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Designing a Vehicle Collison-Avoidance Safety System using Arduino

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Abstract: The future of automotive relies on the mechatronic and electronic systems. The worldwide growth of automotive towards electronic systems suggests that driverless cars would soon be the common commuters. With such improvements safety of the passengers becomes first priority for the manufacturers. Nowadays automobiles come with high end technologies and quick responsive electronic systems. In addition to the passive safety systems, active safety systems definitely avoid collision thereby reducing the chances of injury and death. This project shows the working of an active safety system that is collision avoidance system. To create the model, TINKERCAD software has been used and a detailed working is explained. As a result, the system detects traffic and can alert the driver and stop the vehicle before meeting the collision.
Keywords: Active Safety System, Arduino, Tinkercad, Vehicle Electronics System, Automotive Safety System, Collision Avoidance System, Self-Driving Car, Driverless Vehicle.

I. INTRODUCTION

The death toll is increasing with increasing number of vehicles globally. Automotive safety concern is still a challenge for engineers. A number of factors contribute to the vehicle collision. It may due to poor road conditions, over- speeding, faulty interpretation of traffic speeds or some cases like drunk and drive. Several surveys, studies, research papers, etc. suggest that in most of the cases accidents occur due to human error and poor decision-making, that is either by the mistake or mis-calculation of driver or by its co-passengers or by on-road pedestrians. Hence, day by day vehicles are being made smart by inculcating autonomous things, different Mechatronics components so as to decrease overall human interference and thereby increasing machine involvement, reducing the overall percentage of human error as the required fields checks are already done by designated electronics components and programs.

With the demands of modified designs and powerful engines the drivers are more likely to be engaged into fast and rash driving than just calm drive. Over the era a tremendous progress can be seen in the automotive regarding safety concerns. Since the 1950s, improvements in passive and active safety features decreased the number of deaths every year. According to the National Highway Traffic Safety Administration (NHTSA), 36,096 people died in motor vehicle crashes in 2019, down 2.0 percent from 36,835 in 2018. This number can be reduced more if engineers add more active safety systems to the vehicle.[1],[2] Human factors always contribute to the collision of vehicle which risk the lives of passengers inside the vehicle. Hence reliable electronic safety systems, is a need increasing. The results of active safety systems can prevent injuries, deaths and even property damage expenses. These systems can alert the driver if the driver is not paying attention to the roads or feeling drowsy and the safety is ensured. Some systems stop the vehicle or redirects it if the vehicle is about to engage in the accident. Thus, studying such systems and implementing innovative ideas will definitely help improving the yearly vehicle collision statistics.

An active collision avoidance system measures the distance of frontal traffic and applies breaks if car is approaching the traffic with some speed. This system has been in implementation from few years in luxury cars like BMW, Mercedes Benz, Audi and now available in wider range.

The following circuit design is a prototype simulation model of a collision avoidance system which can alert the driver before indulging into a collision and applies breaks to prevent the collision. The system can also give visual representation of distance between the vehicle and frontal traffic.

The aim of the project is:
To create a system that can identify the distance of the traffic and stop the vehicle before getting into the collision.
To reduce the number of accidents globally.
To get effective output results from the sensors used.

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II. HARDWARE DESIGN

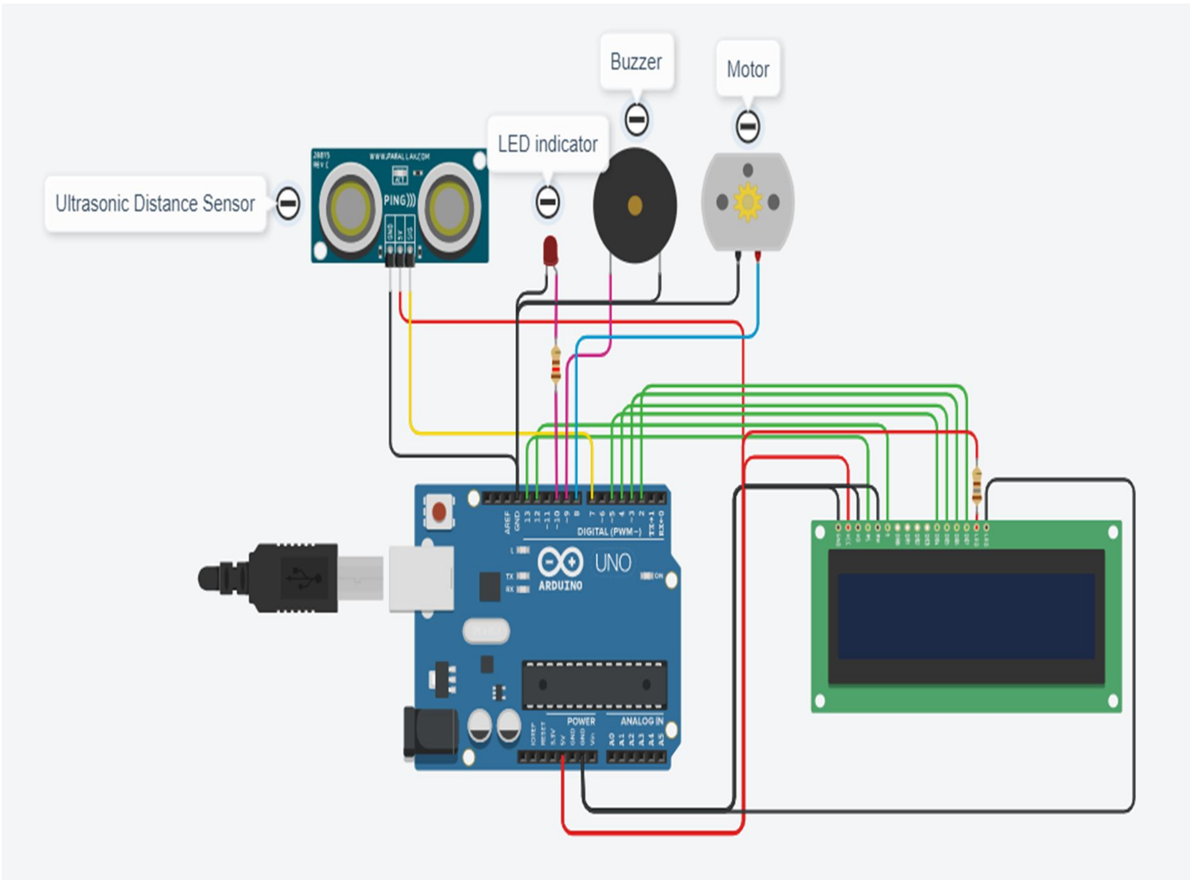

Figure 1: Hardware Design

III. FUNCTIONAL BLOCK DIAGRAM

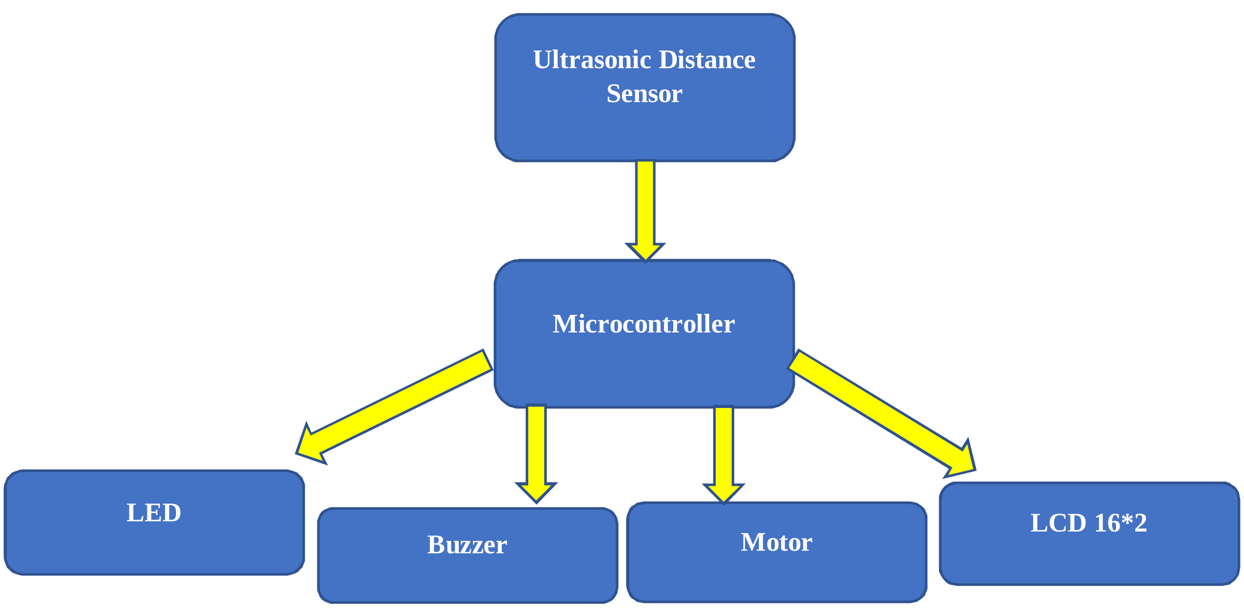

Figure 2: Block Diagram

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IV. INTERFACING THE CIRCUIT DIAGRAM

For the ultrasonic distance sensor, the signal pin is connected to the digital pin D7 of the Arduino. The power and ground pins are connected with 5v pin and ground pin of the Arduino respectively.

For the buzzer, the positive terminal is connected to the digital pin D9 of the Arduino and negative pin is connected to the ground.

For the LED, the anode is connected to the digital pin D10 of the Arduino through a 120ohm resistor.

For the motor, the terminal2 is connected to the digital pin D8 of the Arduino, and terminal1 is connected to the ground.

For the LCD, the data pins D4, D5, D6, D7 of the LCD are connected to digital pins D5, D4, D3, D2 of the Arduino respectively.

V. COMPONENTS DESCRIPTION

A. ATmega328p Microcontroller

ATmega328 is an AVR microcontroller manufactured by Microchip. It follows RISC Architecture and processes up to 8 bits of data. It has a flash type program memory which can store data up to 32KB. With a clock speed of 16MHz, it works on 5v though the recommended voltage is 7v to 12v.[3]

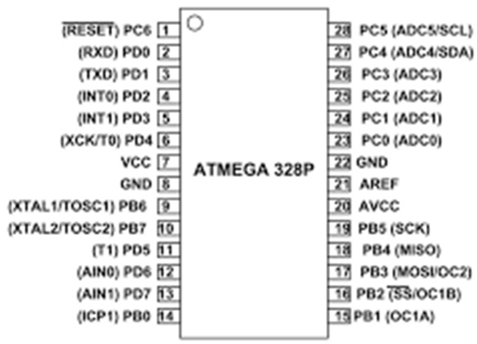

Figure 3: Micrcontroller

B. Ultrasonic Distance Sensor

The sensor works on 5v supply. It can measure precise non contact distance ranging from 2cm to 3m.[4]

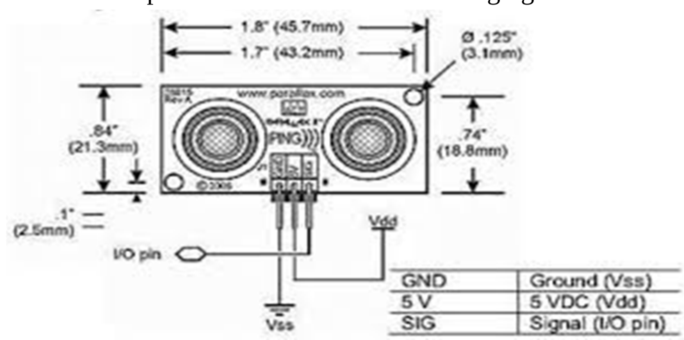

Figure 4: ultrasonic Distance Sensor

C. Motor

The DC motor used here operates on supplying voltage of 4.5v to 9v. Under no load conditions, the speed of the motor is 9000rpm. [5]

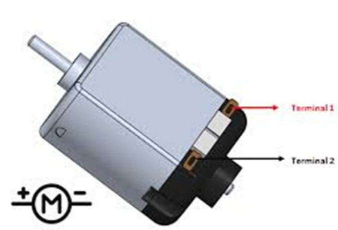

Figure 5: DC Motor

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VI. SOFTWARE DESIGN

```
#include <LiquidCrystal.h>
LiquidCrystal lcd(13, 12, 5, 4, 3, 2);

long readUltrasonicDistance(int triggerPin, int echoPin);

void setup()
{
  Serial.begin(9600);
  pinMode(7,INPUT);//input signal of ultrasonic distance sensor
  pinMode(8,OUTPUT);//dc motor
  pinMode(9,OUTPUT);//buzzer
  pinMode(10,OUTPUT);//LED
  lcd.begin(16,2);
}

void loop()
{

  long duration, cm;

  //The PING)))is triggered by a HIGH pulse or 2 or more microseconds.
  //give a short low pulse beforhand to ensure a clean HIGH pulse
  pinMode(7,OUTPUT);
  digitalWrite(7, LOW);
  delayMicroseconds(2);
  digitalWrite(7, HIGH);
  delayMicroseconds(5);
  digitalWrite(7, LOW);
  //The same pin is used to read the signal from the PING))):
  //a HIGH pulse whose duration is the time (in microseconds) from the sending
  //of the ping to the reception of its echo off of an object.


  pinMode(7, INPUT);
  duration = pulseIn(7, HIGH);

  // convert the time into a distance
  cm = microsecondsToCentimeters(duration);
  int A = cm;
  if (A > 0 && A < 100)
  {
    digitalWrite(10, HIGH);//LED on
    digitalWrite(9, HIGH);//buzzer on
    digitalWrite(8, LOW);//Motor stopped
    lcd.setCursor(0,0);//set position the cursor of LCD
    lcd.print("Brakes Applied");
    delay(2000);
    lcd.clear();

  }
     else if(A > 100 && A < 200)
  {
    digitalWrite(8, HIGH);//Motor is on
    digitalWrite(10, HIGH);//LED on
    digitalWrite(9, HIGH);//buzzer on
    lcd.setCursor(0,0);//set position the cursor of LCD
    lcd.print("Warning");
    delay(200);
    digitalWrite(10, LOW);//LED off
    digitalWrite(9, LOW);//buzzer off
    delay(200);
    lcd.clear();

  }

  else if(A > 200 && A < 300)
  {
    digitalWrite(10, HIGH);//LED on
    delay(500);
    digitalWrite(8, HIGH);//motor is on
    lcd.setCursor(0,0);//set position the cursor of LCD
    lcd.print("Obstacal Detected At");
    lcd.setCursor(0,1);//set position the cursor of LCD
    lcd.print(A);// print the distance of object
    lcd.print("cm");
    digitalWrite(10, LOW);//LED off
    delay(200);


  }
   else if(A > 300)
  {
    digitalWrite(10, LOW);//LED off
    digitalWrite(9, LOW);//buzzer off
    digitalWrite(8, HIGH);//motor is on
   }
}

long microsecondsToCentimeters(long microseconds) {
    return microseconds / 29 / 2;
}
```

Serial Monitor

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VII. PROGRAM FLOW CHART

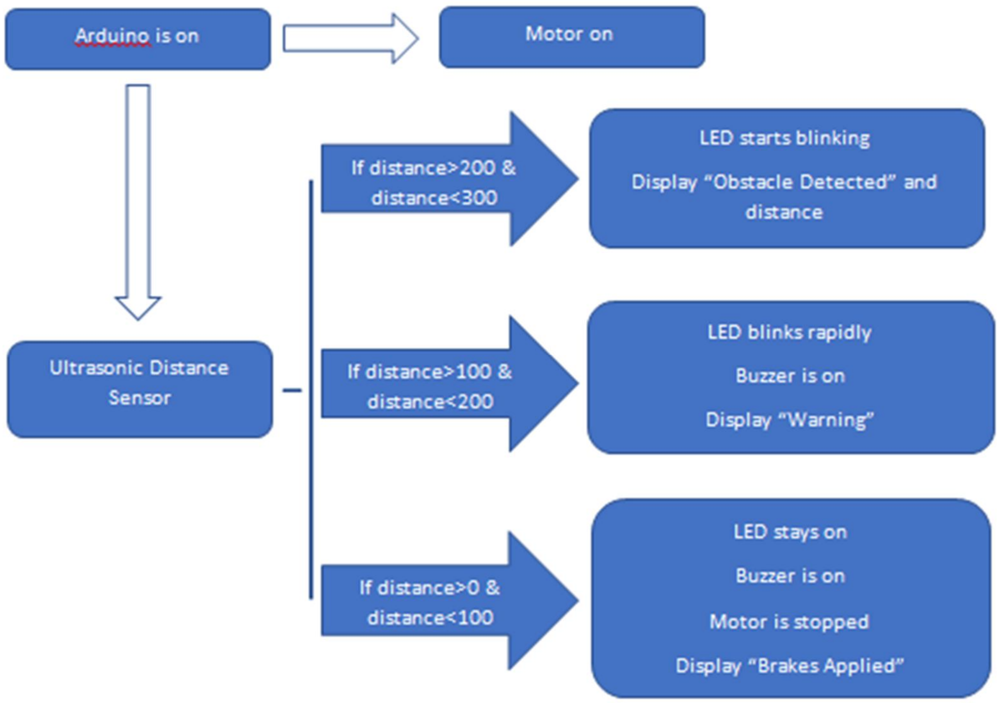

Figure 6: Flow Chart

VIII. DATA DISPLAY

Displaying any data on a display makes it easy for one to understand and interpret the situation. In automobiles LCD screens are used for displaying system data.

The circuit has a LCD 16*2 display which displays the distance between the vehicle and the traffic. The ultrasonic distance sensor measures the distance and through microcontroller displays on the LCD. If the distance between vehicle and traffic is more than 3m then it will not be displayed on the LCD. If the distance is less than 3m then it will be accurately shown on the display to alert the driver.

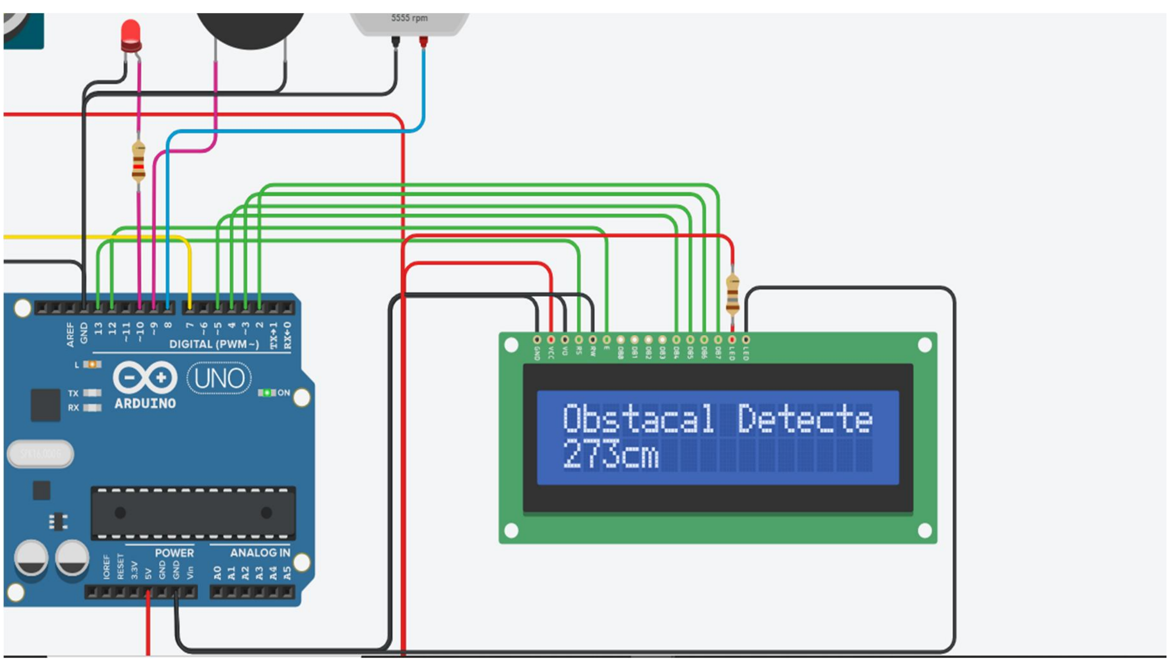

Figure 7: Distance = Less than 3m

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If the distance is less than 2m and greater than 1m, then a warning message will blink on the LCD

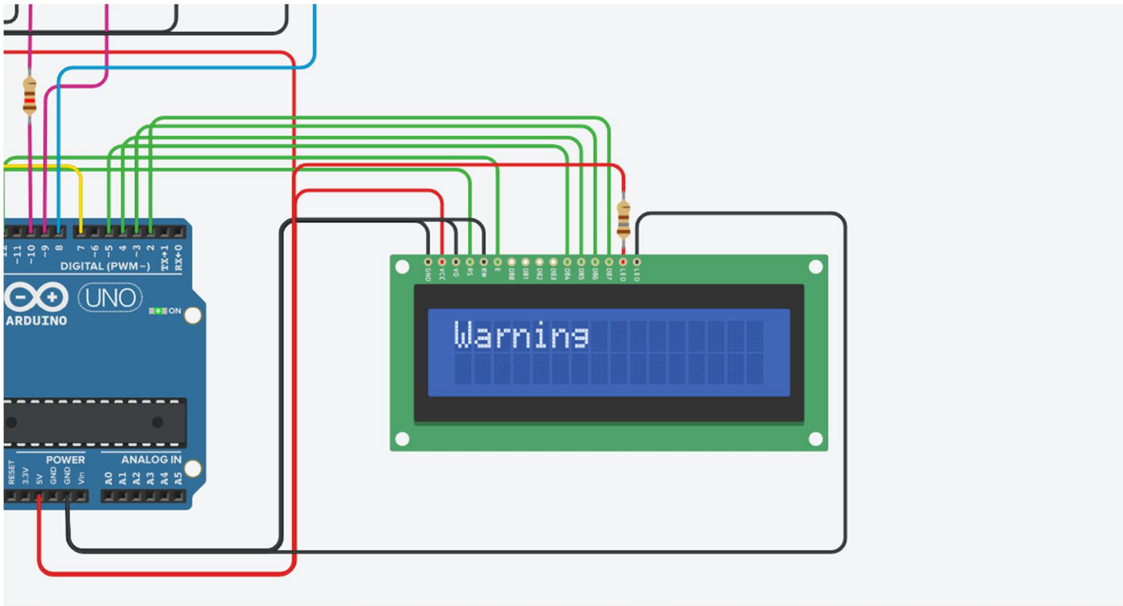

Figure 8: Distance = Less than 2m

If the distance is less than 1m then, “Breaks Applied” message will appear on LCD.

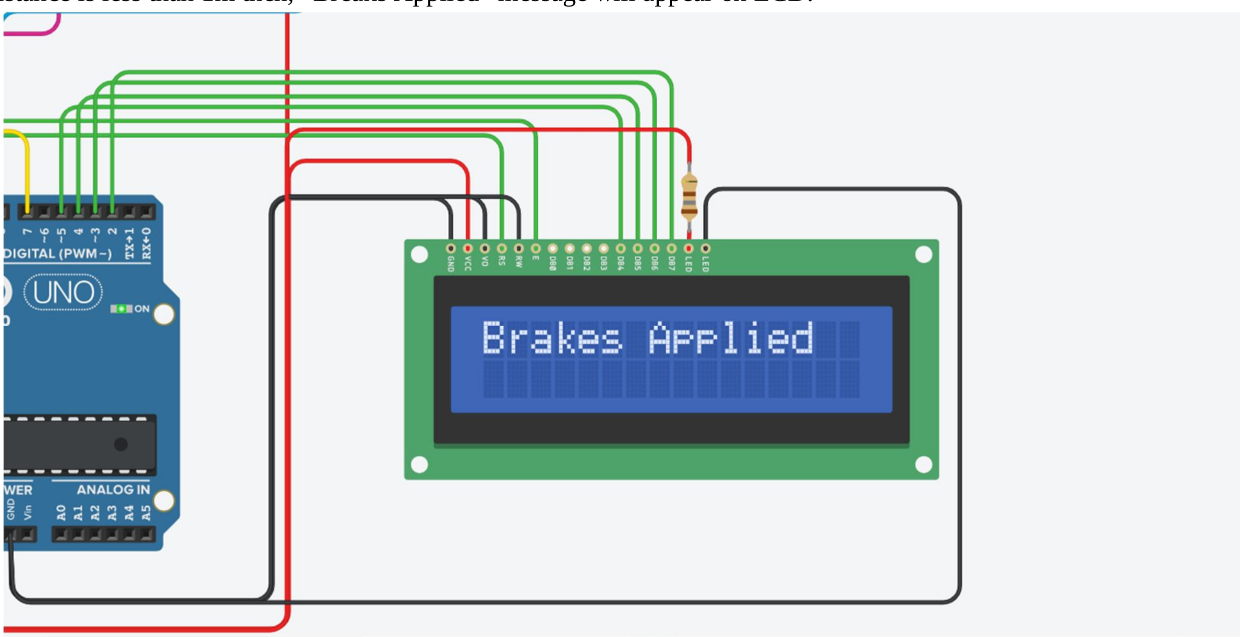

Figure 9: Distance = Less than 1m

IX. WORKING OF SYSTEM

The system is equipped with an ultrasonic distance sensor which continuously measures the distance between the vehicle and traffic/obstacle. It passes this information to the microcontroller which then actuates the actuators. In the proposed design there are three conditions applied to the circuit for working. If the ultrasonic distance sensor senses any obstacle in the distance range of 2m to 3m ahead of the vehicle, then the LED starts blinking. For the addition to the alertness of driver the distance is displayed on the LCD and “Obstacle Detected” message is displayed. If the ultrasonic distance sensor senses any obstacle in the distance range of 1m to 2m ahead of the vehicle, the LED starts blinking rapidly and also a buzzer is alarmed. The LCD will display “Warning” message which will blink. If the ultrasonic distance sensor senses the obstacle in the distance range of less than 1m, then the LED and buzzer will stay on and brakes will be applied. The “Brakes applied” message will display on the LCD.

X. RESULT &CONCLUSION

The prototype is working efficiently giving accurate outputs. It effectively works by stopping the car before the collision can happen. This prototype can save many lives. The system can be used as parking sensor where some find it hard while parking in reverse.

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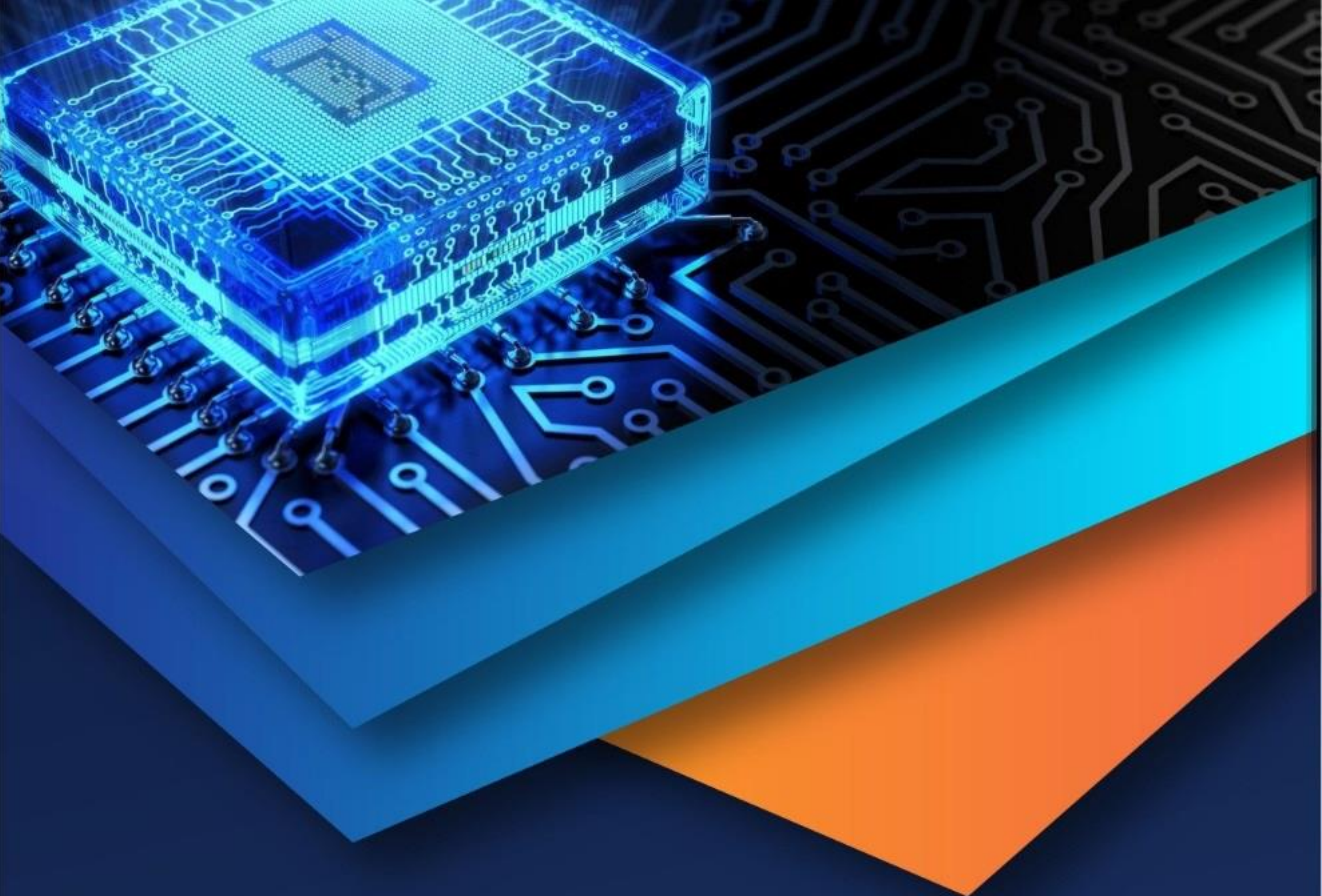

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