Cooch Behar Government Engineering College

“OBSTACLE DETECTION AND SPEED CONTROL OF VEHICLES IN MOTION”

Project Report Submitted in partial fulfilment of the requirements for the degree of Bachelor of Technology from Maulana Abul Kalam Azad University of Technology, West Bengal.
(Formerly known as West Bengal University of Technology)

Submitted By-

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Under the Supervision
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CERTIFICATE OF RECOMMENDATION

It is hereby recommended to consider the project report entitled "**OBSTACLE DETECTION AND SPEED CONTROL OF VEHICLES IN MOTION**" submitted by-

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for partial fulfilment of the requirements for the award of the degree of Bachelor of Technology in Electrical Engineering from Maulana Abul Kalam Azad University of Technology (formerly known as West Bengal University of Technology).

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Board of Examiners

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ABSTRACT

The primary object of this project is to detect any obstacle in front of any moving vehicle and controlling the speed in the critical zone. Various electronic as well as electrical equipments have been used in order to give the demo model the desired success.

The equipments are assembled according to the circuit diagram and the final model is prepared. The Ultrasonic sensor used in the circuit detects the distance of the obstacle ahead of the vehicle from itself and provides signal to the Arduino microcontroller. The program provided to the Arduino board plays the most crucial role in this project. All the logical expressions are kept in the program and all the specific functions of the equipments are controlled through the Arduino digital as well as analog outputs.

The motor driver plays an important role in controlling the speed of the motors according to the distances provided in the Arduino code. The zones are divided into three categories, viz. ‘Safe zone’, ‘Warning Zone’, ‘Critical Zone’, ‘Power off zone’. The main operation of the project includes warning the driver through a beeping alarm when the obstacle is in a safe distance; when the obstacle falls under the critical zone, warning the driver though continuous alarm and reducing the speed as well, and finally turning the power off when the obstacle comes exactly in front of the vehicle.

ACCIDENT AVOIDANCE THROUGH OBSTACLE DETECTION AND SPEED CONTROL OF VEHICLE IN MOTION

Chapter 01: Introduction:

PROJECT OVERVIEW

Various studies worldwide have concluded that numerous fatal accidents happen due to the inattentiveness of the driver. The reasons behind these are manifold, such as, 'Usage of mobile phones', 'Dizziness of the driver', etc. In most of the cases the accidents become fatal.

In this particular project, an attempt has been made in order to solve this problem by detecting the obstacle ahead from a safe distance, and reducing the speed to a certain extent so that the collision can be avoided or at least reducing the fatality. The distance is measured by the ultrasonic sensor mounted at the front-head of the demo car and the exact distance measured by itself is displayed in a display mounted on the same.

The Arduino UNO R3 microcontroller board is used to operate the digital as well as analog functions as required. The microcontroller controls the speed of the motors used through the digital outputs provided to the motor drivers.

The motor drivers will control the speed when required and thus, the speed of the car is reduced as per the given distance.

As the range of the ultrasonic sensor is too short to apply it in the real-life scenario, a different sensor, capable of executing the aforesaid operation can be used there. In order to make the project convenient as well as low in cost, the ultrasonic sensor has been used in the project environment.

AIM & OBJECTIVE

In order to detect the obstacle in front of a car in motion from a safe distance and reduce the speed to a certain extent, and send an alarm to the driver when the distance becomes critical.

Chapter 02: Literature Review:

As per the views of Barrett, 2013, the microcontrollers play an amazing role in robotics as well as electronic automation. The automation industry has been growing rapidly by the virtue of the microcontrollers similar to the Arduino UNO R3. The Arduino UNO R3 microcontroller board is, much popular among its peers due to the ease of availability, low cost, and many other benefits.

In the opinion of Gabriel *et al*., 2020, in the case of robotics the Arduino board, the ultrasonic sensor and the lcd combo has a huge potential. The input gained from the sensor works as the most valuable input for the Arduino board, and the distance can be shown in the display through the program written in the Arduino IDE.

The speed of the motor can be controlled through the motor drive as programmed in the Arduino IDE. In both the cases of Brushless DC motor as well as conventional motors the speed can be controlled. According to Gamazo-Real *et al.,* 2010, the speed of DC motors can be controlled through the digital signals from the Arduino board with the help of motor drivers.

In the views of Kut ai, 2020, the LED displays are crucial parts of robotics. The result of detection in all the cases, can be presented through the display.

The road accidents can be reduced through the detection of the obstacles ahead of it, and through the speed control of the motors in terms of Electric Vehicles. EV is the future and various new innovative operations can be executed through the EV (Peerzada *et al.* 2021).

Chapter 03: Equipments and their explanation:

EQUIPMENTS USED

- Arduino UNO R3.
- L298N Motor Driver.
- Gear motors.
- HC-SR04 Ultrasonic sensor.
- 16 × 2 Liquid Crystal Display (LCD).
- Buzzer.
- Light Emitting Diodes (LED).
- Battery.
- Resistors.
- Breadboard.
- Jumper wires.
- Car wheels.

RESPECTIVE FUNCTIONS OF THE EQUIPMENTS

All the equipment has been selected keeping in mind the ease of access, the cost and the convenience in working.

1. ARDUINO UNO R3:

This particular equipment is the heart of the project. It has certain particular sections in it, where multiple pins and other electronic equipment are set. The sections are as follows:

- Power section.
- Analog input section.
- Digital input/output section.
- Other equipments.

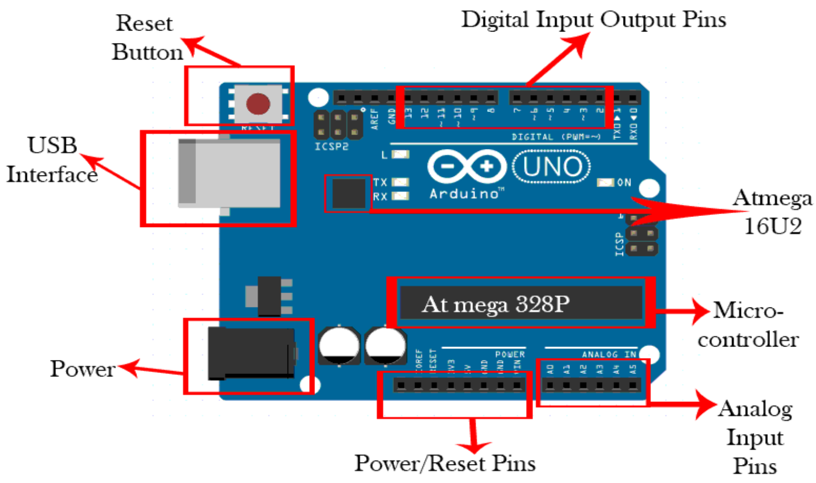

Fig 01: The different sections of the Arduino UNO R3 module.

Source: https://circuitfever.com

The Power section has one V_{in} pin, two Ground pins, one +5V pin, and one +3.3V pin. The Analog input section has six pins ranging from A_0 to A_5. The Digital input/output section has in total 16 pins out of which 6 pins can be used as Pulse Width Modulation (PWM) outputs.

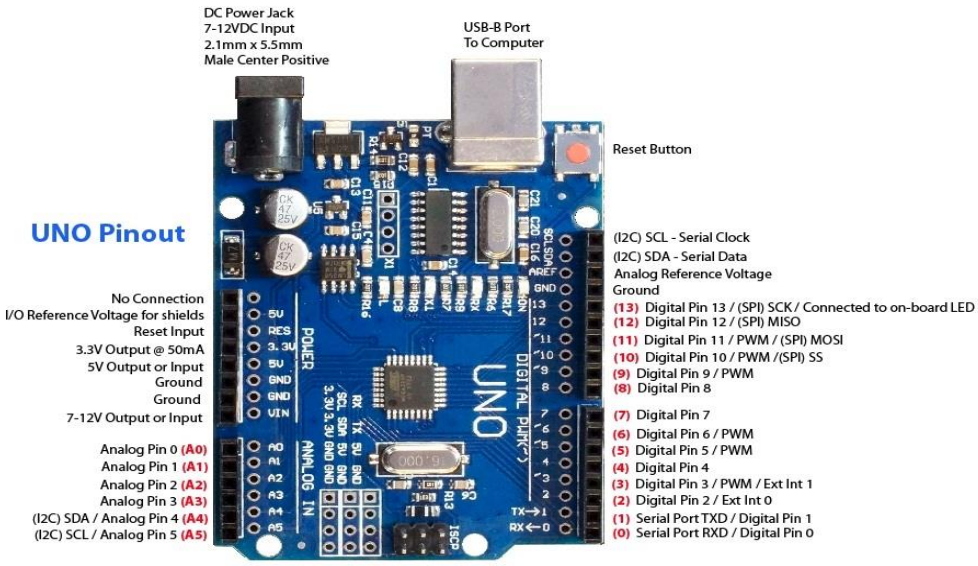

Fig 02: The detailed representation of all the pins.

Source: https://www.sunrobotics.in/shop

The other equipment includes a 16MHz ceramic resonator that generates the ATmega328P's clock signal; a USB connection that is primarily used to upload the code to the Arduino UNO module, but it acts as the power source too, in some cases, when no other power sources aren’t available; and some other essential equipment like a power jack, an ICSP header and a reset button, all of which have their respective functions.

Out of the 16 digital output pins, the pin no. 13 can be used as the built-in LED pin. The input/output voltage of the Arduino UNO module is +5V, whereas, the nominal input voltage through the barrel plug ranges between +7V to +12V. The DC current per input/output pin is 20mA.

The schematic diagram of the Arduino UNO R3 module is as shown in the figure below:

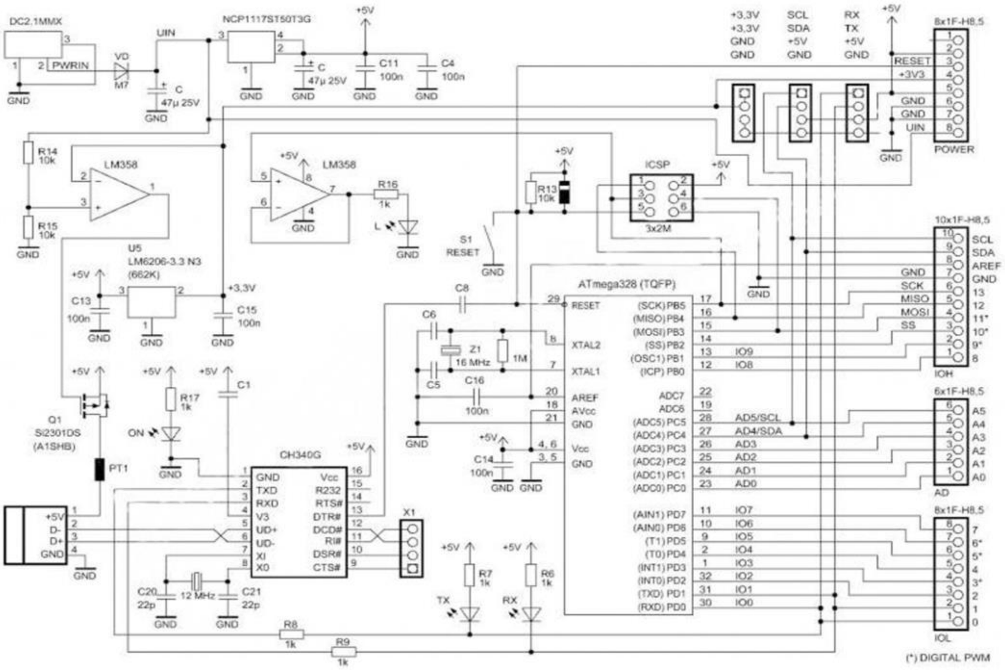

Fig 03: The different sections of the Arduino UNO R3 module.

Source: https://electronoobs.com

Why specifically UNO R3 is used amongst all other versions of the Arduino module?

There are numerous versions of the Arduino board available in the market. Some of those are enlisted below:

- Arduino Uno (R3).
- Arduino Nano.
- Arduino Micro.
- Arduino Due.
- Arduino Mega (R3) Board.
- Arduino Zero.

The reasons behind selecting the Arduino UNO R3 model in this project are as follows:

- ❖ Compatibility over other models.
- ❖ Light architecture and less interface.
- ❖ Lack of the need of higher GPIO as well as a stronger CPU over others.
- ❖ Ease of performing desktop prototyping.
- ❖ Being cheaper in cost.

2. L298N MOTOR DRIVER:

If the Arduino board is treated as the heart of this project, the L298N motor driver is no less than the backbone of the same. The main objective of reducing the speed of the motors through the digital output signals passed by the Arduino board is done with the help of this driver.

A motor is an electronic device that helps convert electrical energy into mechanical energy. Therefore, a motor driver allows one to conduct automatic work using electrical power. Choosing the correct type of motor driver is essential because it allows your engine to work efficiently with the microcontroller of the users' choice.

The different parts of the driver include:

- Power section.
- Input and Enable section.
- Output section.

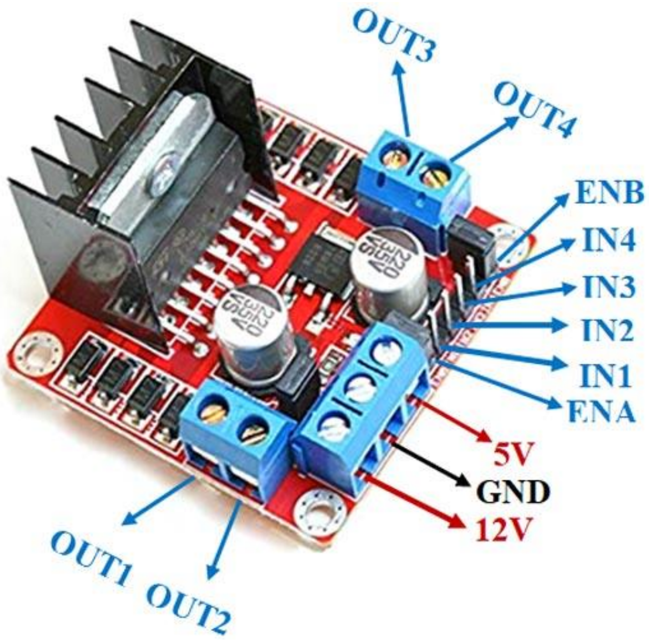

Fig 04: The different parts of the L298N motor driver.

Source: https://components101.com

The power section of the driver has three pins, the +12V pin, the GND pin, and the +5V pin. The digital input section has six pins in total, out of which two are enable pins, marked as ENA and ENB, and the rest of four are the digital input pins, ranging from IN1 to IN4.

The signals are provided through the PWM pins of the Arduino board to the input pins of the driver which eventually controls the speed as well as the direction of the motors. Whereas, the enable pins enable the PWM signals for the motors.

The +12V voltage is taken directly from the power source, and the +5V voltage supplies the required power to the internal circuits of the driver. The chip used in the driver is a Double H bridge chip. The maximum motor supply voltage and the maximum motor supply current are 46V and 2A respectively.

The schematic circuit diagram of the L298N motor driver is as follows:

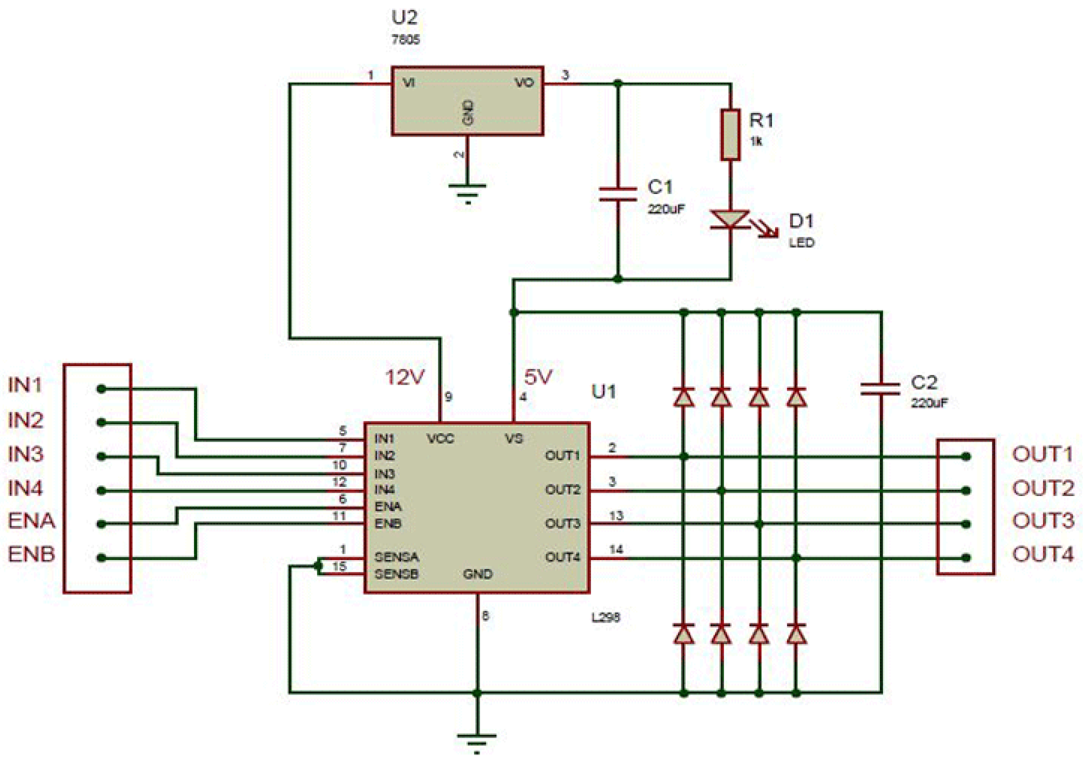

Fig 05: The schematic diagram of the L298N motor driver.

Source: https://components101.com

Why is the L298N driver given preference here over other drivers?

There are numerous motor drivers present in the market that do the job effortlessly. But specifically, the said driver is used in this project for some special reasons. Some of those are mentioned below:

- Maximum supply voltage 46V.
- Maximum output DC current 4A.

- Low saturation voltage.
- Over-temperature protection.
- Logical “0” Input Voltage up to 1.5 V.

3. Gear Motors:

A gear motor is an all-in-one combination of a motor and gearbox. The addition of a gear head to a motor reduces the speed while increasing the torque output. The most important parameters in regards to gear motors are speed (rpm), torque (lb-in) and efficiency (%).

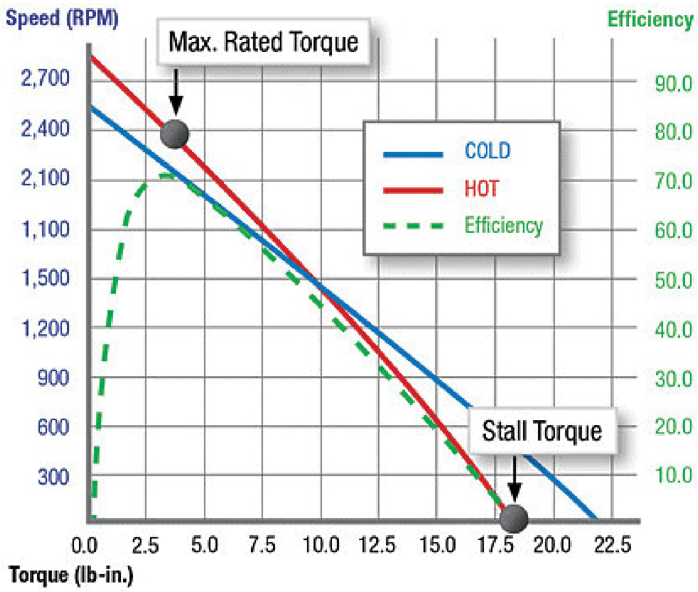

Fig 06: The performance curve of the DC Gear motor.

Source: https://islproducts.com/design-note

The Gear motors can be of various types, such as-

- Brushed gear motor.
- Brushless gear motor.
- Planetary gear motors.
- Stepper gear motors.
- Servo gear motors.

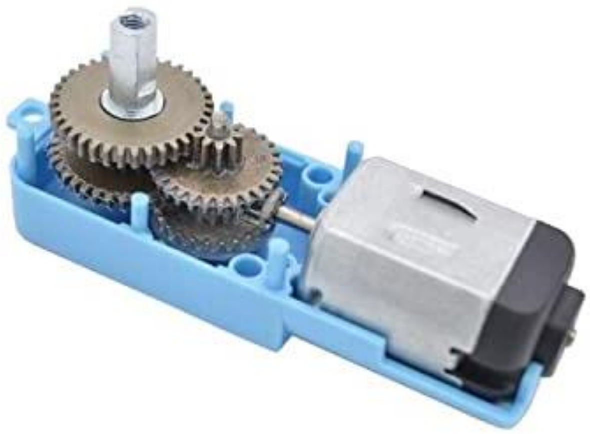

Fig 07: The internal structure of a DC Gear motor.

Source: https://www.ubuy.co.in/product

Working principle of DC Gear motors:

A gear motor develops torque due to hydraulic pressure acting against the area of one tooth. There are two teeth trying to move the rotor in the proper direction, while one net tooth at the centre mesh tries to move it in the opposite direction. In the design of a gear motor, one of the gears is keyed to an output shaft, while the other is simply an idler gear. Pressurised oil is sent to the inlet port of the motor.

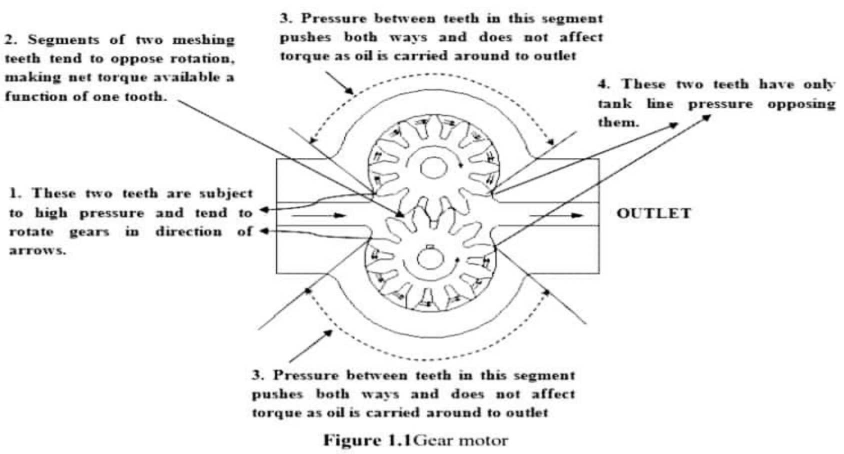

Fig 08: The schematic diagram of the different parts of the DC Gear motor.

Source: https://learnmech.com

Instead of using a normal conventional DC motor, in this project the gear motors have been used, so that the speed of the same can be controlled through the PWM signals effortlessly. In the case of normal DC motors, the momentum could generate unnecessary hurdles while controlling the speed that won't be in this case.

4. **HC-SR04 Ultrasonic Sensor:**

Just like the Arduino UNO R3 and the L298N motor driver, the Ultrasonic sensor is another most important piece of equipment in this project.

What is Ultrasound?

Ultrasound is high-pitched sound waves with frequencies higher than the audible limit of human hearing.

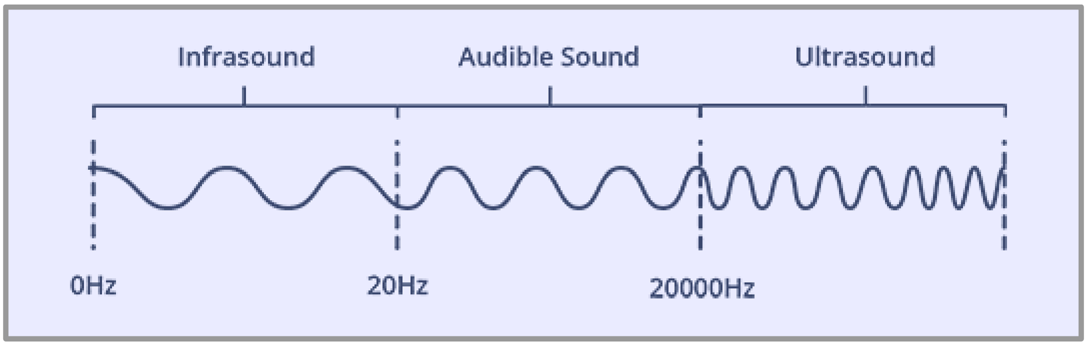

Fig 09: The range of the Ultrasound.

Source: https://lastminuteengineers.com

Human ears can hear sound waves that vibrate in the range from about 20 times a second (a deep rumbling noise) to about 20,000 times a second (a high-pitched whistling). However, ultrasound has a frequency of over 20,000 Hz and is therefore inaudible to humans.

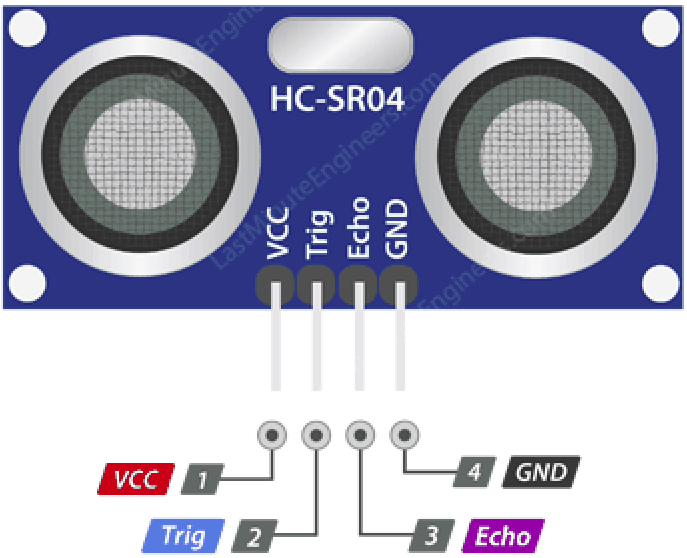

Fig 10: The pin configuration of the HC-SR04 Ultrasonic sensor.

Source: https://lastminuteengineers.com

At its core, the HC-SR04 Ultrasonic distance sensor consists of two ultrasonic transducers. The one acts as a transmitter which converts electrical signals into 40 KHz ultrasonic sound pulses. The receiver listens for the transmitted pulses. If it receives those it produces an output pulse whose width can be used to determine the distance the pulse travelled.

The sensor has the following specifications:

- Operating Voltage- DC 5V
- Operating Current- 15mA
- Operating Frequency- 40KHz
- Max Range- 4m
- Min Range- 2cm
- Ranging Accuracy- 3mm
- Measuring Angle- 15 degree
- Trigger Input Signal- 10µS TTL pulse
- Dimension- 45 x 20 x 15mm

Working principle of the HC-SR04 Ultrasonic sensor:

The ultrasonic sensor works on the principle of the SONAR and RADAR system which is used to determine the distance to an object.

An ultrasonic sensor generates the high-frequency sound (ultrasound) waves. When this ultrasound hits the object, it reflects as echo which is sensed by the receiver as shown in below figure.

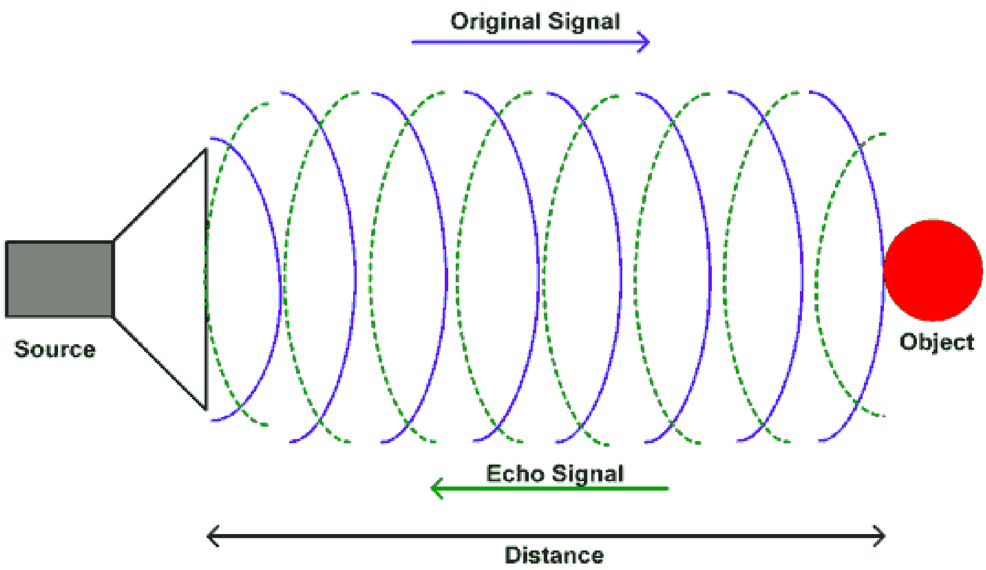

Fig 11: The working principle diagram of the ultrasonic sensor.

Source: https://www.electronicwings.com

In the ultrasonic module HCSR04, we have to give a trigger pulse, so that it will generate ultrasound of frequency 40 kHz. After generating ultrasound i.e., 8 pulses of 40 kHz, it makes the echo pin high. Echo pin remains high until it does not get the echo sound back. So, the width of the echo pin will be the time for sound to travel to the object and return back. Once we get the time we can calculate distance, as we know the speed of sound.

5. 16 × 2 Liquid Crystal Display (LCD):

The 16×2 LCD is named so because; it has 16 Columns and 2 Rows. There are a lot of combinations available like, 8×1, 8×2, 10×2, 16×1, etc. But the most used one is the 16×2 LCD, hence we are using it here. All the mentioned LCD displays will have 16 Pins and the programming approach is also the same.

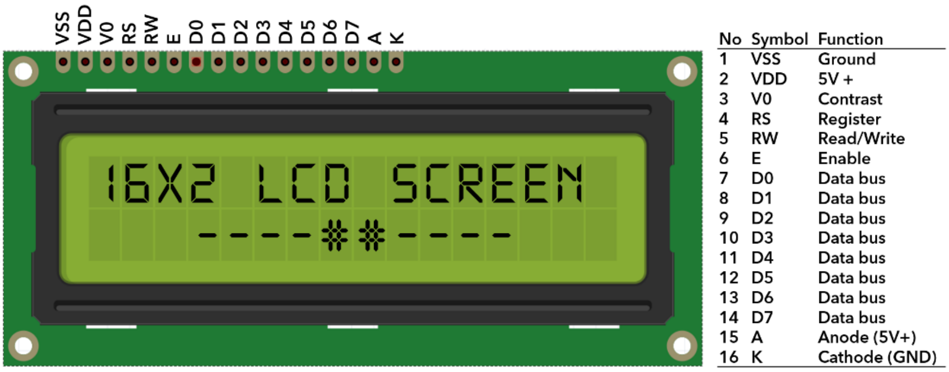

Fig 12: The 16×2 LCD with pin configuration.

Source: https://kut.ai/microcontrollers

The pin configuration of the 16×2 LCD in detail:

Pin No.	Pin Name	Pin Type	Description
1	VSS	Source	Ground pin of LCD
2	VCC	Source	Supply voltage pin
3	V_0/VEE	Control	Adjusts the contrast
4	Register Select (Rs)	Control	Data register
5	Read/Write (Rw)	Control	Read/Write operation
6	Enable (E)	Control	Always kept high to perform Read/Write operation

7 - 14	Data bits (0 -7)	Data/Command	Sending command or data
15	LED +ve	LED	Normal LED operation
16	LED -ve	LED	Normal LED operation

Table 01: The pin configuration of the 16×2 LCD screen.

6. Buzzer:

A buzzer is an audio-signal device**.** The main function of this is to convert the signal from audio to sound. Generally, it is powered through DC voltage and used in timers, alarm devices, printers, alarms, computers, etc. Based on the various designs, it can generate different sounds like alarm, music, bell & siren.

Fig 13: The pin configuration of a buzzer.

Source: https://www.elprocus.com

The pin configuration of the buzzer is shown above. It includes two pins namely positive and negative. The positive terminal of this is represented with the '+' symbol or a longer terminal. This terminal is powered through +5 Volts whereas the negative terminal is represented with the '-' symbol or short terminal and it is connected to the GND terminal.

The specifications of a buzzer are as follows:

- ❖ The frequency range is 3,300Hz
- ❖ Operating Temperature ranges from – 20° C to +60°C
- ❖ Operating voltage ranges from 3V to 24V DC
- ❖ The sound pressure level is 85dBA or 10cm
- ❖ The supply current is below 15mA

The internal configuration of a buzzer is shown in the diagram below:

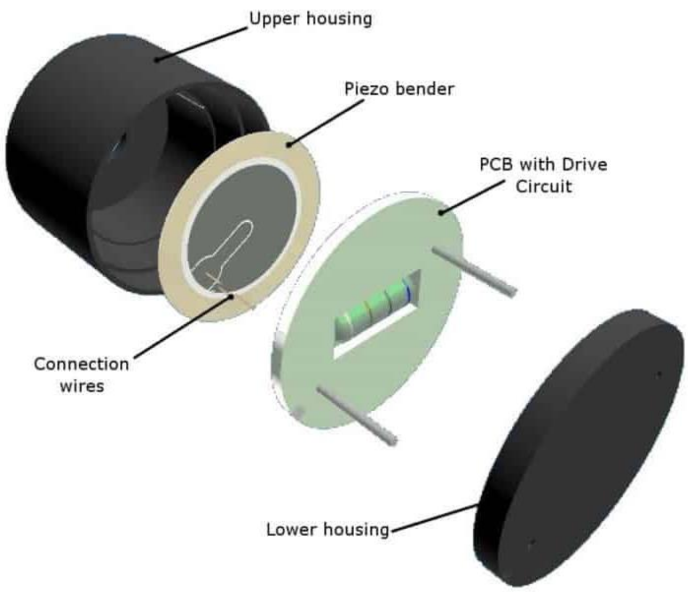

Fig 14: The internal configuration of a buzzer.

Source: https://islproducts.com

7. Light Emitting Diodes:

A light-emitting diode (LED) is a semiconductor device that emits light when an electric current flows through it. When current passes through an LED, the electrons recombine with holes emitting light in the process. LEDs allow the current to flow in the forward direction and block the current in the reverse direction.

Fig 15: The Light Emitting Diodes.

Source: https://www.electronicshub.org

The colour of an LED is determined by the material used in the semiconducting element. The two primary materials used in LEDs are aluminium gallium indium phosphide alloys and indium gallium nitride alloys. Aluminium alloys are used to obtain red, orange and yellow light, and indium alloys are used to get green, blue and white light. Slight changes in the composition of these alloys change the colour of the emitted light.

Three pairs of LEDs have been used in this project. Out of which one is Red, one is Yellow, the other is Green in colour.

8. <u>Battery:</u>

The battery is the primary power source in this project. Two 9v batteries are connected in series and a total of +18V is used in this project.

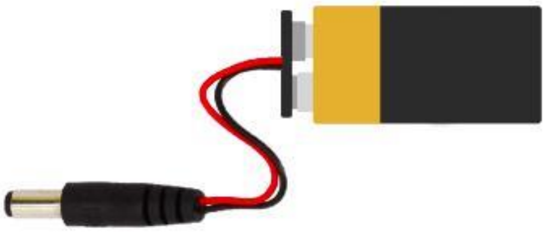

Fig 16: Battery along with the connector.

Source: Self-Created.

9. Resistors:

The resistors used in this project are basically to cut down the current supply to the LEDs. The rating of the LEDs used in this project is 1KΩ for each one of those.

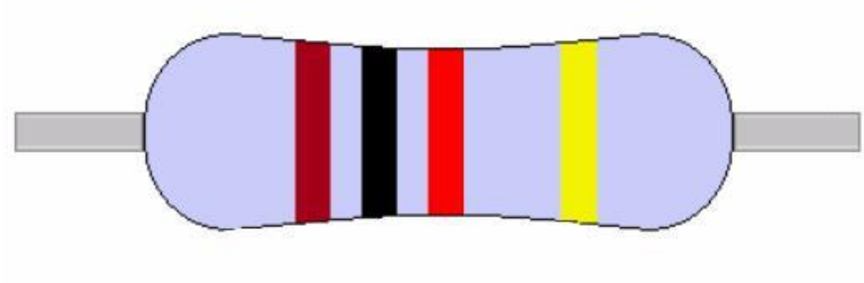

Fig 17: The colour representation of a 1KΩ resistor.

Source: Self-Created.

11. Jumper Wires:

A jumper wire (also known as jumper, jumper wire, DuPont wire) is an electrical wire, or group of them in a cable, with a connector or pin at each end (or sometimes without them - simply “tinned”).

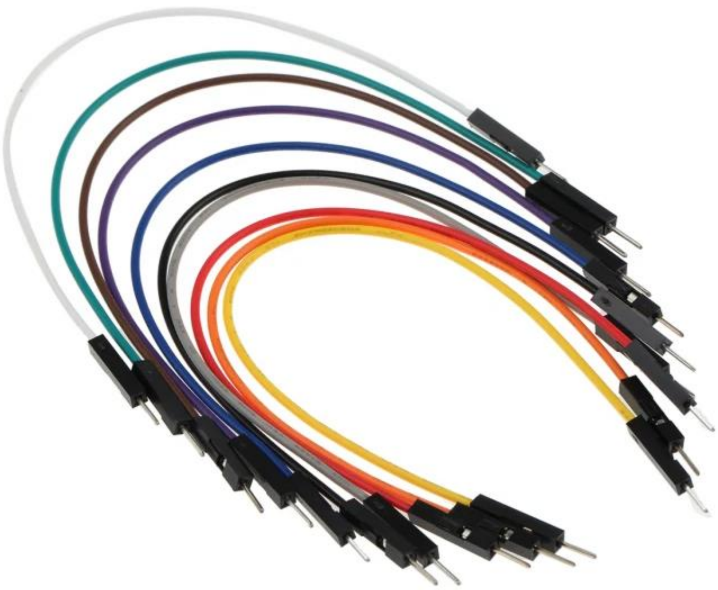

Fig 18: The different coloured jumper wires.

Source: https://export.rsdelivers.com/product

It is normally used to interconnect the components of a breadboard or other prototype or test circuit, internally or with other equipment or components, without soldering.

Chapter 04: Working principle of the project:

WORKING PRINCIPLE

The main objective of this project is to detect any obstacles in front of a moving car and warn the driver, and when the distance becomes critical, reducing the speed of the car to a certain extent. In order to achieve this, the first job is to arrange all the equipment into a single circuit and prepare the car model with the help of it.

In the beginning all the equipment, such as the L298N motor driver, HC-SR04 ultrasonic sensor, 16×2 LCD, buzzer, LEDs, etc. are connected to the specific pins of the Arduino UNO R3 board. The following diagram made on the simulation platform displays the entire circuit of the project.

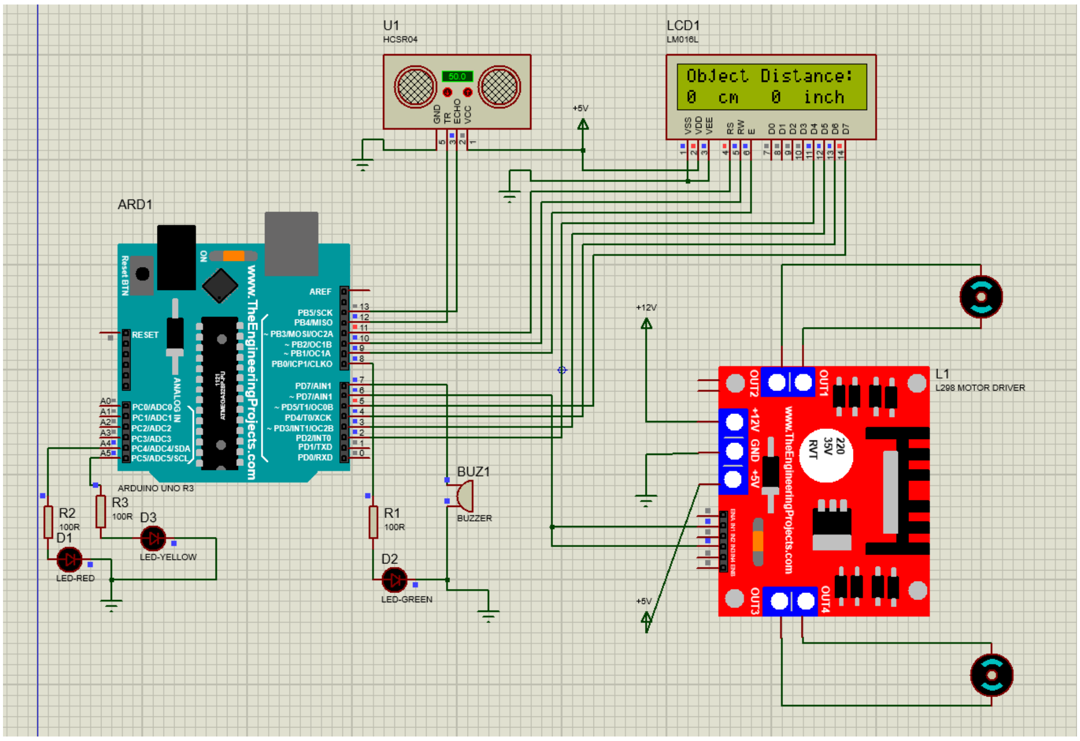

Fig 19: Circuit diagram of the entire project.

Source: Self-Created in Proteus Professional 8.

Display connection

The most important part is to connect all the pins of the 16×2 LCD to the output pins of the Arduino board. The pin sequence is shown in the table below-

16×2 LCD	Arduino UNO R3
R_s	11
R_W	10
E	9
D_4	2
D_5	3
D_6	4
D_7	5

Table 02: Pin configuration for connecting the display with the Arduino board.

Ultrasonic sensor connection

In order to detect the obstacle as well as measure its distance, the HC-SR04 ultrasonic sensor becomes highly crucial. The TRIG and ECHO pins of the sensors are connected to the 12th and 13th pins of the Arduino board respectively. The V_{CC} and the GND pins of the sensor are connected to the +5V wire and the GND wire of the circuit respectively with the help of the breadboard.

Motor driver connection

The L298N motor driver is connected directly to the +12V terminal of the battery via the +12V port in itself. The +5V pin and the GND pins are connected to the respective ports in the breadboard. The output pins are connected to the two motors through their respective terminals. The IN1 and IN3 ports of the drivers are sorted through the breadboard and the common wire is connected to the PWM output of the Arduino board through the pin no. 6.

LEDs and buzzer connection

The analog pins of the Arduino board named 'A4' and 'A5' are used as digital outputs with the help of the code. The Red LED has been connected to the A4 pin and the YELLOW one in the A5. The GREEN LED has been connected to the pin no. 8 of the Arduino digital output ports. The buzzer is connected to the pin no. 7.

Thus, the circuit gets completed. The next step is to write the code into the Arduino IDE and provide all the pins their respective functions. The operation of the components is clear from the circuit diagram displayed in the figure no. 20.

Working procedure

Whenever any obstacle comes in front of the ultrasonic sensor, it starts measuring the exact distance of it from the vehicle head. Going in this way, when the distance becomes less than the given distance (Warning Zone), the respective pins get activated and the Buzzer and the LEDs starts warning the driver automatically. In the 'Critical Zone', the programmed phenomenon is executed. As soon as this phenomenon starts happening, the speed of the motors gets reduced to a certain extent (that is given through the code).

The Green LED remains activated throughout the operation, only except the period when the Red LED is active.

Chapter 05: Arduino code and explanation:

The project is primarily based on the program used in the Arduino UNO R3 microcontroller. All the pins of the Arduino board are declared properly in the code and the respective functions are also provided to the pins in there. (*The entire code is provided in the Appendix section*).

Explanation to the code:

In the beginning, the library named “LiquidCrystal.h” is included in the program. This library is primarily required for the functions of the LCD. Once the library is included, all the pins required for the complete function of the LCD are declared inside a user defined function.

After declaring the LCD pins, the Ultrasonic sensor pins are also declared inside some specific variables. Along with the sensor pins, all the other equipment, such as the LEDs and the Buzzer pins are also declared in the similar way. In order to give the speed controlling operation a success, two more variables are declared, and some specific values are assigned into them.

There are two major parts in the entire Arduino code. One is the ‘setup’ part, and another is the ‘loop’ part. All the roles of the variables are assigned properly using the specific library function named “pinMode”. Along with the role of the variables, the initialization of the LCD functions is also made in the ‘setup’ section.

The main execution of the code is performed in the ‘loop’ section. There are two library functions named ‘digitalWrite’ and ‘delay’, which are really important in this project. The role of the digitalWrite function is to assign specific functions to the digital output pins, and the role of delay is to hold the same function for some specific time period.

There are two user defined variables named ‘duration’ and ‘distance’, which are the main basis of the obstacle detection as well as speed control. The duration is measured by a specific function named “pulseIn” through the echo pin of the ultrasonic sensor. The distance is measured on the basis of the duration of the ultrasound pulses. The equation used here is as follows:

$$\text{Distance} = (\text{Duration} / 2) / 29.2$$

As both the duration as well as the distance variables are called inside the loop section of the code, the respective functions of the variables are called continuously and the distance is measured automatically. The distance measured in this way is displayed in the LCD continuously both in cm as well as inch.

Finally, the most important part is executed in the program, that is the logical part. The Arduino microcontroller is provided with a command where it is instructed to force the specific PWM pin of the board to reduce the speed of the motor to a certain extent.

Once the code is compiled successfully, it is uploaded to the Arduino UNO R3 microcontroller through the USB cable connected to the computer through the USB port of the board. In the Arduino IDE, the board model, as well as the port of the board are selected beforehand, so that the IDE can detect the board and upload the code successfully into it.

Chapter 06: Results and Analysis:

As per all the information provided above the circuit diagram has been prepared in the simulation platform named "Proteus Professional 8". After getting assured about the results from the simulation, the physical model has been prepared.

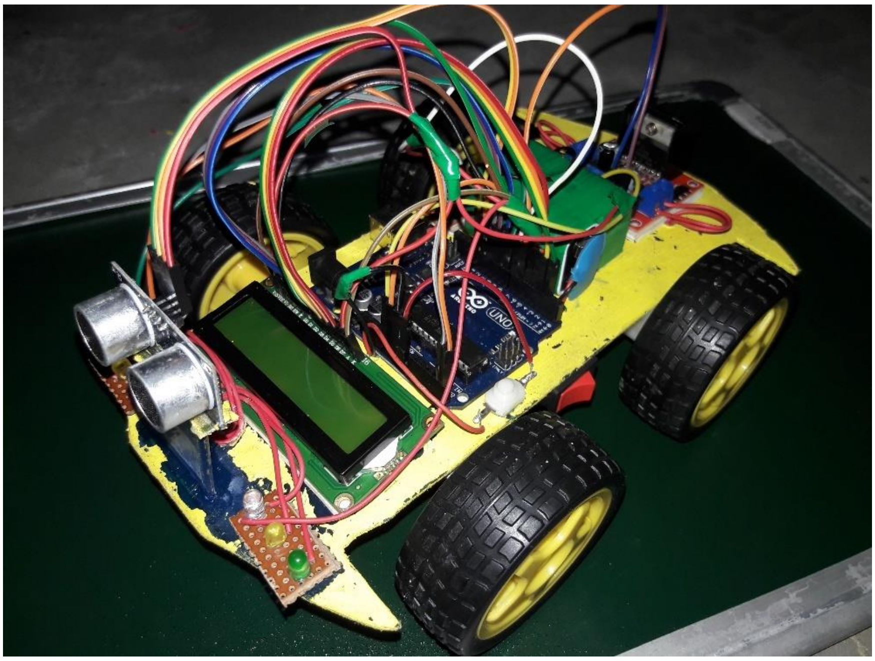

Fig 20: The model car.

In the figure above, the entire physical model has been presented. The L298N motor driver is kept in the extreme back; after that, the battery module, the Arduino UNO R3 board, the 16×2 LCD, and the Ultrasonic sensor are placed one after another. The LEDs are placed in both the sides of the sensor. Two switches and the buzzer have been placed according to the availability of space on the car body.

When both of the switches are turned on, all the equipments are turned on and the car starts moving. Initially, the motors rotate at their maximum speeds till the car is in the 'Safe zone'. In the 'Warning Zone', the Yellow LEDs and the Green LEDs blink simultaneously along with the beeping buzzer. When the car is in the 'Critical Zone', the other two LEDs gets turned off and the Red LED gets tuned on only and the buzzer rings continuously. Finally, in the 'Power off zone' the functions of the LEDs as well as the motors gets turned off.

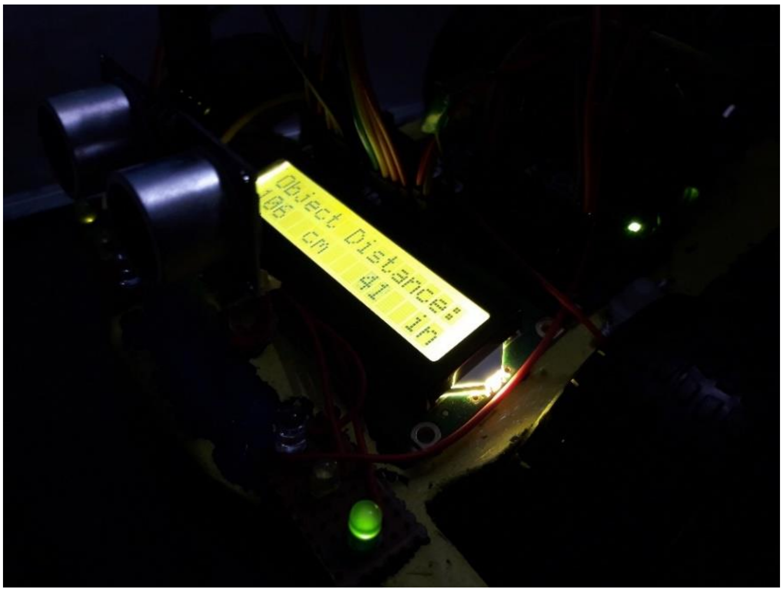

Fig 21: The car is in the 'Safe Zone'.

In the figure above, the state of the car is displayed when it is in the 'Safe Zone'. The distances are displayed in the LCD properly and accurately.

Fig 22: The car is in the 'Warning Zone'.

In the figure above, the state of the car in the ‘Warning Zone’ has been displayed. The distances are displayed in the LCD as well.

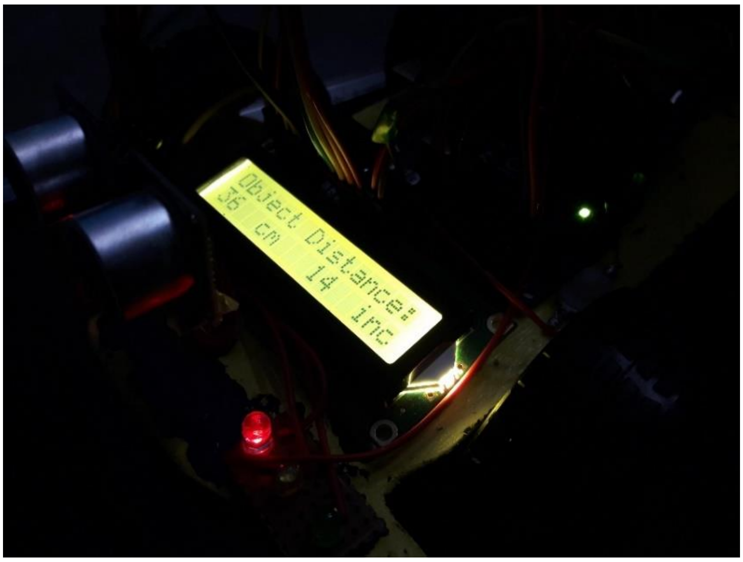

Fig 23: The car is in the ‘Critical Zone’.

In the figure above, the distance of the obstacle from the vehicle-head is displayed in the LCD and the state of the car has been displayed too, when it is in the Critical Zone’.

Fig 24: The car is in the ‘Power Off Zone’.

In the figure above, the state of the car has been displayed when the vehicle is in the ‘Power off zone’. The minimal distance that is provided to the microcontroller through the code is displayed in the LCD as well.

All the observations gained after executing and running the final physical model are explained carefully and in detail above.

Chapter 07: Conclusion:

The primary objectives of the project have been successfully achieved. The distance of the obstacle from the vehicle has been successfully measured and the three zones, viz. ‘Safe Zone’, ‘Warning Zone’, ‘Critical Zone’, and the ‘Power off zone’ has been successfully detected by the sensor and the motor speed has been controlled accordingly.

The physical assembling has been executed precisely keeping in mind all the crucial factors such as ‘Cost of the equipments’, ‘Ease of availability’, etc. Many parts of the model have been made manually using very normal materials, such as the base of the car has been prepared from a waste plastic board, the wirings have been made on a left-over board, etc.

All the used equipments are explained in this report itself and their specialities as well as the working principles are explained in detail too. In the results section, the real images of the physical model have been used and the observations have been shown as well.

After analysing all the assessments and observing the entire it can be concluded that the main objective of this project has been achieved and the physical demo has been prepared successfully.

Chapter 08: Future Scope:

In the modern-day scenario, the accidents due to the negligence of the driver is quite common. Various research reports show that, in most of the cases the driver either uses their mobile phones while driving, or any sudden obstacle appears in front of the moving vehicle.

The objective of this project is to solve this particular problem by detecting the obstacle from a safe distance and warning the driver continuously. When the physical model is prepared, it is observed that the objective has been achieved successfully in the demo environment.

Considering all the statements above, it can be said clearly that this particular idea can resolve the aforesaid issues, and can save many lives by avoiding the accidents as well. Hence, this particular project has solid scope in near future.

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Appendices:

The entire Arduino code is provided below:

```
//Inclusion of the library for LCD display
#include<LiquidCrystal.h>

//Declaring all the pins for the LCD display
LiquidCrystal LCD(11, 10, 9, 2, 3, 4, 5);

//Declaring the 'trig' pin of the ultrasonic sensor for the pin
no. 12 of Arduino digital output
int trigPin = 12;

//Declaring the 'echo' pin of the ultrasonic sensor for the pin
no. 13 of Arduino digital output
int echoPin = 13;

//Declaring the motor output for the pin no. 6(PWM) of Arduino
digital output
int M = 6;

//Declaring the buzzer and red LED for the pin no. 7 of Arduino
digital output
int buzzer = 7;

//Declaring the green LED for the pin no. 12 of Arduino digital
output
int green = 8;

//Declaring a variable 'val1' for the speed control of the motors
int val1 = 255;

//Declaring the variables 'val2' & 'val3' for the speed control
of the motors
```

```
int val2 = 100;
int val3 = 0;


//Declaring the variables 'red' & 'yellow' for the red and yellow
LEDs.

int red = A4;
int yellow = A5;

//Declaring the variables to measure the duration and distance in
the sensor
long duration, distance, inch;

void setup() {

  //Setting all the pin outputs of the Arduino module according
to the pin declared variables

  pinMode(M, OUTPUT);
  pinMode(trigPin, OUTPUT);
  pinMode(echoPin, INPUT);
  pinMode(buzz, OUTPUT);
  pinMode(green, OUTPUT);
  pinMode(red, OUTPUT);
  pinMode(yellow, OUTPUT);

  //Setting the LCD display output

  LCD.begin(16,2);
  LCD.setCursor(0,0);
  LCD.print("Object Distance:");

}
void loop() {
```

```
  //The functions of the pins start here.
  //The sensor is given instructions to transmit the signal.

  digitalWrite(trigPin, LOW);
  delayMicroseconds(2);
  digitalWrite(trigPin, HIGH);
  delayMicroseconds(10);
  digitalWrite(trigPin, LOW);
  duration = pulseIn(echoPin, HIGH);
  distance = (duration/2) / 29.1;
  inch = (distance/2.54);

  //Providing instructions to the display to show the measured
distance continuously

  LCD.setCursor(0,1);
  LCD.print("     ");
  LCD.setCursor(0,1);
  LCD.print(distance);
  LCD.print("  cm");
  LCD.print("   ");
  LCD.print(inch);
  LCD.print("  inch");
  delay(250);

  //The logic behind the speed controlling of the motor via the
sensor starts

  if(distance <= 120 && distance > 70){
    analogWrite(M, val1);
    digitalWrite(yellow, HIGH);
    digitalWrite(green, LOW);
    delay(45);
    digitalWrite(green, HIGH);
    digitalWrite(yellow, LOW);
```

```
    digitalWrite(red, LOW);

    tone(buzzer, 1000);
    delay(200);
    noTone(buzzer);
    delay(200);
    }

  else if(distance <= 15){
    analogWrite(M, val3);
    digitalWrite(buzzer, LOW);
    digitalWrite(green, LOW);
    digitalWrite(yellow, LOW);
    digitalWrite(red, LOW);
    }

  else if(distance <= 70){
    analogWrite(M, val2);
    digitalWrite(yellow, LOW);
    digitalWrite(red, HIGH);
    digitalWrite(green, LOW);
    digitalWrite(buzzer, HIGH);
    }

  else {
    analogWrite(M, val1);
    digitalWrite(buzzer, LOW);
    digitalWrite(green, HIGH);
    digitalWrite(yelow, LOW);
    digitalWrite(red, LOW);
    }

}
```