SPEED BREAKER EARLY WARNING SYSTEM USING LIDAR SENSOR

MINI PROJECT REPORT

Submitted by

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Dissertation submitted in partial fulfillment of the requirements for the degree of

BACHELOR OF ENGINEERING

IN

ELECTRONICS AND COMMUNICATION

ENGINEERING

SONA COLLEGE OF TECHNOLOGY,

SALEM (AUTONOMOUS)

ANNA UNIVERSITY: CHENNAI 600 025

MAY 2022

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BONAFIDE CERTIFICATE

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ACKNOWLEDGEMENT

At this pleasing moment of having successfully completed ourProject, we wish to convey our sincere thanks and gratitude to ourParents and the college management our chairman **Sri. C. VALLIAPPA,** and our vice chairmen**Sri. CHOCKO VALLIAPPA**and **Sri. THYAGU VALLIAPPA** who provided all the facilities to us.

We would like to like to express our sincere thanks to our principal, **Dr. S. R. R. SENTHILKUMAR** for motivating us to do our project and for offering adequate duration for completing our project.

We are also immensely grateful to our head of the department, **Dr. R. S. SABEENIAN,** for his constructive suggestion and encouragement during our project.

We also express our heartfelt and sincere gratitude to our guide **Dr. G. RAVI** for his support and concern in helping us complete our project works.

We also express us indebt thanks to our teaching and Non-teaching staffs of Electronics and Communication Engineering Department, Sona College of Technology. Last but not least we like to thank our friends and family for their support during this project.

ABSTRACT

Speed breakers in India are mostly uncertain and does not have a proper indication or sign boards to indicate the speed breakers. The excessive use of speed breakers on national highways distracts vehicle drivers. In addition to that, drivers often can't recognize the appearance of unmarked speed breakers and lose control of the vehicle, causing serious accidents and loss of lives. In the literature, there exist a few methods to warn on-road drivers about the upcoming speed breakers which are highly error-prone and time consuming. Moreover, none of them pay any heed to track the information of infringing speed breakers. In this project, we come forward with a system that facilitates autonomous dynamic speed breaker detection and warning generation for the on-road drivers.

Our project involves the early detection of speed breakers using **TF-Mini Micro LiDAR sensor** to indicate the occurrence of speed breakers to the drivers in rural and urban roads. LiDAR sensor is used to measure the distance in a most efficient way. The sensor uses light rays to detect and range the distance. Usage of sensors resulted in much accuracy to detect the obstacles on road. Driver can also be intimated with other uncertain obstacles on road. The occurrence of the speed breakers are taken to the notice of the driver so that the accidents can be reduced in a much efficient scale. By making the driver to notice the speed breakers the car can also be prevented from damage. The proposed system outperforms the state-of-the-art works with which it is compared to in terms of response time and accuracy.

TABLE OF CONTENTS

LIST OF FIGURES

CHAPTER-1

INTRODUCTION

1.1 INTRODUCTION

Road accidents continue to be a leading cause of death, disabilities and hospitalization in the country despite our commitment and efforts. India ranks first in the number of road accident deaths across the 199 countries and accounts for almost 11% of the accident related deaths in the World.

A total number of 449,002 accidents took place in the country during the calendar year 2021 leading to 151,113 deaths and 451,361 injuries. In percentage terms, the number of accidents decreased by 3.86 % in 2021 over that of the previous year, while the accident related deaths decreased by 0.20 % and the persons injured decreased by 3.86.

Speed breaker is a traffic management tool that is used to slow down fast moving vehicles near schools, hospitals, toll booths, flyover entry and exit for safety purposes. The vertical deflection to reduce the speed of vehicles is known as speed bumps, speed humps, speed cushions, speed ramps and speed tables.

In India the urban and rural areas are more prone to uninstructed speed breakers. These speed breaker causes damage to both the vehicle and can cause accidents.

The proposed system has been designed to overcome the evil effects of speed breakers and reduce the accident rate in a consistent manner. The monitoring and detection of speed breakers can reduce the possibilities of road accident which are caused due to the speed breakers in road can be reduced in a much efficient manner. This speed breaker early warning system can also detect if any unwanted obstacle lying on the road too.

The upcoming chapter of the literature describes the hardware, software and other working of the speed breaker early warning system.

1.2 EFFECT OF IMPROPER SPEED BREAKERS

The improper and unscientific use of speed breakers causes distraction and leads to the road accidents and loss of lives. In addition to this driver cannot recognize the unmarked speed breakers and lose their control on vehicle which also leads to accidents, injuries and death.

- **MEDICAL CONDITIONS & AMBULANCE DELAY:**

Speed breakers can cause medical issues including back problem, abdominal injury, or other disabilities which are extremely painful. Apart from major discomfort to ambulance passengers speed breakers can cause delay to ambulance which can cause death.

- **DAMAGE TO VEHICLES:**

Construction of unscientific speed breakers causes damage to vehicles as well. A speed breaker prompts the driver to apply breaks while riding. Unscientific speed breakers can cause unnecessary delay and damage to the vehicles especially to the cars.

- **POLLUTION:**

The acceleration & decrease of speed caused by the speed breakers can cause atmospheric pressure. Heavy vehicle can cause excessive noise pollution & vibration to the adjoining properties.

CHAPTER 2
LITERATURE REVIEW

2.1 LITERATURE SURVEY

A comprehensive literature review has been done and some of the possible efficient technologies and methodologies based on literature review and experimentation are suggested in the project for speed breaker detection and early warning system. Malaya Mohanty et al. [1] proposed a clear idea about the geometric construction of speed breakers in Indian roads and the approach the vehicle drivers should follow when the head towards a speed breaker and the literature also gave a brief explanation about the speed limit which is to be followed when you're going over a speed breaker. Kaplesh Rajput et al. [2] proposed a literature about the traditional and modern speed breakers in India and around the globe. Teja Tallam et al. [3] proposed a literature analyzing the speed profile to be followed while driving in urban roads. Korra Ravi Kirana et al. [4] conducted a critical analysis of speed bump and speed hump and geometric design of the curved speed hump. Environmental based speed recommendations for the future smart cars has been proposed by IEEE international symposium on circuits and systems [5]. A speed guidance strategy for multiple signalized intersections based on car-following model was proposed by Tang, T.Q et al. [6]. De Nunzio, G., et al [7] proposed a study based on the Speed advisory and signal offsets control for arterial bandwidth maximization and energy consumption reduction.Vision based speed breaker detection for autonomous vehicle is a technology proposed by Arvind C.S et al. [8] was one of the technology proposed to detect the speed breakers based on the image processing applications. A similar kind of project to detect the obstacles on road was proposed based on the image

processing technology was introduced by Madli, R et al. [9]. Another existing project includes the detection of speed breakers by collecting the information of various speed breakers which are in a particular locality and positioning the obtained information is a cloud and reposition the observed information in global positioning system so that the driver can be indicated about the forth coming speed breakers in a much efficient manner was proposed by Ganesan, K. et al. [10]

2.2 EXISTING METHODOLOGY

By referring the above paper, it is found that no such systems are existed with all the integrated features but proposed system includes these all features such as monitoring and detecting the upcoming speed breakers using light detection and ranging sensor and indicating the driver with a LCD module and a buzzer so that the driver can get notified about the upcoming speed breaker and can reduce the speed of the vehicle and can reduce the rate of accidents in a consistent way.

2.3 DRAWBACKS

The drawbacks in existing methodology are as follows,

- The image processing based detection of speed breaker involves in the detecting the white painted signed indication of speed breaker on road which is unfortunately not present in most of the urban roads in India and thus this model is considered to be of less practical feasibility.
- The vision based image processing of speed breaker detection is used to detect the speed breaker by mounting a camera which takes continuous image of the road and spots if there is any hump in the road and then indicates the driver about the speed breaker in this method is the repositioning of the camera is likely to happen then the system produces false results.

- The collection of data from various urban roads and repositioning them in global positioning system is not feasible to make use by all people to use these kind of system.

CHAPTER-3

PROBLEM STATEMENT

Indian roads are mostly uncertain about the construction and it has high risks of accidents to occur. The speed breakers in Indian roads also share a great effect in accidents in India. Illegal or unplanned speed breaker can lead to safety hazard and a reason for traffic congestion. These threads to people should be reduced.

So, in this regard to save people's lives and time we proposed a project titled SPEED BREAKER EARLY WARNING SYSTEM USING LiDAR SENSOR. In this proposed system we are using sensor like LiDAR which is light detection and ranging sensor which uses light as its distance ranging parameter. These sensed parameters will be displayed on a LCD module and also indicates the driver with a buzzer sound.

3.1 MOTIVATION

The main motivation is to reduce the death rate which is caused due to the uncertain parameters in road and to introduce a latest technology in the field of automobile by using the domain of embedded systems. Similarly, with the help of our speed breaker early warning system the other unidentified object in the road can also be detected and can indicate the driver if any object is present. The speed breaker early warning system can also reduce the damage which the vehicles occur when there is some illegal or other speed breakers beyond the construction norms.

The main motive is to make sure the process is cost effective and easy implementation.

3.2 OBJECTIVE

Due to current demand, this project work can help to overcome the demand to reduce the road accidents based on the working of the sensors. The circuit is designed in a way that the usage of power is limited. Hence it substantially reduces the electricity usage and on other hand the light detection and ranging sensor has high accuracy in detecting the distance and hence the sensor can also indicate the driver about the distance in which the upcoming speed breaker is about to reach so that the driver can notified about the forthcoming speed breakers and can get alerted about the obstacle and can follow the speed limits to be applied.

CHAPTER-4

PROPOSED METHODOLOGY

This project consists of circuit which is mounted to the lower surface of the car. The circuit consists of light detection and ranging sensor which uses light rays to detect and estimate the distance between the vehicle and the object detected. The sensor then calculates the distance and if the distance is less than the threshold the LCD module indicates the distance between the vehicle and the obstacle detected. In addition to the indication of the distance a buzzer is added to the circuit so that the driver can also hear the indication of the upcoming speed breaker. The figure4.1 explains the working of the frame work.

4.1 FRAME WORK

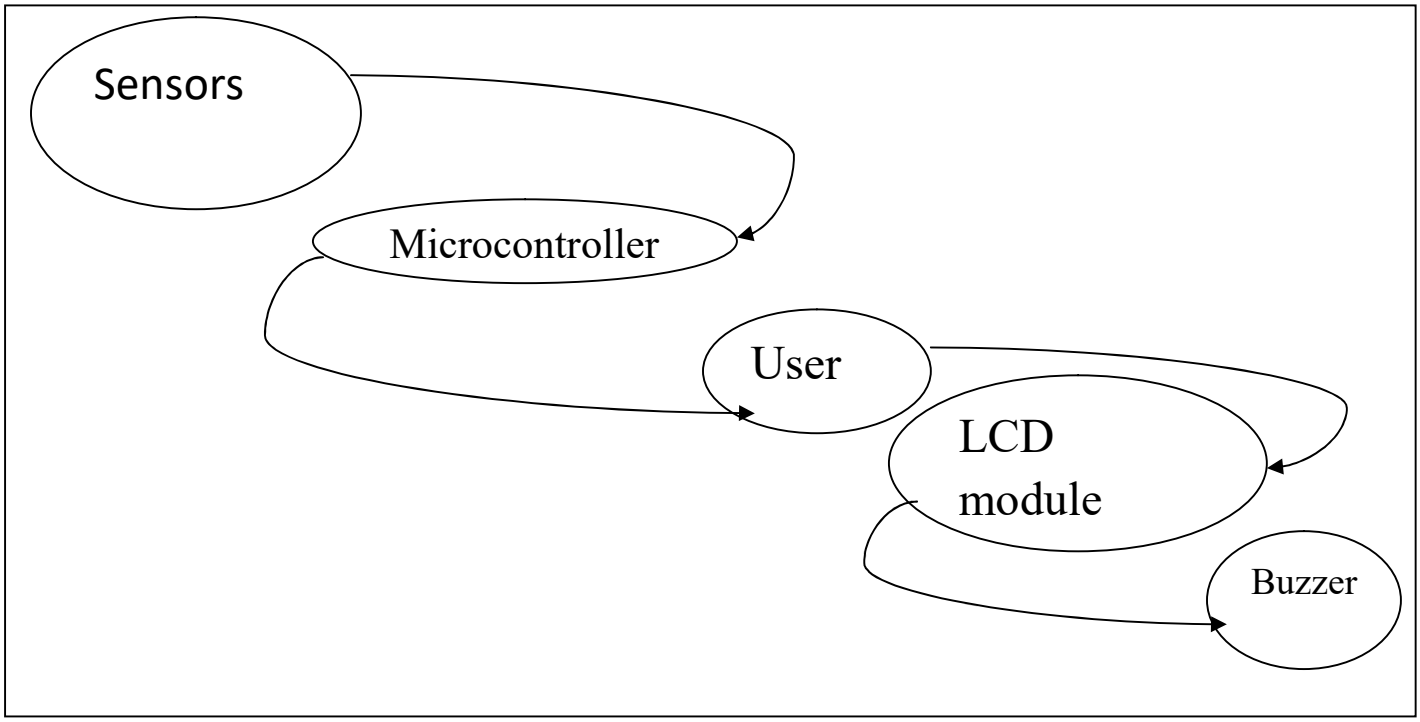

Figure.4.1 Frame work

4.2 BLOCK DIAGRAM

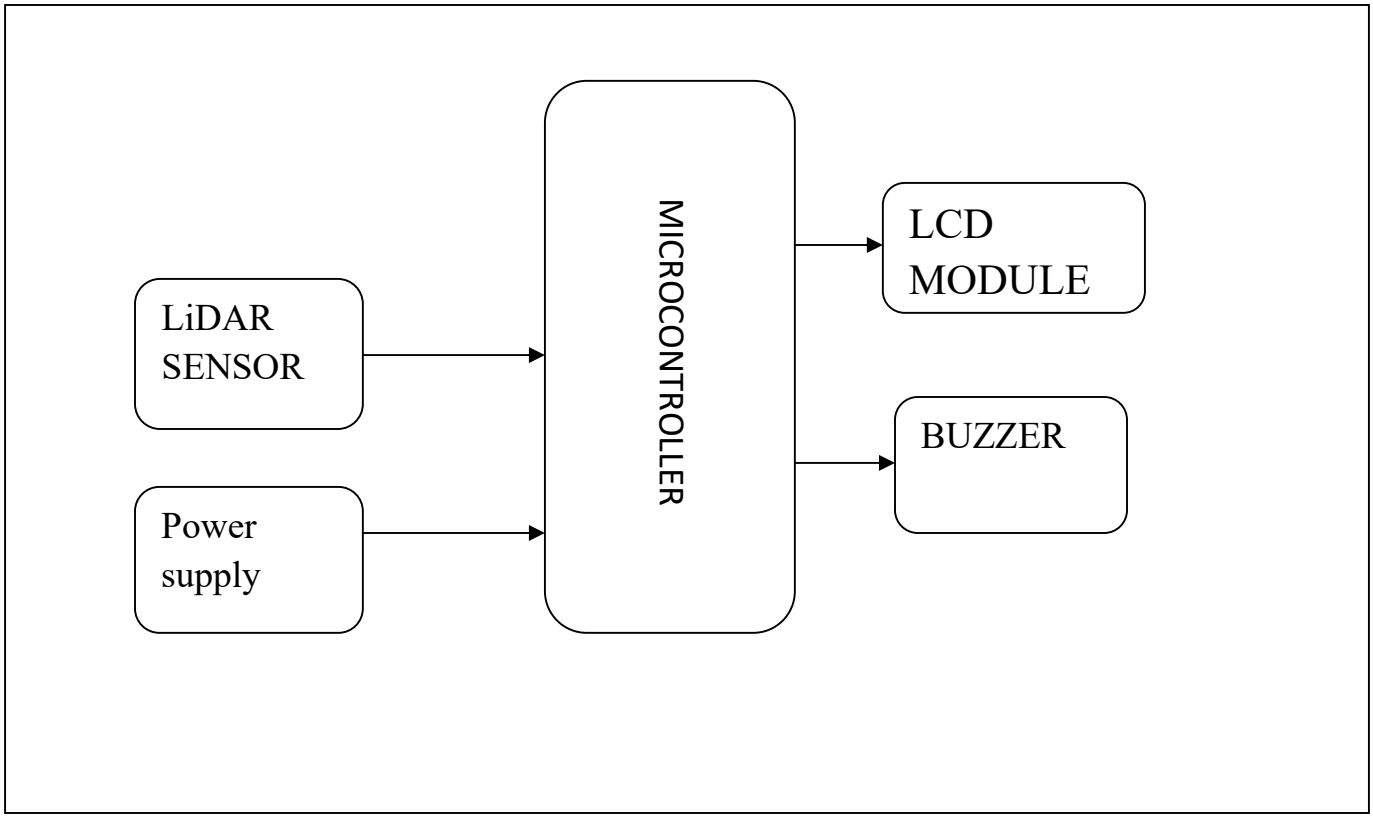

Figure.4.2 Block Diagram

The block diagram of the research and the complete flow of this project is shown in Figure. 4.2,

1. The input power supply is provided to the micro controller.
2. Now, the light detection and ranging sensor measures the distance.
3. If the distance of the vehicle and the obstacle is less than the given threshold the buzzer starts to alert.
4. The LCD module indicates the distance between the vehicle and the obstacle.
5. Now after completing the step 4 the process keeps on repeating.

4.3. CIRCUIT DIAGRAM

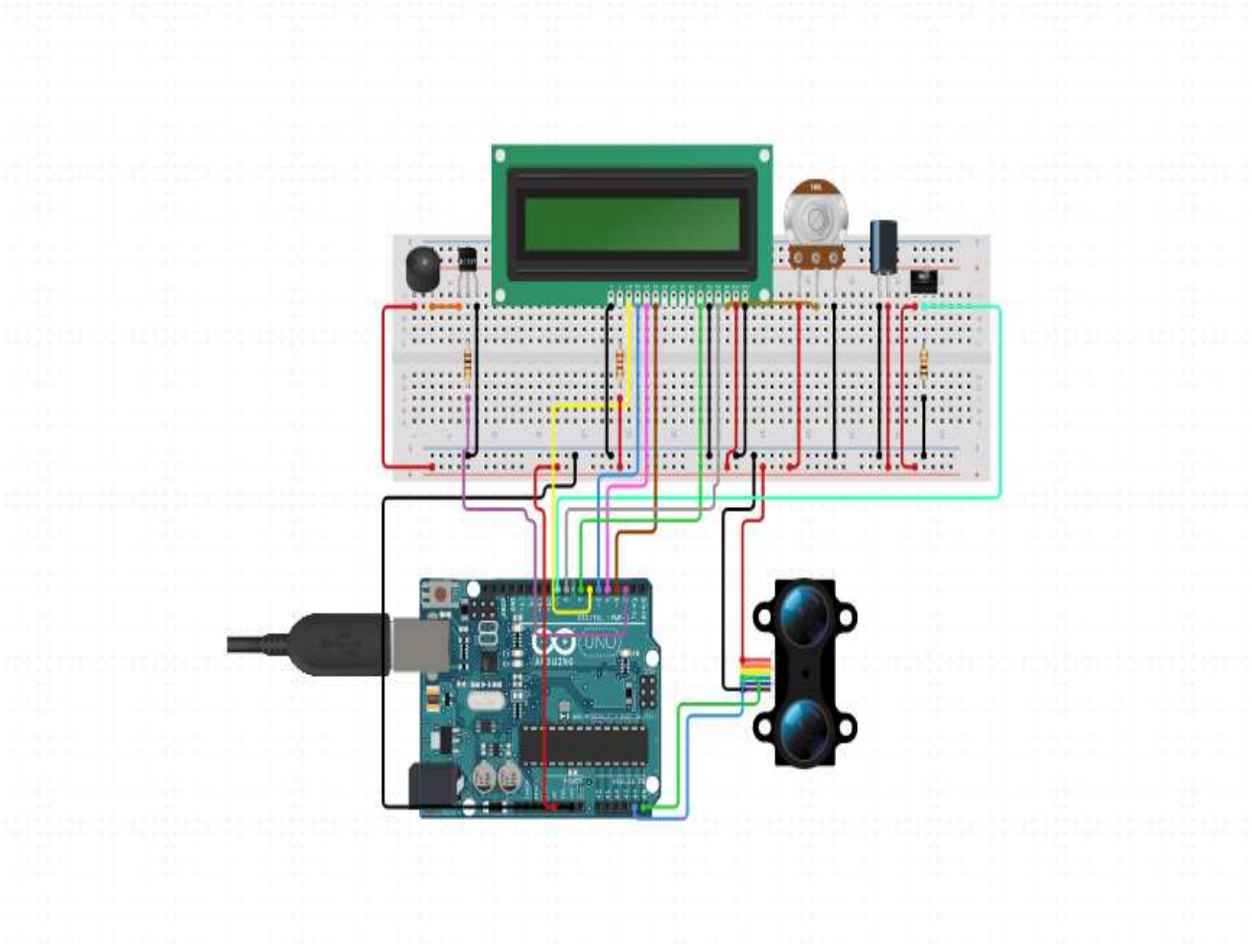

Figure 4.3 CIRCUIT DIAGRAM

WORKING

The circuit Figure 4.3, consists of micro controller, LiDAR sensor, LCD module and buzzer.

The working at this project is based on one condition

- If sensor detects the obstacle less than the threshold limit.

If the sensor detects the obstacle less than the threshold limit, then

- The driver gets alerted about the speed breaker with a buzzer sound.
- The LCD module displays the distance between the obstacle and the vehicle.
- Due to these conditions the driver gets to know about the speed breaker.
- The driver then slows down the vehicle and crosses the obstacle

Now again the process starts from the beginning.

CHAPTER-5

HARDWARE COMPONENTS

5.1 ARDUINO UNO

The predominant part of this system is the ARDUINO UNO. The ARDUINO UNO is shown in the Figure 5.1 ARDUINO UNO is a microcontroller. It is simple and smart, interactive, and programmable. The sole reason for using ARDUINO UNO is because of its compatibility and less power consumption and it are more users friendly too. This reduces the cost and hence ARDUINO UNO is cheaper than other devices available in market. The device can be physically handled as well. When an error is most likely to occur it can be rectified in an efficient manner also.

FIGURE 5.1 ARDUINO UNO

5.2 LiDAR sensor

The LiDAR sensor is abbreviated as light detection and ranging sensor. The LIDAR sensor us shown in the figure 5.2 is basically connected to the lower part of the vehicle.

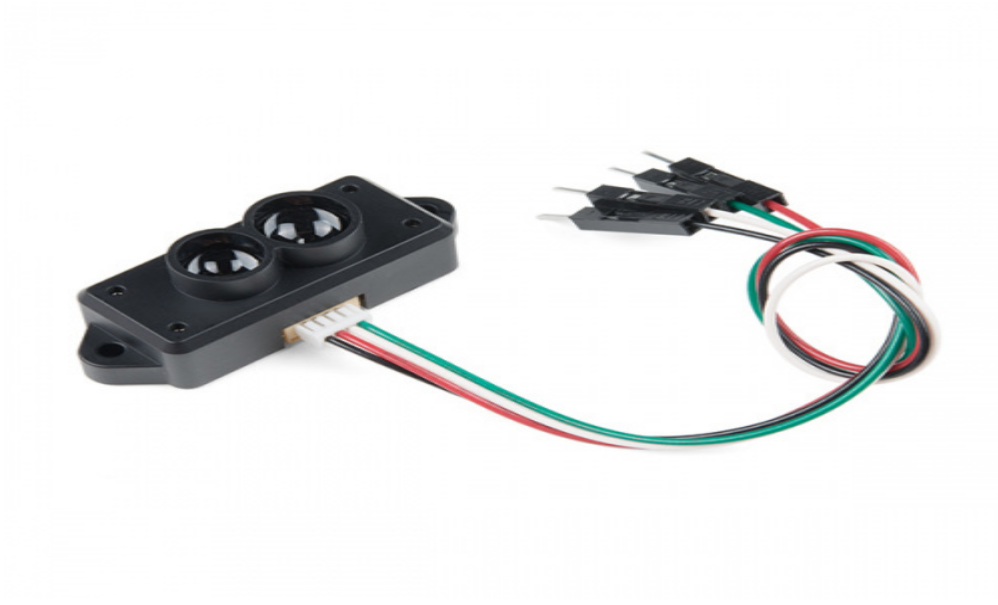

FIGURE 5.2 LIDAR SENSOR

LIDAR (sometimes also written as "LiDAR", "Lidar", or "LADAR") is used in a wide range of land management and planning efforts, including hazard assessment (including lava flows, landslides, tsunamis, and floods), forestry, agriculture, geologic mapping, and watershed and river surveys.

A LiDAR system calculates how long it takes for beams of light to hit an object or surface and reflect back to the laser scanner. The distance is then calculated using the velocity of light*. These are known as ‘Time of Flight’ measurements.

5.3 LCD MODULE

An LCD is **an electronic display module that uses liquid crystal to produce a visible image**. The 16×2 LCD display is a very basic module commonly used in DIYs and circuits. The 16×2 translates o a display 16 characters per line in 2 such lines.

Figure 5.3 LCD MODULE

5.4 BUZZER

A buzzer or beeper is an audio signaling device, which may be mechanical, electromechanical, or piezoelectric. Typical uses of buzzers and beepers include **alarm devices, timers, train and confirmation of user input such as a mouse click or keystroke**.

FIGURE 5.4 BUZZER

CHAPTER-6

SOFTWARE REQUIREMENTS

6.1 ARDUINO (IDE)

The ARDUINO Integrated Development Environment (IDE) is a cross platform application (for Windows, macOS, Linux) that is written in function from C and C++. It is used to write and upload program to ARDUINO compatible boards, but also, with the help of third-party cores, other vendor development boards.

User written code only requires two basic functions, for starting the sketch and the main program loop, that are compiled and linked with a program sub main() into an executable cyclic executive program with the GNU toolchaain, also included with the IDE distribution. By default, avrdude is used as the uploading tool to flash the user code onto official ARDUINO boards.

6.2 CODE

```
// Include Libraries

#include "Arduino.h"

#include "Buzzer.h"

#include "LiquidCrystal.h"

#include "LIDARLite.h"

#include "Wire.h"

#include "Button.h"



// Pin Definitions

#define BUZZER_PIN_SIG      2

#define LCD_PIN_RS     8

#define LCD_PIN_E       7

#define LCD_PIN_DB4  3

#define LCD_PIN_DB5  4

#define LCD_PIN_DB6  5

#define LCD_PIN_DB7  6

#define SLIDESWITCH_PIN_2          9
```

```
// Global variables and defines


// object initialization
Buzzer buzzer(BUZZER_PIN_SIG);
LiquidCrystallcd(LCD_PIN_RS,LCD_PIN_E,LCD_PIN_DB4,LCD_PIN_DB5,LCD_PIN_DB6,LCD_PIN_DB7);
LIDARLitelidarLite;
Button slideSwitch(SLIDESWITCH_PIN_2);


// define vars for testing menu
const int timeout = 10000;       //define timeout of 10 sec
char menuOption = 0;
long time0;


// Setup the essentials for your circuit to work. It runs first every time your circuit is powered with electricity.
```

```
void setup()
{
   // Setup Serial which is useful for debugging
   // Use the Serial Monitor to view printed messages
Serial.begin(9600);
   while (!Serial) ; // wait for serial port to connect. Needed for native USB
Serial.println("start");

   // set up the LCD's number of columns and rows
lcd.begin(16, 2);
lidarLite.begin(0, true); // Set configuration to default '0', change this number to try out alternate configurations. I2C speed set to 400 kHz.
slideSwitch.init();
menuOption = menu();

}

// Main logic of your circuit. It defines the interaction between the components you selected. After setup, it runs over and over again, in an eternal loop.
void loop()
```

```
{



if(menuOption == '1') {
   // Buzzer - Test Code
   // The buzzer will turn on and off for 500ms (0.5 sec)
buzzer.on();       // 1. turns on
delay(500);              // 2. waits 500 milliseconds (0.5 sec). Change the value in the brackets (500) for a longer or shorter delay in milliseconds.
buzzer.off();      // 3. turns off.
delay(500);              // 4. waits 500 milliseconds (0.5 sec). Change the value in the brackets (500) for a longer or shorter delay in milliseconds.
   }
   else if(menuOption == '2') {
   // LCD 16x2 - Test Code
   // Print a message to the LCD.
lcd.setCursor(0, 0);
lcd.print("Circuito Rocks !");
   // Turn off the display:
lcd.noDisplay();
```

```
delay(500);
   // Turn on the display:
lcd.display();
delay(500);
   }
   else if(menuOption == '3') {
   // LIDAR-Lite v3 - Test Code
   // Take a measurement with receiver bias correction and print to serial terminal
   int lidarLiteDist = lidarLite.distance();
Serial.print(lidarLiteDist);
Serial.println(" [cm]");
delay(50);
   }
   else if(menuOption == '4') {
   // SPDT Slide Switch (Breadboard-friendly) - Test Code
   //read Slide Switch state.
   //if Switch is open function will return LOW (0).
   //if it is closed function will return HIGH (1).
   bool slideSwitchVal = slideSwitch.read();
```

```
Serial.print(F("Val: ")); Serial.println(slideSwitchVal);
    }


    if (millis() - time0 > timeout)
    {
menuOption = menu();
    }


}




// Menu function for selecting the components to be tested
// Follow serial monitor for instrcutions
char menu()
{


Serial.println(F("\nWhich component would you like to test?"));
Serial.println(F("(1) Buzzer"));
```

```
Serial.println(F("(2) LCD 16x2"));
Serial.println(F("(3) LIDAR-Lite v3"));
Serial.println(F("(4) SPDT Slide Switch (Breadboard-friendly)"));
Serial.println(F("(menu) send anything else or press on board reset button\n"));
   while (!Serial.available());

   // Read data from serial monitor if received
   while (Serial.available())
   {
      char c = Serial.read();
      if (isAlphaNumeric(c))
      {

if(c == '1')
                        Serial.println(F("Now Testing Buzzer"));
                else if(c == '2')
                        Serial.println(F("Now Testing LCD 16x2"));
                else if(c == '3')
                        Serial.println(F("Now Testing LIDAR-Lite v3"));
```

```
            else if(c == '4')
                    Serial.println(F("Now Testing SPDT Slide Switch (Breadboard-
friendly)"));
        else
        {
Serial.println(F("illegal input!"));
            return 0;
        }
        time0 = millis();
        return c;
      }
   }
}
```

CHAPTER-7

IMPLEMENTATION AND WORKING

7.1 WORKING METHODOLOGY

The connections are made like the above given figure block diagram. Then it starts to upload its data to the hardware device that is to ARDUINO UNO. The these data are being executed. The execution stage incorporates different stages like calculating the distance, checking the distance with the given threshold value, sending output to the LCD module and the Buzzer.

The figure 7.1 prototype displays the various components that process the different parameters. Similarly, the figure 7.2 displays the output of the designed prototype which is displayed on the LCD.

7.2 PROTOTYPE OF THE PROJECT

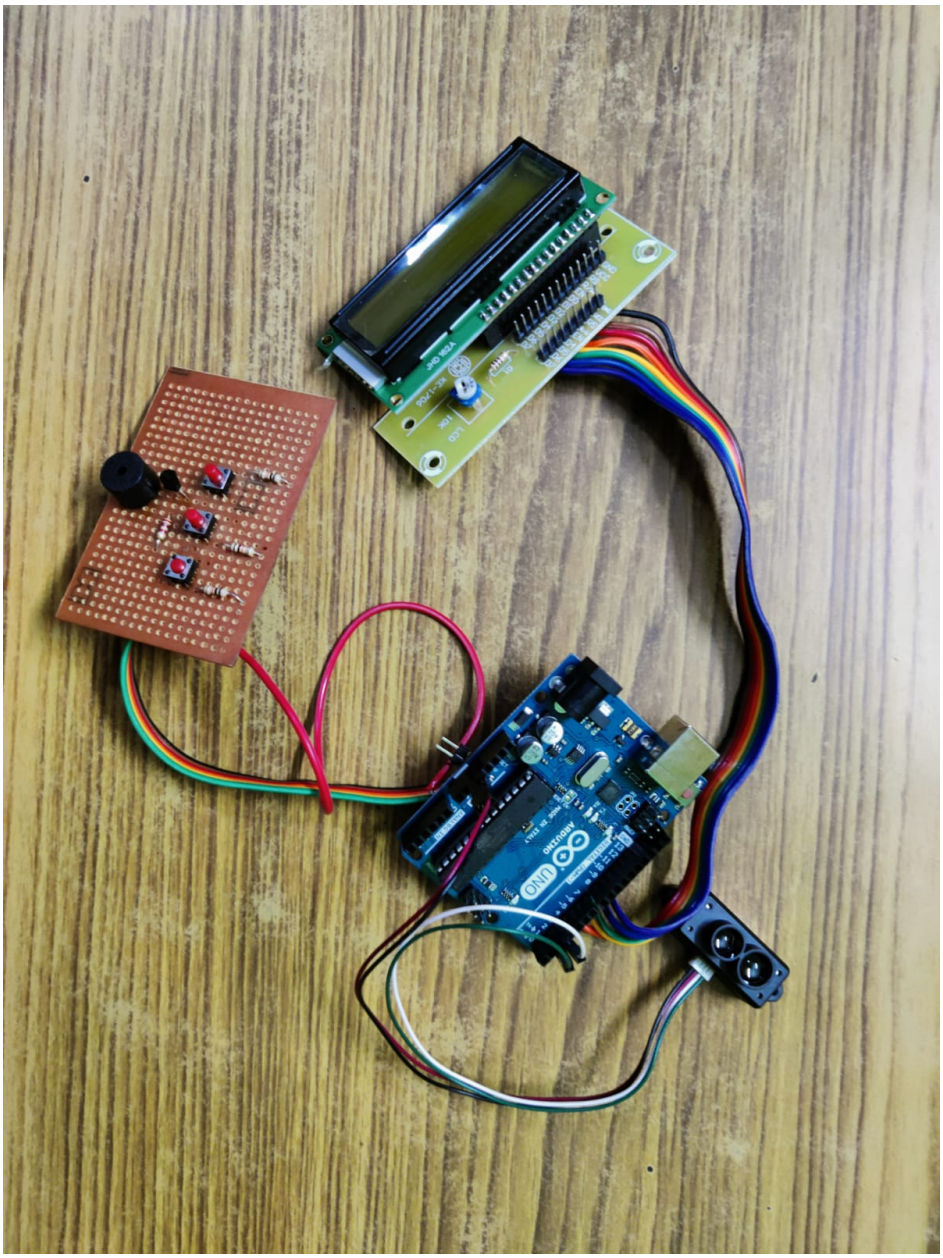

Figure 7.1 PROTOTYPE OF THE PROJECT

7.3 OUTPUT OF THE MODEL

Figure 7.2 OUTPUT OF THE WARNING OF PROTOTYPE

The above output indicates the warning for the prototype when the threshold for detecting the obstacle was given as 100 centimeters so that the indication in the LCD module and the buzzer also indicates the driver about the detected obstacle.

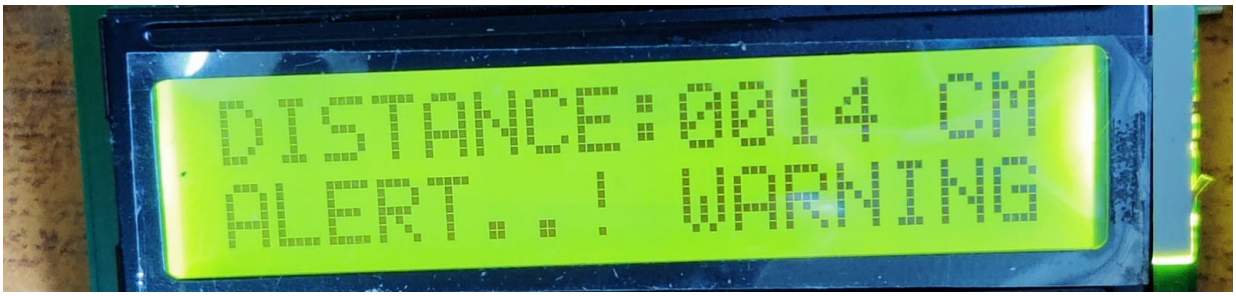

Figure 7.3 OUTPUT WARNING OF THE PROTOTYPE

The output of the prototype indicates the distance between the vehicle and the obstacle when the obstacle is found less than the threshold then the warning is created as indicated in figure 7.2

CHAPTER-8

RESULT AND DISCUSSION

This embedded system based **SPEED BREAKER EARLY WARNING SYSTEM USING LIDAR SENSOR** created a new driving experience. The drivers got alerted when a speed breaker is mostly to occur and they sensed to reduce the speed of the moving vehicle so that the speed limitation to cross the speed breaker is achieved. The passengers on other end too experienced a smooth riding experience as the vehicle got slow in the speed breaker and so there is no sudden jerk of the vehicle while crossing the speed breaker. This speed breaker early warning system also reduces the road accidents which are caused due to the speeding of the car when the speed breaker is likely to occur. The project also reduced the damage to the car avoiding the car to getting dumped in the speed breaker. Later on, this project will create a trend in automobile industry and empower more extensive utilization of the embedded systems.

CHAPTER-9

CONCLUSION

This speed breaker early warning system is an embedded system based project where the accuracy to calculate the distance using LIDAR sensor is achieved. The driver then gets to notified by the forth coming obstacle and the driver can reduce the speed of the vehicle which in turn makes the driver to sense the environment. This result to reduce the road accidents in a very consistent manner. The vehicle can also be prevented from being dumped into the speed breaker. The project also makes the driver to note the obstacle in road if any. The project will create a new driving experience.

This project implies the embedded system to solve real time problem which we all face while driving. This project makes the driver to be alert about the surrounding obstacles. This project was made much more efficient by the usage of the LIDAR sensor than using sensors like ultrasonic sensors for distance measurement. The distance calculated by the LIDAR sensor has higher efficiency than any other distance measuring sensors. This project is of more practical related and user friendly and can be installed easily.

CHAPTER-10

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