Driver's Mate To Prevent Accidents on Sharp Turns in Mountainous Areas

Kiran Rathi
Department of Electronics and Communication
Swami Keshvanand Institute of Technology,
Management & Gramothan
Jaipur, India

Udyan Srivastava
Department of Electronics and Communication
Swami Keshvanand Institute of Technology,
Management & Gramothan
Jaipur, India

Abstract— **Road traffic accidents claim the lives of around 1.3 million individuals each year. Accidents in hilly areas contribute a large part to these crashes. The main reason behind these accidents is the lack of visibility at sharp turns. An economical and reliable system is required which alerts the driver about the presence of an object on another side of the turn so that the accident could be avoided. In this article, a system based on an ultrasonic sensor, infrared sensor, Arduino Uno, LEDs, and LCD is presented which can be easily implemented in the hilly areas to prevent accidents.**

Keywords— *Road safety, Arduino, Ultrasonic Sensor, Infrared Sensor, alert system, hilly areas*

I. INTRODUCTION

In 2017, the number of accidents on curved roads was 54,077 of which 17,814 people died and 57,346 were injured. In 2018, the number of accidents increased by 18.5 % and resulted in 64,100 accidents, 19,996 deaths, and 68,878 injuries [1]. The main reason behind these accidents is lack of visibility as the driver is not aware of the presence of an object on the other side of the turn and hence, they are not able to control the vehicle which results in a collision and fatal injuries.

These accidents could have been prevented if the driver got an early alert about the presence of an object on another side of the turn. When used properly, a horn can be used for this purpose. However, it is not a good idea to use it during the rainy season as it can't be heard [2].

To prevent such accidents, an ultrasonic-based alert system is presented in this article which will alert the driver about the presence of another vehicle so that the driver can consciously control the vehicle and the accident could be avoided.

II. OVERVIEW OF EXISTING SYSTEMS

Nowadays automobiles are equipped with features like Automatic Emergency Brake (AEB), Auto-Steering, Forward Collision warning which assist the driver in situations when the accident is about to happen.

A. Automatic Emergency Brake

AEB is a new technology that warns a driver of an impending collision and aids the driver in utilising the vehicle's maximum braking capability. AEB can stop autonomously if the situation gets serious and the driver does not respond.

B. Steering Pattern Detection System

The vehicle's steering pattern recognition system uses an electronic monitoring system to record the movements of the steering wheel. It can also notify the driver if it gets suspicious. [3].

C. Forward Collision Warning System

The system uses a radar sensor in the front of the car to determine the distance between the vehicles ahead and their relative speed. It then prompts the driver to slow down when the vehicle suddenly changes its direction. [4].

D. Drawbacks of Current Systems

The mentioned systems are effective but not much efficient. Automatic Emergency Break might not work at sharp turns because it would not get much time to respond. Steering Pattern Detection System alerts the driver when it detects something abnormal but at sharp turns, the driver may not be able to control the vehicle if the object is too close. Forward Collision Warning technology works on plain and straight roads and it is not effective on curvy roads. Hence, these features are individually effective but collectively not efficient on sharp turns. The proposed system detects the chance of an accident early and alerts the driver so that the accident could be prevented.

III. PROPOSED SYSTEM

The system consists of an Infrared sensor, Ultrasonic sensor, Arduino Uno, LEDs, and LCD. Arduino IDE is used to program the Arduino UNO. An infrared sensor is placed at a pole on the sharp turn to detect the presence of an object. As soon as it detects, it sends a signal to the microcontroller. An ultrasonic sensor is also placed with the infrared sensor which measures the distance of the object and displays it on the LCD with the help of a microcontroller. LEDs of different colours glow according to the distance between the turn and the object to alert the driver. An identical setup will be placed on the other side of the road to increase the overall accuracy of the system. This system is efficient and can be implemented easily on the sharp turns of mountainous roads to avoid accidents. The speed of sound waves in air is 343 m/s, which is equal to 29.1 microseconds/cm. As a result, the following formula is used to determine the distance:

$$D = (t / 2)/29.1$$

where,
d = distance between ultrasonics sensor and object
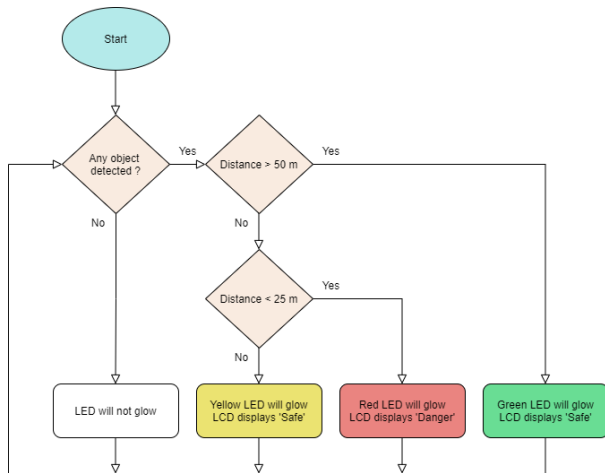t = time taken by ultrasonic wave to travel back and forth

Fig 1: Block Diagram of Proposed System

IV. SYSTEM DESIGN

The designed system is divided into two parts:

1. Hardware Design
2. Software Design

A. Hardware Design

Infrared and ultrasonic sensor detect the presence of an object on the other side of turn and sends the signal to the microcontroller. The microcontroller processes the signal and sends the instruction to LEDs and LCD.
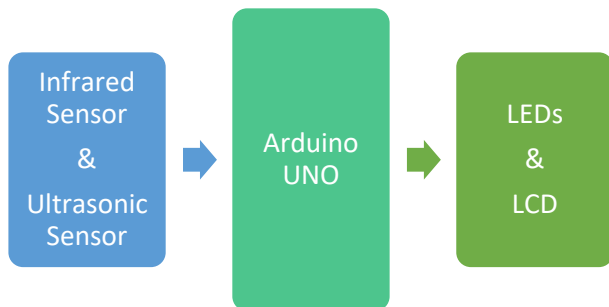

Fig 2: Block Diagram of the system

a. Arduino Uno

The Arduino Uno is a 14 digital I/O pins board (including 6 PWM outputs) having 6 analog inputs, a power jack and a USB connector. It is based on ATmega 328P. This package includes everything needed to start using the microcontroller unit [5].
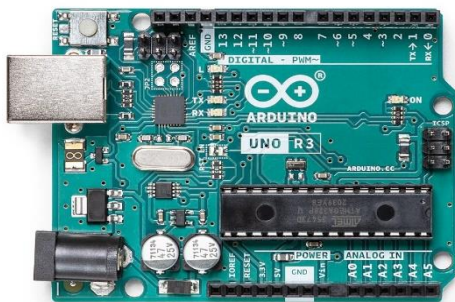

Fig 3: Arduino Uno

b. HC-SR04 Ultrasonic Sensor

This is a distance sensor which is used frequently with Arduino, ARM, PIC, Raspberry Pi, and other microcontroller and microprocessor platforms.

A +5V regulated supply is given to the sensor through ground pins and Vcc of the microcontroller. This sensor consumes less than 15mA current and therefore it can be powered through the onboard 5V pins. Both the Echo and the Trigger pins are I/O pins that can be connected to the microcontroller's I/O pins. For the measurement, the trigger pin should be kept high for 10 microseconds and then it is turned off. Due to this operation the transmitter emits a 40Hz frequency ultrasonic wave, and the receiver waits for returning wave. After being reflected by any object as the wave is back to the sensor, the Echo pin becomes high for a time period which will be equal to the time taken by the wave in returning to the sensor.

The time for which Echo pin remains high is measured by the MCU/MPU as it determines the time taken by the wave to return to the sensor. The distance is calculated using this information. [6].

Fig 4: Working of an Ultrasonic Sensor

c. Infrared Sensor

The IR Transmitter and Receiver, Variable Resistor (Trimmer pot), Op-amp, and output LED are the major components of the IR sensor module. Infrared LEDs emit light in the infrared frequency range. We can't see infrared light because its wavelength (700nm – 1mm) is significantly longer than visible light. When light strikes on a photodiode, it conducts and functions as an IR receiver. As a voltage comparator, the IR sensor uses an LM358 Operational Amplifier (Op-Amp). The comparator compares the photodiode's series resistor voltage (pin 3) with the preset threshold voltage (pin 2). The variable resistor is used to tune the distance detection range for the object.

The VCC pin receives a 5 VDC supply, and the negative supply is linked to the module's GND terminal. When an item is detected within the IR sensor's range, the output LED illuminates and remains off in otherwise conditions. [7].

Fig 5: Infrared Sensor Module

B. Software Design

The programming of the whole system is done in Arduino IDE,
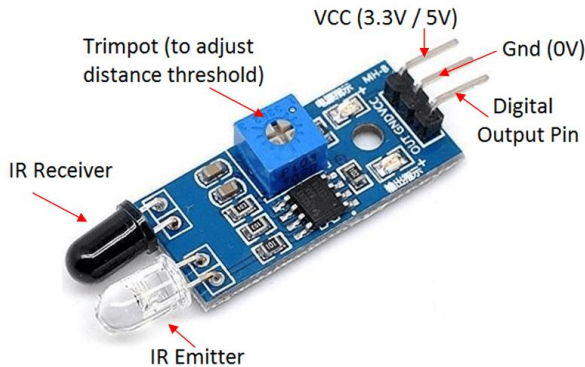
which is an open-source software used to program any Arduino board. A pulse signal is generated and sent through the trigger pin of the ultrasonic sensor. It reflects and is received by the echo pin whenever it strikes an object. The distance between the sensor and the object is determined using the received data. Based on the calculated distance, Arduino sends the instructions to the LEDs and LCD. If no signal is received by the echo pin, then the microcontroller sends the instruction to LCD to display the message that the road is safe to go. The output of the infrared signal is also sent to the microcontroller and actions are taken based on the programming.
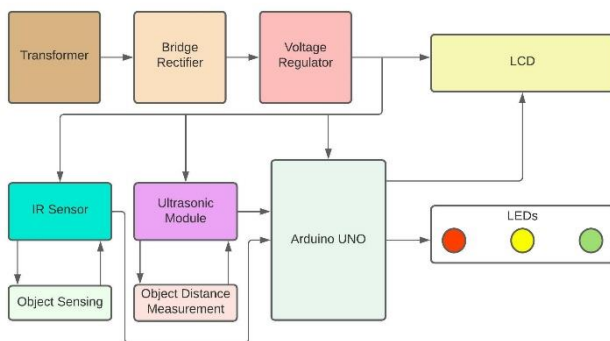

Fig 6: Working Module of the system

V. SIMULATION

Proteus 8 Professional software is used to simulate the system. The simulation's outcomes are displayed below.:
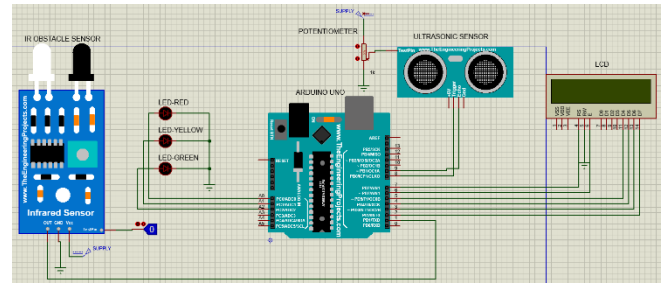

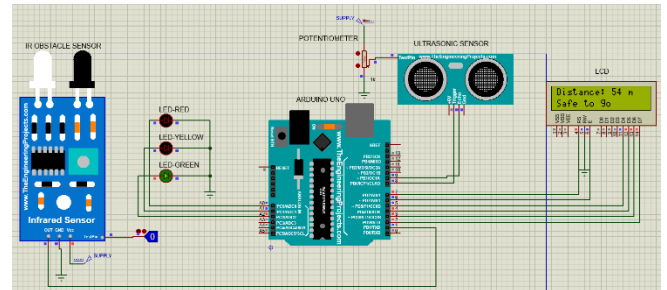Fig 7: Circuit Diagram of System simulation on Proteus

Fig 8: Green LED glows and LCD shows 'Safe to go' when distance is more than 50 m
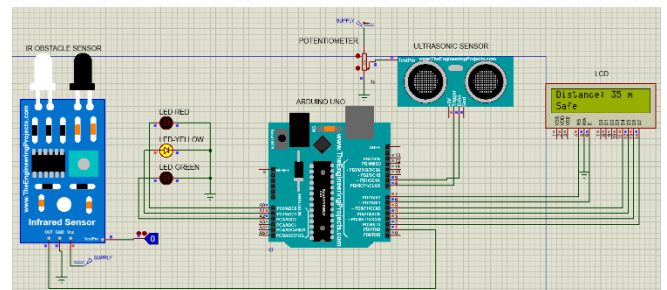

Fig 9: Yellow LED glows and LCD shows 'Safe' when distance is more than 25 m and less than 50 m
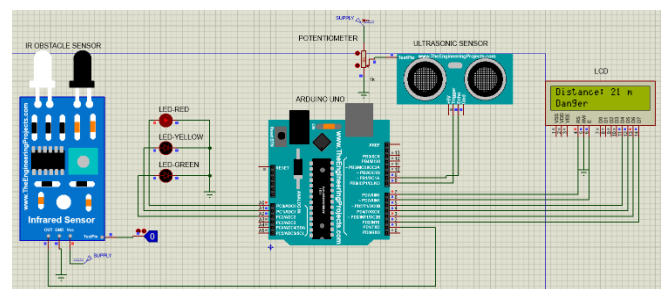

Fig 10: Red LED glows and LCD shows 'Danger' when distance is more than 25 m

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driver_mate

```arduino
#include <LiquidCrystal.h>

#define trigPin 8
#define echoPin 9
#define redLed A0
#define yellowLed A1
#define greenLed A2
#define infraredPin 1

//                BS  E  D4 D5  D6 D7
LiquidCrystal lcd(7, 6, 5, 4, 3, 2);

int pos = 0;

void setup() {
  pinMode(trigPin, OUTPUT);
  pinMode(echoPin, INPUT);
  pinMode(redLed, OUTPUT);
  pinMode(yellowLed, OUTPUT);
  pinMode(greenLed, OUTPUT);
  pinMode(infraredPin, INPUT);

 lcd.begin(16,2);

  lcd.setCursor(0, 0);
lcd.clear();
   delay(1000);
}

void loop() {
  long duration, distance;
  digitalWrite(trigPin, LOW);
  delayMicroseconds(2);
  digitalWrite(trigPin, HIGH);
  delayMicroseconds(10); // Added this line
  digitalWrite(trigPin, LOW);
  duration = pulseIn(echoPin, HIGH);
  distance = (duration/2) / 29.1;

if(infraredPin==HIGH && distance>50)
{
  digitalWrite(A0, LOW);
  digitalWrite(A1, LOW);
```

Fig 11: Snippet of the Arduino Program

VI. CONCLUSION

The proposed system can reduce the accidents in hilly areas to a great extent. The algorithm and the code used to design the system is efficient in taking precise readings and helping the driver to take appropriate action. The device can be scaled to industry standards and provide a cost-efficient safety feature.

VII. REFERENCES

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