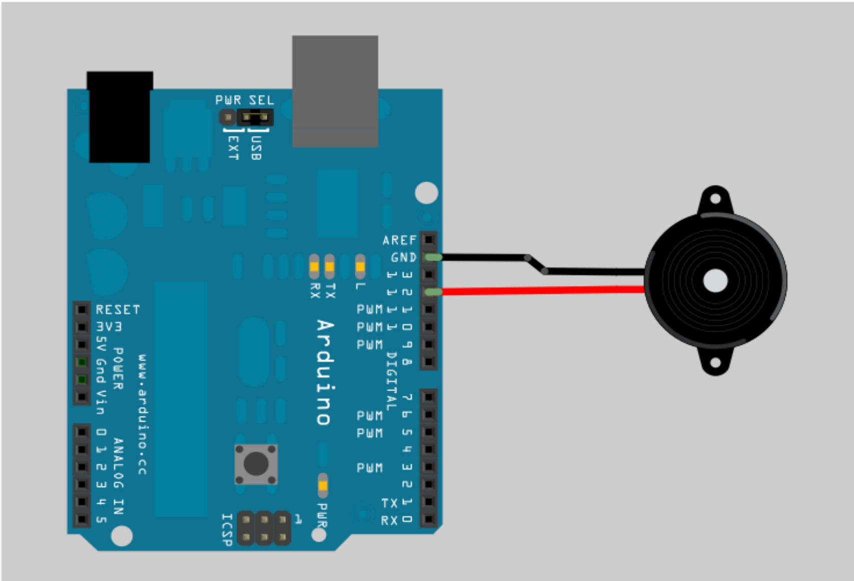


FIG 1.9 : BUZZER CONNECTED WITH ARDUINO

2.7 INSTALLING the LCD:

The LCD is installed in the prototype and connected to the micro-controller as described above. The LCD describes the situation and displays different alert signals i.e. “Emergency”, “Good to go” etc.

Fig 1.10 : LCD connected with Arduino

2.8 MOTOR Driver to Arduino:
The motor driver has six pins. Of all the pins two pins connect to Ground and VCC. The other pins are used to rotate the motor in specific direction.

Motor/Pin state	Pin1	Pin2	Pin3	Pin4	OUTPUT
Motor1	HIGH	LOW			FORWARD
Motor1	LOW	HIGH			REVERSE
Motor2			HIGH	LOW	FORWARD
MOTOR2			LOW	HIGH	REVERSE

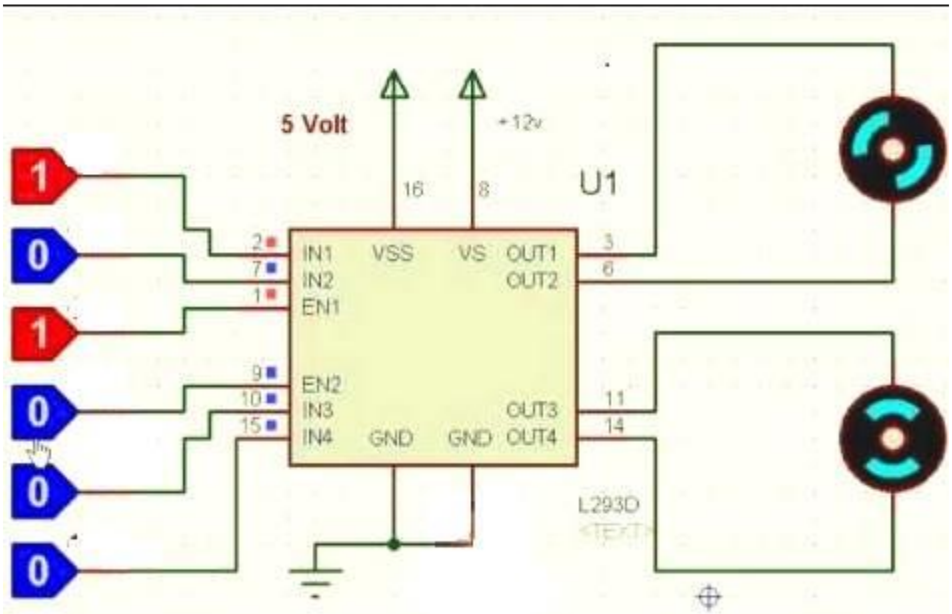


Fig 1.11 : Schemetics of motor driver L293D

2.9 COMPLETE System Algorithm:

Firstly, when the robot starts, it searches for obstacles. If there is an obstacle just in front of it then it does not move. If the road is clear it starts going forward while constantly checking for obstacles. While there is an obstacle it senses it and calculates the distance between them. At the same time the sensor in the opposite side also does the same thing. So, ultimately the robot searches for obstacles and when found it reduces its speed. When the distance is below the programmed data then the car sends alerts through Buzzer and LCD. Now if there are obstacles from both the sides then the robot vehicle compares which side is more close to the obstacle and after the calculations it responses with necessary speed changes at the forward or the reverse direction. Thus the robot avoids obstacle every time. The car is also intelligent to stop its speed automatically at the time of parking.

Flowchart showing complete algorithm:

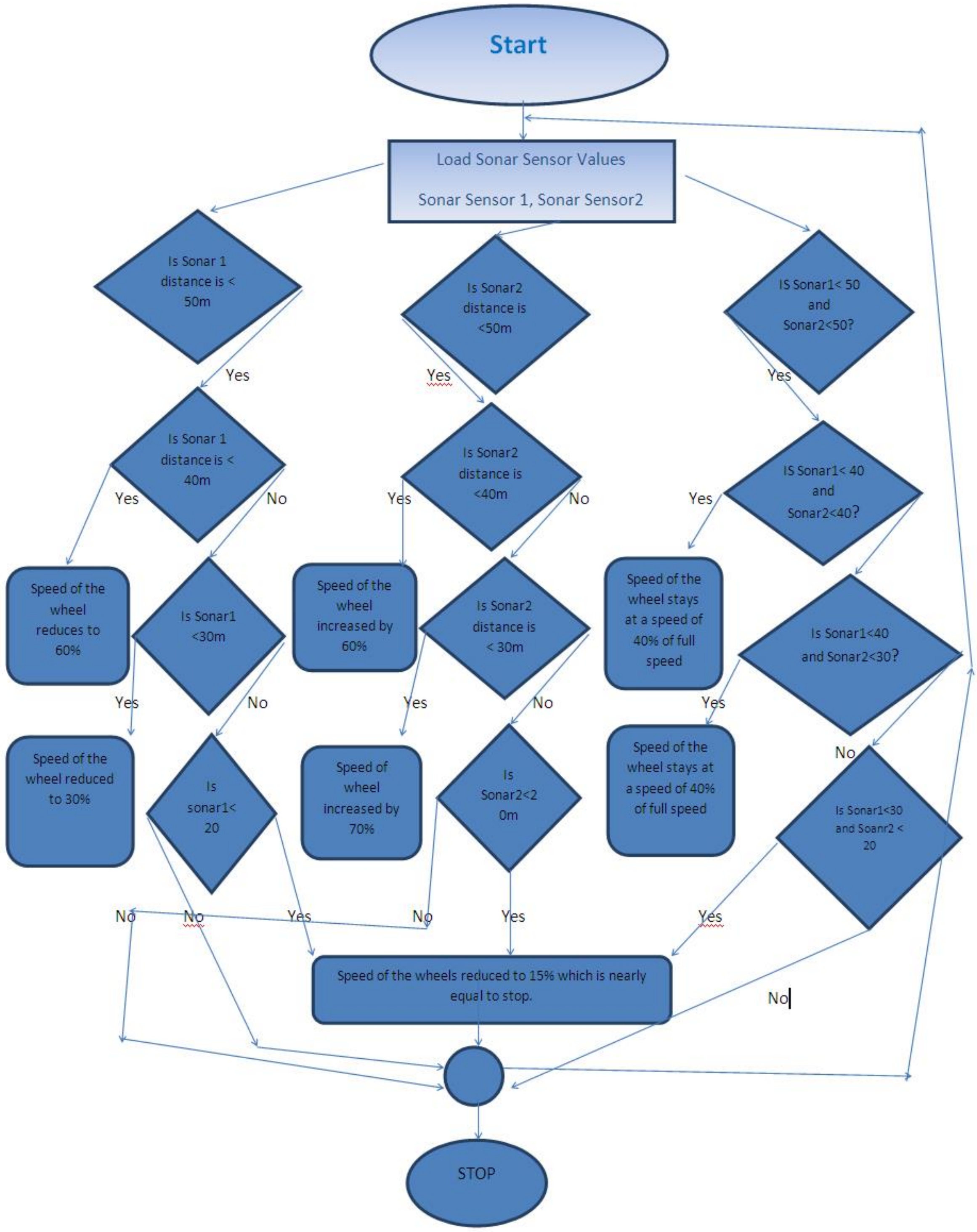
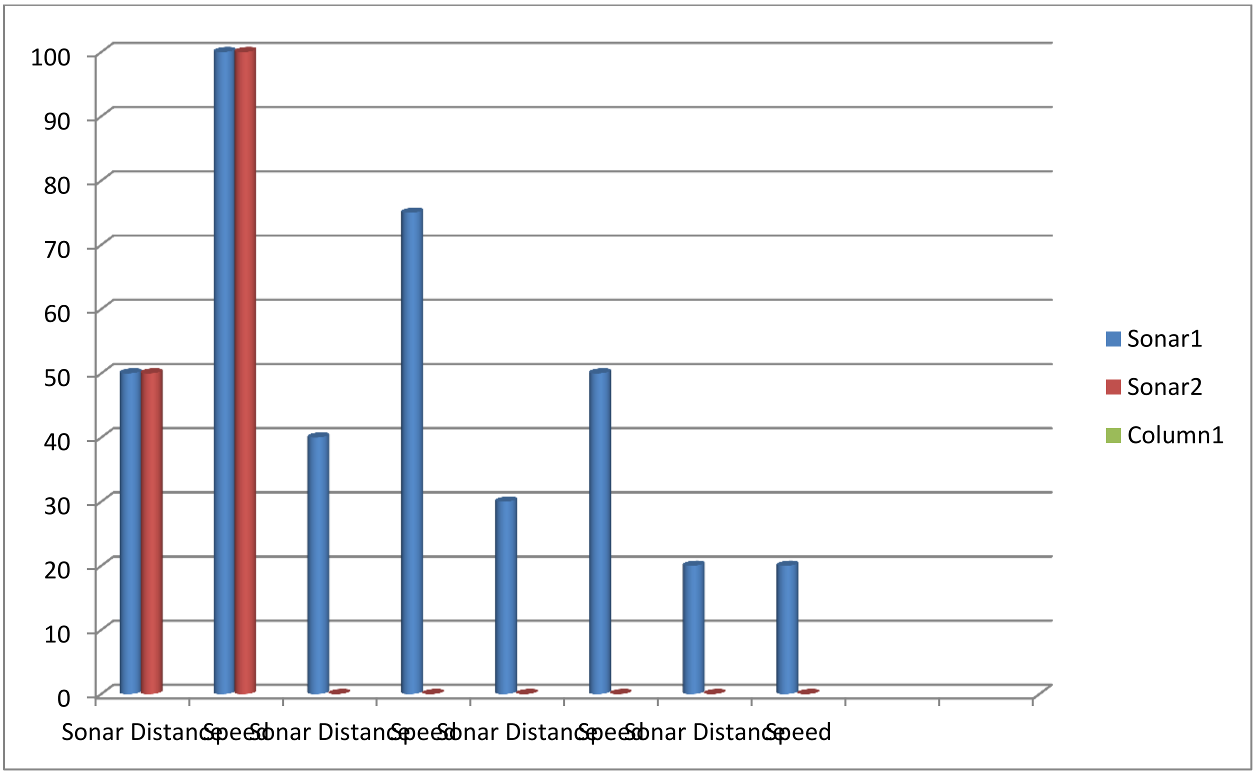


FIG 1.12: FLOW CHART OF OUR WHOLE SYSTEM

CHAPTER III

EXPERIMENT AND RESULT ANALYSIS

We have experimented on the robots and observed the efficiency. We set different obstacles at arbitrary times to observe its output pattern that is speed behavior. We have changed the obstacle block suddenly to observe sudden changes in the speed. Finally from the output of the speed behavior we prepared the following graphs:



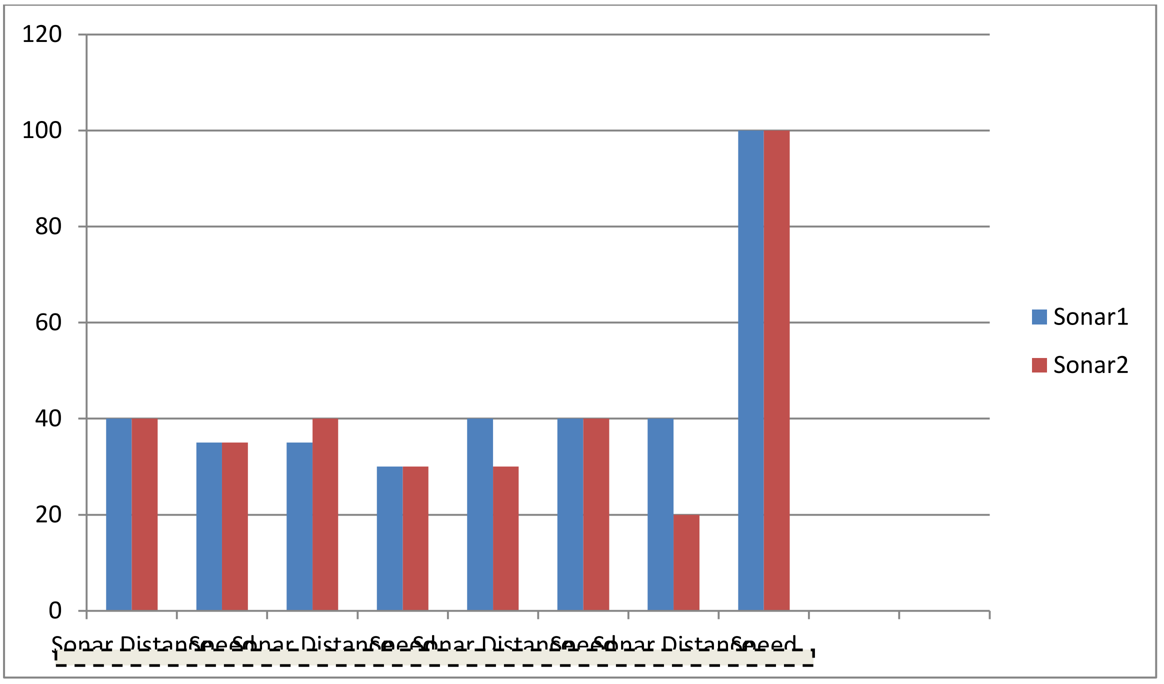


Fig. 1.13: Graphical analysis of the finding from the experiment

From the above graph we can see that with the changes of data from the sonar sensor the prototype changes its speed instantaneously. To our observation our original motto was successful. The prototype worked well but we think that implementing this in the practical vehicles may have some shortcomings. In that case the current algorithm has to be changed. The hardware can also be replaced based on the necessity.

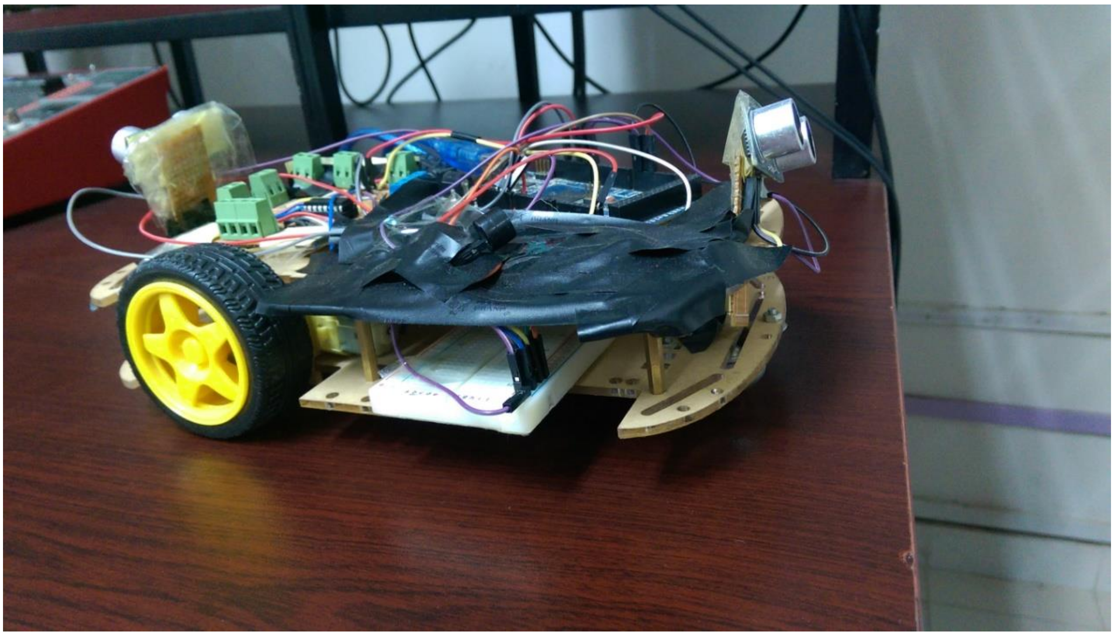


FIG 1.14: Our designed prototype robot vehicle (a)

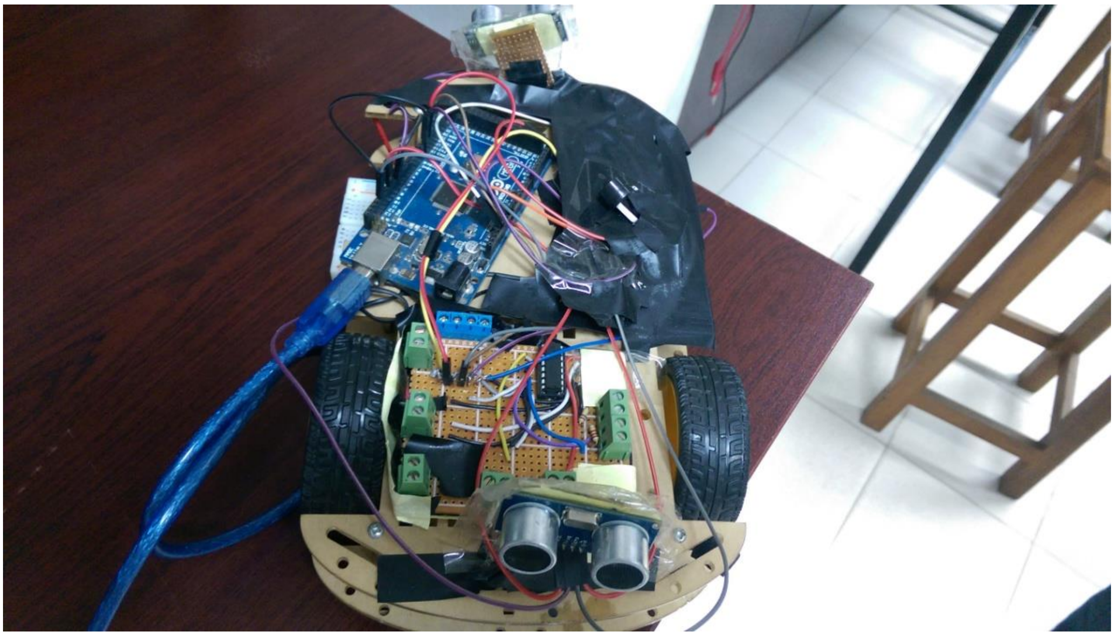


Fig 1.15: Our designed robot prototype vehicle (b)

CHAPTER IV

Future Plan :

So far we have been able to build a robot proto type vehicle to avoid accident for front side and back side. Our main idea is to have protection from all side. If there comes an object from left side, the car will automatically move to the right side and the object comes from the right side, the object will automatically move to the left side. For further implementation in future to use in real car and to detect long distance for the big cars, we will use radar. There should be a switch to ON and OFF this software for parking system . Since Bangladesh is an over dense country most of the accident occurs here because the drivers can not control their speed during traffic jam and cause small accidents and even leads to the huge accidents. We are even planning this to apply on a solar system car which will not be eco friendly but also will be a smart car for this generation.

CONCLUSION

Accident avoidance system is usually more complex than we have demonstrated. But the complex systems while providing with some advantages often costs high and needs delicate hardware. The system which we have introduced here is more than enough for avoiding usual situation. For different situation the design may prove a bit less useful but at the same time if we consider the trade off this system is very handy to set up and is very cheap compared to the tradition accident avoidance systems. We believe that with the improved set of algorithm and hardware implementation this system may prove blessings for mass people who do not afford to buy automatic vehicles.

Appendices

A. Programming code of Microcontroller:

The whole code has been burned into an Arduino board.

A.a Arduino:

Arduino is a family of single-board microcontrollers, intended to make it easy to build interactive objects or environments . The hardware consists of an open-source hardware board designed based on an 8-bit Atmel AVR microcontroller or a 32-bit Atmel ARM. The systems provide sets of digital and analog I/O pins that can be interfaced to various extension boards and other circuits. Some models feature a USB interface for loading code from personal computers [3].

The first Arduino was introduced in 2005. Its designers sought to provide an inexpensive and easy way for hobbyists, students, and professionals to create devices that interact with their environment using sensors and actuators [51]. Common examples for beginner hobbyists include simple robots, thermostats and motion detectors. Arduino boards come with a simple integrated development environment (IDE) that runs on regular personal computers and allows users to write programs for Arduino using C or C++ [3].

Arduino boards can be purchased assembled or as do-it-yourself kits. Hardware design information is available for those who would like to assemble an Arduino by hand [3].

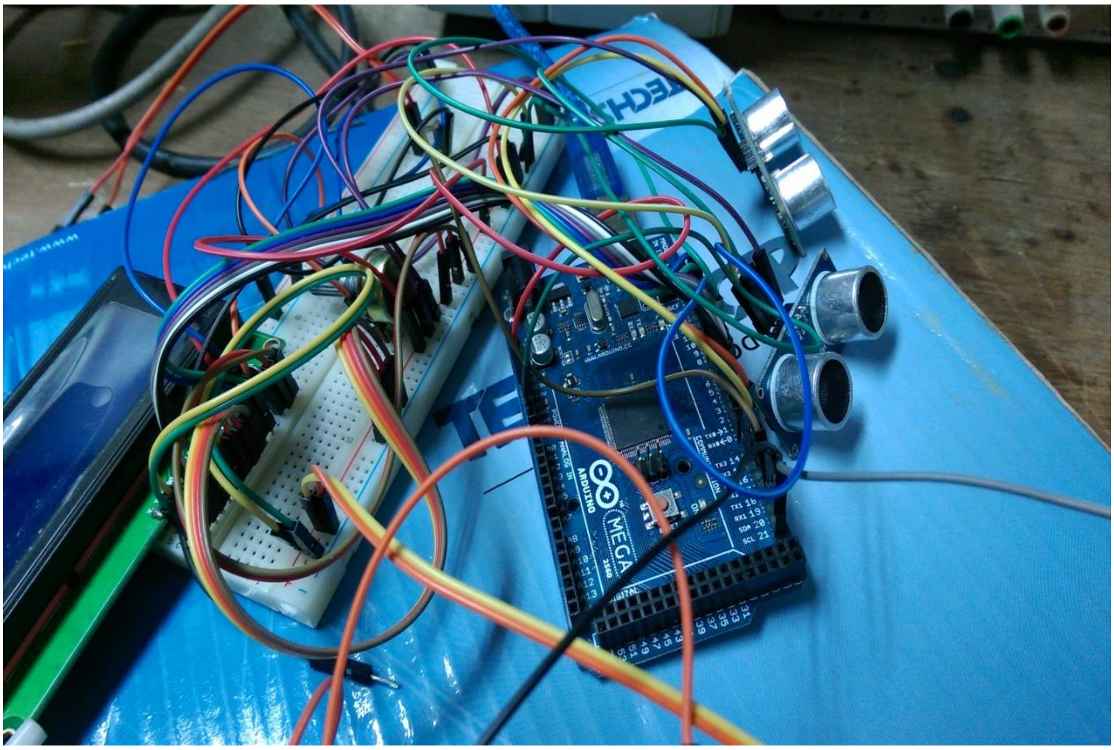


Fig 1.16: Arduino interfaced with LCD and sonar

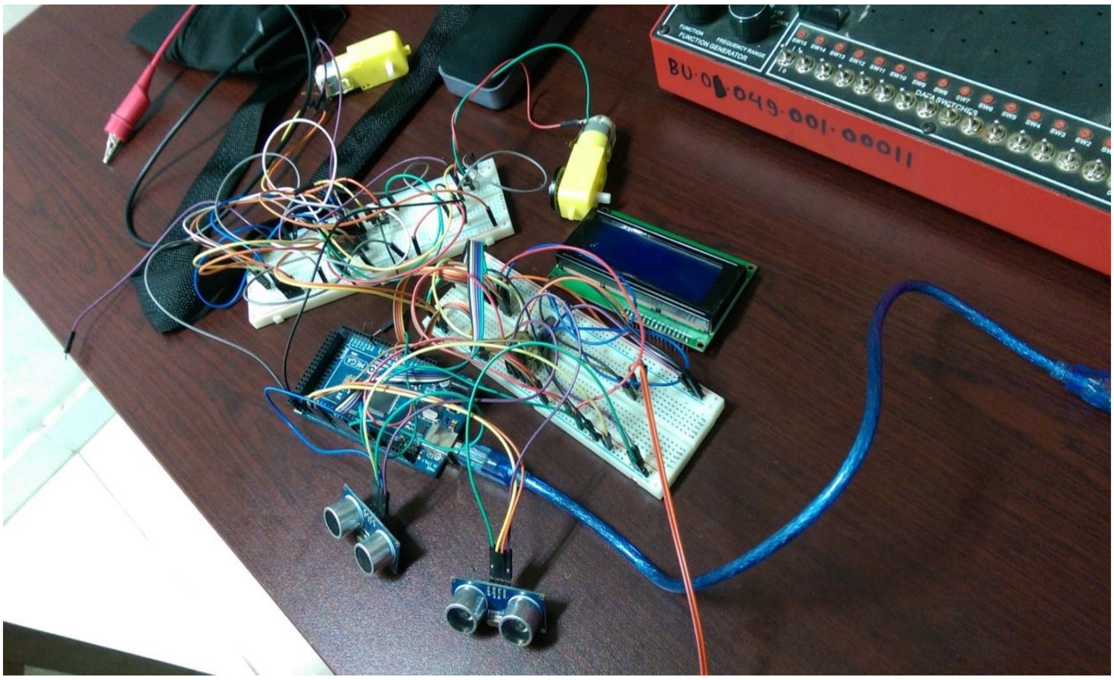


Fig 1.17: Arduino mega connecting with sonar, LCD and motor driver L293D.

B. Arduino IDE code:

B.a Arduino code::

```
#include <LiquidCrystal.h>
LiquidCrystal lcd(12, 11, 5, 4, 3, 2);
#define sonarTrig1 8
#define sonarEcho1 7
#define sonarTrig2 14
#define sonarEcho2 15
#define dir1 16
#define dir2 17
#define Motor1 10
#define Motor2 13
#define buzzer 36
void setup() {
  // put your setup code here, to run once:
   lcd.begin(20, 4);
  lcd.noCursor();
  lcd.noBlink();
 Serial.begin(9600);

  pinMode(sonarTrig1, OUTPUT);
  pinMode(sonarEcho1, INPUT);
  pinMode(dir1, OUTPUT);
  pinMode(dir2, OUTPUT);
  pinMode(sonarTrig2, OUTPUT);
  pinMode(sonarEcho2, INPUT);
  pinMode(Motor1,OUTPUT);
  pinMode(Motor2,OUTPUT);
}


void loop() {
  // put your main code here, to run repeatedly:

         int volt1;
         int volt2;
        int sonar1=getDistance1();
        int sonar2=getDistance2();

            volt1=sonar1*2;
```

```
            //analogWrite(newVoltA0,volt);
            //int temp=analogRead(newVoltA0);

            volt1= map(volt1, 0, 1023, 0, 255);

             volt2=sonar2*2;
            //analogWrite(newVoltA0,volt);
            //int temp=analogRead(newVoltA0);

            volt2= map(volt2, 0, 1023, 0, 255);


        if (50<sonar1<=40) {


            Serial.println((String)"Distance of sonar1:"+sonar1+" cm
"+"Voltage:"+volt1+" v");
        digitalWrite(Motor1,HIGH);
        digitalWrite(dir1,LOW);
        digitalWrite(Motor2,HIGH);
        digitalWrite(dir2,LOW);

         Serial.println("print motor");


      if (40<sonar1<=30) {


            Serial.println((String)"Distance of sonar1:"+sonar1+" cm
"+"Voltage:"+volt1+" v");
       analogWrite( Motor1, 175);
       digitalWrite(dir1,LOW);

     analogWrite( Motor2, 175);
     digitalWrite(dir2,LOW);

     Serial.println("hi");


       if (sonar1<30) {
         lcd.display();
            lcd.setCursor(1, 2);
```

```
        lcd.print("Emergency");
        digitalWrite(buzzer,HIGH);

        Serial.println((String)"Distance of sonar1:"+sonar1+" cm "+"Voltage:"+volt1+" v");
    analogWrite( Motor1, 50);
    digitalWrite(dir1,LOW);

   analogWrite( Motor2, 50);
   digitalWrite(dir2,LOW);

   Serial.println("Bye");


    }

      if ((50<sonar1<40)&&(sonar2<40)) {


      Serial.println((String)"Distance of sonar2:"+sonar2+" cm "+"Voltage:"+volt2+" v");
    analogWrite( Motor1, 175);
    digitalWrite(dir1,LOW);

   analogWrite( Motor2, 175);
   digitalWrite(dir2,LOW);

   Serial.println("hi");



   if ((50<sonar1<40)&&(sonar2<30)) {

       lcd.display();
        lcd.setCursor(1, 2);
        lcd.print("Emergency");
        digitalWrite(buzzer,HIGH);


        analogWrite( Motor1, 130);
        digitalWrite(dir1,LOW);
```

```
analogWrite( Motor2, 130);
digitalWrite(dir2,LOW);

Serial.println("hi");


        if ((sonar1<50)&&(sonar2<40)) {


      Serial.println((String)"Distance of sonar2:"+sonar2+" cm "+"Voltage:"+volt2+" v");
  analogWrite( Motor1, 100);
  digitalWrite(dir1,LOW);

analogWrite( Motor2, 100);
digitalWrite(dir2,LOW);

Serial.println("hi");


        if ((50<sonar1<40)&&(sonar2<30)){

      Serial.println((String)"Distance of sonar2:"+sonar2+" cm "+"Voltage:"+volt2+" v");
  analogWrite( Motor1, 75);
  digitalWrite(dir1,LOW);

analogWrite( Motor2, 75);
digitalWrite(dir2,LOW);

Serial.println("hi");



        }

    }

}
    }
  }
    }
}
```

```
int getDistance1()
{

  long duration1,distance1;
  digitalWrite(sonarTrig1,LOW);
  delayMicroseconds(2);
  digitalWrite(sonarTrig1,HIGH);
  delayMicroseconds(50);
  digitalWrite(sonarTrig1,LOW);

  duration1=pulseIn(sonarEcho1,HIGH);
  distance1=(duration1/2)/29.1;
  return distance1;



}
int getDistance2() {
{

  long duration2,distance2;
  digitalWrite(sonarTrig2,LOW);
  delayMicroseconds(2);
  digitalWrite(sonarTrig2,HIGH);
  delayMicroseconds(50);
  digitalWrite(sonarTrig2,LOW);

  duration2=pulseIn(sonarEcho2,HIGH);
  distance2=(duration2/2)/29.1;
  return distance2;
}
}
```

LIST OF REFERENCES

[1] INVESTIGATION OF LASER AND ULTRASONIC RANGING SENSORS FOR MEASUREMENTS OF CITRUS CANOPY VOLUME S. D. Tumbo, M. Salyani, J. D. Whitney, T. A. Wheaton, W. M. Miller

[2] Experimental Characterization of Polaroid Ultrasonic Sensors in Single and Phased Array Configuration Alex Cao* and Johann Borenstein** The University of Michigan, Department of Mechanical Engineering

[3] Cognitive efficiency in robot control by Emotiv EPOC
Chowdhury, P. ; Sch. of Eng. & Comput. Sci., BRAC Univ., Dhaka, Bangladesh ; Kibria Shakim, S.S. ; Karim, M.R. ; Rhaman, M.K.

[4] Agricultural Machinery Safety Alert System Using Ultrasonic Sensors L. Guo, Q. Zhang, S. Han [5] T. Yagi, Y. Kuno, Y. Uchikawa, “Prediction of eye movements from EEG,” Proceedings of the 6th International Conference on Neural Information Processing (ICONIP’99), Perth Austria, 16-20, pp. 1127-1131, Nov 1999.

[6] Global Integration of Ultrasonic Sensors Information in Mobile Robot Localization L. Moreno, J. M. Armingol, A. de la Escalera and M. A. Salichs Universidad Carlos III de Madrid, Division of Systems Engineering and Automation.

[7] Analysis of Vehicle Detection with WSN-Based Ultrasonic Sensors
Youngtae Jo and Inbum Jung * Department of Computer Information and Communication Engineering, Kangwon National University, Chuncheon, Gangwondo 200-701, Korea, *sensors ISSN 1424-8220*

[8] http://www.engineersgarage.com/electronic-components/16x2-lcd-module-datasheet [last visited 1-04-2015]

[9 http://www.ti.com/lit/ds/symlink/l293.pdf36, Issue 2, Part 1, pages 2352-2359, Mar2009. [last visited on 4-04-2015]

[10] http://www.instructables.com/id/Easy-ultrasonic-4-pin-sensor-monitoring-hc-sr04/?ALLSTEPS [last visited on 5-04-2015]