GE107-Tinkering Lab
PROJECT REPORT

Drowsiness Detection System

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Abstract

The main idea behind this project is to develop a nonintrusive system which can detect fatigue of any human and can issue a timely warning. Drivers who do not take regular breaks when driving long distances run a high risk of becoming drowsy, a state which they often fail to recognize early enough. According to the expert's studies show that around one quarter of all serious motorway accidents are attributable to sleepy drivers in need of a rest, meaning that drowsiness causes more road accidents than drink-driving. This system will monitor the driver's eyes using a eye blink sensor and by developing an algorithm of time difference between eye open and eye closing, we can detect symptoms of driver fatigue early enough to avoid the person from sleeping. If the driver is found to be drowsiness in the eyes for more than 2 seconds, then the eye blink sensor senses the blink rate. If the eyes are found to be closed, then the buzzer buzzes and thus the driver got alerted. These sensors are interfaced with Arduino UNO. Buzzer rings in case of drowsiness detection and speed of the car varies on detection of both cases.

Keywords: drowsiness detection, driver fatigue, eye blink detection, eyeblink sensor, IR sensor (Infrared rays).

Introduction

Driving while drowsy or in a drunk state are the two main reasons for traffic accidents and its related financial losses. Most countries cost 3% of their GDP due to road crashes and nearly about 1.35 million people die each year. In the case of India, India constitutes 1% of vehicle population but 6% of total global road accidents and approximately 151 thousand road accident deaths. One of the primary agencies that conducts research on road and driver safety is the national highway traffic safety administration. In a study looking at critical reasons for road accidents 94% of car accidents are caused by drivers out of which 25 to 30% of accidents are caused due to drowsiness and drunk driving. Apart from improvised automobile structures to reduce the accidents, drivers' attitude while driving is not addressed properly to evaluate drivers in attention. There are three main approaches to go through they are visual based approach, driving behaviour-based approach and physiological technique involving analysis of vital signals like brain activity, heart and pulse rate. This requires the usage of electronic devices which are attached to drivers' body can act as annoyance to the driver. Driving behaviour-based approach evaluates drivers' behaviour over a period of time by observing variations in the speed, steering wheel angle, acceleration, lateral position and breaking. Through this parameter the driver's attention and activities can be measured. A complete drowsiness detection system demonstrated a real-time approach to detect driver's distraction using eye movements and driving performance, and date was made to train and test both support vector machining and logistics regression models to recognise driver's distraction Visual based approach analyses drivers' facial images like eye blinks, yawning and head movements. Hammond et.al proposed a drowsiness detection system through assessment of eye status in the near infrared spectrum. Moriyama et al predicted the eye

status by using templates to match with eyelids. Number of eye blinks of the driver is another method to detect drowsiness. This approach based on visual features are preferred because of its non-interference with the driver. Most of the published research on computer vision approaches to detection of fatigue has been focused on the analysis of blinks and head movements. However, in the fatigue detection systems developed to date, drowsiness warning systems using image processing have become most widely used because it provides a remote detection. Due to the increase in the amount of automobiles in recent years, problems created by accidents have become more complex as well. Traditional transportation system is no longer sufficient. In recent years, the intelligent vehicle system has emerged and became a popular topic among transportation researchers. However, the research of safety in vehicles is an important subset of intelligent vehicle system research. Meantime, an active warning system is one of the designs on active safety systems. The safety warning systems, mostly active warning systems for preventing traffic accidents have been attracting researchers. Owing to the progress of digital signal processing technology, real time image processing is beginning to achieve breakthroughs in the field of many practical applications. Typically, after high hours of driving or in the absence of an alert mental state, the eyelids of the driver will become heavy due to fatigue. The attention of the driver starts to lose focus, and that creates risks for accidents. These are typical reactions of fatigue, which is very dangerous. Usually, many exhausted drivers are not aware that they are falling asleep. In fact, many such drivers can fall asleep any time during their driving.

Related Work

Previous works are reportable within the literature survey to drop the number of road accidents due to drowsiness detection and monitoring drowsiness systems based on real-time data.

Various researches are done to calculate driver drowsiness based on objective and subjective measurements . Measurements related to the subject are related to questionnaires given to drivers . P.Davidson et al. designed a simple system that uses the Haar Algorithmic program to detect objects and facial features using OpenCV libraries. The eye region is captured from captured images with measurement factors. Then they find the eyelid to live the extent of the eye closure. A. Paola designed a method to notice symptoms of driver sleepiness supported by an infrared camera. By exploiting the development of bright features, AN algorithmic program for sleuthing and to pursue the driver's eyes have been designed. Once sleepiness is detected, the application warns the motive force with an alarm message. C Kumar used the method called Otsu thresholding to detect facial features. The attention is created by finding face features and main points like hair and possible face center . Morphological operation and Kmeans is used for correct eye detecting. Then a proper set of form options square measure calculated and the trained exploitation non-linear SVM to urge the standing of the attention. There are various factors that reflect driver driving behavior and performance which include environment issues like (climate changes, bad road conditions), physiological and biological

factors (tiredness, age) social and economic factors (alcohol, drugs, tobacco, irregular work shift) and issues related to vehicle (bad condition, damaged vehicle) all these factors will affect the driving force at bigger extent each mentally and physically. In this method there are drawbacks like analysis is conducted either before or after driving events and driver drowsiness connected problems are not taken into consideration through driving tasks For nearly the last 20 years, Methods like muscle fatigue estimation based diagnostic methods have contended significant importance in detecting driver fatigue physically. SEMG has been used as a base for various other researchers to find out muscle fatigue in several forms of vehicles which include cars, two-wheelers, heavy vehicles. The modification in the electromyogram method was related to muscle metabolic process which can find driver fatigue physically.There are chances of using highly sensitive sensors like Load cell primarily based on low-value Nanostructured compound into handwheel which has the technology to track reading in a real-time environment and send details to hardware for monitoring pressure, so as to form a better detection system which can combine both physical and facial features. In particular, we have the option to design an effective integrated system to observe the pressure of the driver hand on handwheel and eye blinking features. This system uses both camera- based and sensor-based solutions and therefore the signals incoming from both sensor and camera threshold values are calculated. Previous works have through the subsequent physiological signal to detect drowsiness: Graphical record ECG, myogram EMG, Electron-cephalogram EEG, and electrooculogram EoG. Previous works have used EOG signals to spot driver sleepiness through changes in eye movement. The electric difference between the tissue layers generates different electrical fields that give different signals from eye orientation; these chances are measured as EOG signals. Previous research has investigated changes in eye movement by inserting a disposable Ag-Cl conductor on either side of the eye and 3rd conductor in the middle of the head for reference. Based on these signals given by electrodes on different parameters like speed and slow-motion movements of eye drowsiness are detected, a decision is taken to inform the user.

Methodology: System Architecture which contains Components used for the project, Figures, Explanations, Codes etc [8 marks]

Results and conclusion: 1 page [3 marks]

Methodology

In this section , we are going to see the Design Requirements of the project and about the components used in this project.

As we know , the basic purpose of this system is to track the driver's eye movements using Eye blink Sensor and if the driver is feeling drowsy, then the system will trigger a warning message using a loud buzzer alert. And this is done with the help of the following components.

This system utilized an image processing technique to detect the eye blink of the driver. If the driver's eyes remain closed for a certain period of time, the driver is said to be drowsy. As a result we get immediate information related to the driver's condition and speed of the vehicle is reduced which reduces the chances of road accidents. In the training phase, the system uses the input image of driver from real time camera and input image undergoes several image processing steps and required feature is extracted from an image

Materials required for this project are as*:-*

1. Arduino Nano
2. Eyeblink Sensor
3. RF Transceiver Module
4. HT12D and HT12E Integrated circuits
5. Buzzer
6. 9V Battery
7. 12V DC power supply
8. Transistors
9. Capacitors

1. Arduino Nano

Arduino is an open source computer hardware and software company, project, and user community that designs and manufactures single-board microcontrollers. The microcontroller kits are used for building digital devices and interactive objects that can sense and control objects in the physical world. The project's products are distributed as open- source hardware and software, which are licensed under the GNU Lesser General Public License

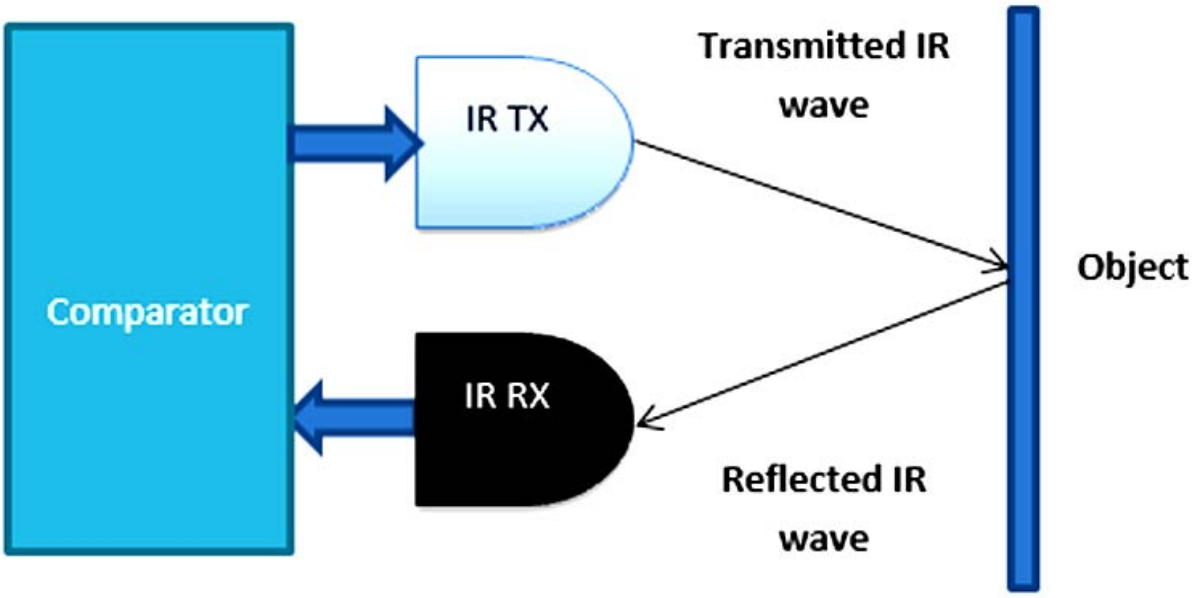
(LGPL).General Public License (GPL), permitting the manufacture of Arduino boards and software distribution by all.

Arduino came with a common platform Integrated Development Environment. The Arduino UNO is a microcontroller board based on the ATmega328. It has 14 digital Input/output pins , 6 analog inputs, a 16 MHz crystal oscillator, a USB connection, a power jack, an ICSP header, and a reset button. The Arduino UNO is a microcontroller board based on the ATmega328. It has 14 digital input/output pins of which 6 can be used as PWM outputs, 6 analog inputs, a 16 MHz crystal oscillator, a USB connection, a power jack, an ICSP header, and a reset button. It is connected to a computer with a USB cable or power it with a AC-to-DC adapter or battery to get started.

2. Eye Blink Sensor

The eye blink sensor is used to detect the eye blinks and using which we can also detect the activities like the Drowsiness of the driver while driving.It works by illuminating the eye and eyelid area with infrared light, then monitoring the changes in the reflected light using a phototransistor and differentiator circuit. It contains an Infrared transmitter and Receiver LED which is used to detect the eye blink.The exact functionality depends greatly on the positioning and aiming of the emitter and detector with respect to the eye.

The working of the simple IR sensor is shown as below:



As shown in the image above, infrared sensors consist of two elements: an infrared transmitter which acts as the source, and infrared receiver which acts as the receiver. Infrared sources include an IR LED and Infrared detectors include photodiodes. The energy emitted by the infrared source is reflected by an object and falls back on the infrared detector. When the light emitted by the IR LED falls on the receiver, the resistance of the photodiode falls down significantly. This photoreceiver is connected with a potentiometer to form a voltage divider circuit, which gives a variable analog output when blinking activity is detected.

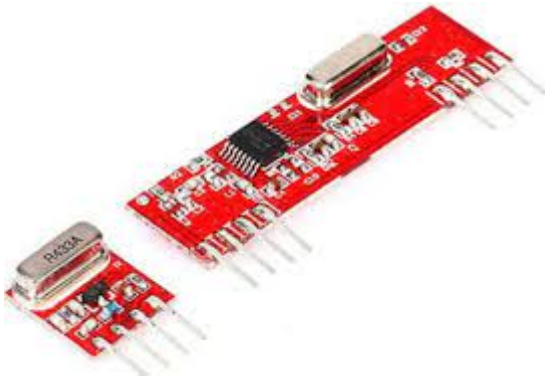
When the incident radiation is more on the photodiode, the voltage drop across the series resistor/Potentiometer will be high. In the Comparator IC which is nothing but Operational **Amplifiers**, or **Op-amps**, both the reference analog voltage and the actual output voltages are compared. If the voltage across the resistor series to the photodiode is greater than that of the reference voltage, the output of the comparator is high, else Low. As the output of the comparator is connected to an LED, it glows when the sensor detects some activity such as eye blinking. The threshold voltage can be adjusted by adjusting the potentiometer depending on the environmental conditions.

Technical Specifications of Eye Blink Sensor

- Working Voltage: 5V DC
- Output: TTL(5V/0V)
- Onboard 3 Pin Header for connections
- Infrared Technology

3. RF Transceiver Module

The RF stands for Radio Frequency. The corresponding frequency range varies between 30 kHz & 300 GHz. Here we are using a **433 MHz RF Transceiver Module**. This **RF module** comprises a 433 MHz **RF Transmitter** and **RF Receiver**. The transmitter/receiver (Tx/Rx) pair operates at a frequency of **433 MHz.** An RF transmitter receives serial data and transmits it wirelessly through RF through its antenna. The transmitted data is received by an RF receiver operating at the same frequency as that of the transmitter.



RF Transmitter

The RF transmitter module uses **Amplitude Shift Keying** (ASK) and operates at 433MHz. The transmitter module takes serial data input and transmits that signal through RF. The transmitted signals are then received by the receiver module wirelessly.

1. Ground: **Transmitter ground.** Connect to the ground plane
2. Data: Serial data input pin
3. VCC: Supply voltage; 5V
4. ANT: Antenna output pin

RF Receiver

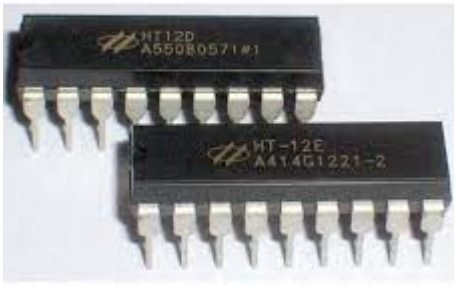
The RF receiver module receives the data and sends it to the data OUTPUT pin. The output data can be decoded by the Microcontroller for further action.

1. Ground: **Receiver ground.** Connect to the ground plane
2. Data: Serial data output pin
3. VCC: Supply voltage; 5V
4. ANT: Antenna output pin

4. HT12E and HT12D I.C.s

The HT12E Encoder ICs are a series of CMOS LSIs for Remote Control system applications. They are capable of Encoding 12 bits of information which consists of N address bits and 12-N data bits. Each address/data input is externally trinary programmable if bonded out.

The HT 12D ICs are a series of CMOS LSIs for remote control system applications. These ICs are paired with each other. For proper operation, a pair of encoder/decoder with the same number of address and data format should be selected. The Decoder receives the serial address and data from its corresponding decoder, transmitted by a carrier using an RF transmission medium and gives output to the output pins after processing the data.



Code

```
int flag=0;

int t1=0;

int t2=0;

int buzzerpin=7;

int sensorpin=2;

void setup()
```

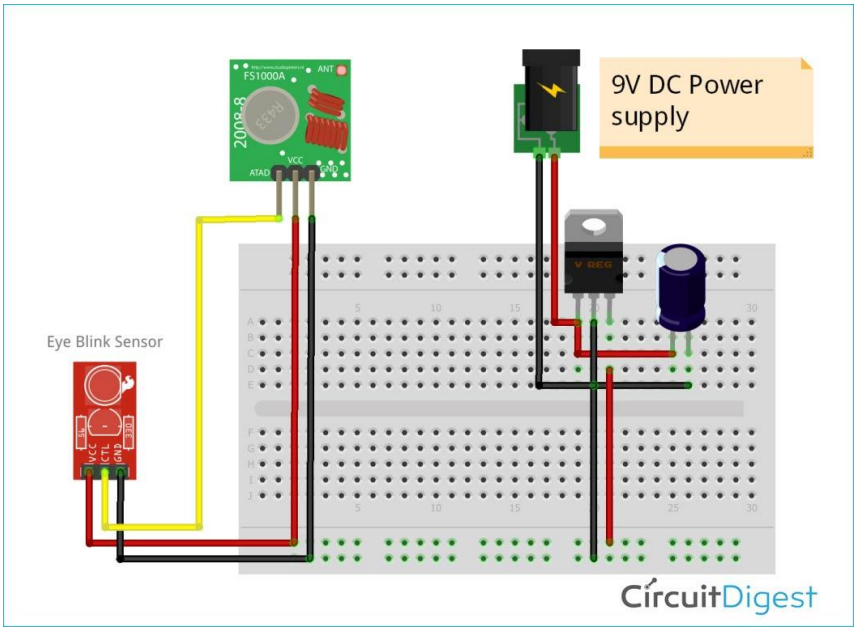
```
{
  Serial.begin(9600);
  pinMode(buzzerpin,OUTPUT);
  pinMode(sensorpin,INPUT);

}
void loop()
{
  int x=digitalRead(sensorpin);
  Serial.println(sensorpin);

    if(x==1)
  {
    flag=1;
    t1=millis();
  }
  else if(x==0)
  {
    flag=0;
    t2=millis();
    Serial.println(t2-t1);
    if((t2-t1)>2000)
    {
      digitalWrite(buzzerpin,HIGH);
      Serial.println("Alert2!!!!!!!!!!!!!!!!!!");
      int y=digitalRead(sensorpin);
```

```
    if(y==1){
    digitalWrite(buzzerpin,LOW);}
  }
  else;
 }
}
```

Principal of Model

Our detection system mainly consist of two sections:

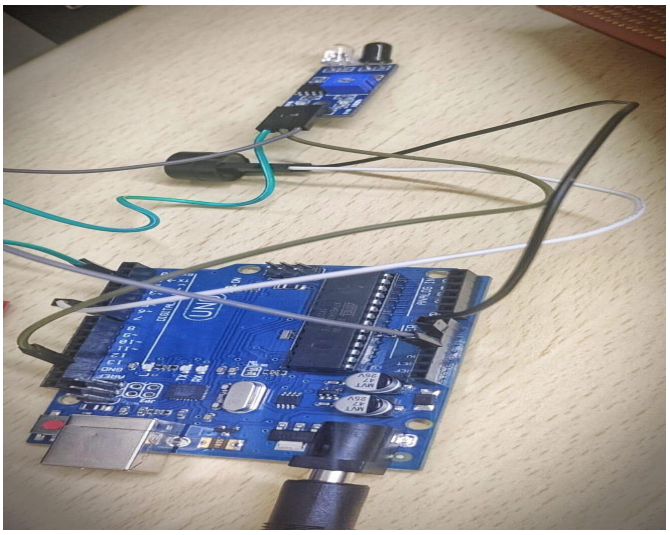
1. **Transmitter section** –The transmitter section consists of an RF Transmitter and Eye Blink Sensor. As shown in the figure, first the 9V DC battery is stepped down to 5V DC using a 7805 voltage regulator, and then the 5V DC supply is given to the Eye Blink Sensor and RF Transmitter. The output pin of the eye blink sensor is fed to the RF transmitter to transmit it wirelessly to the receiver end.

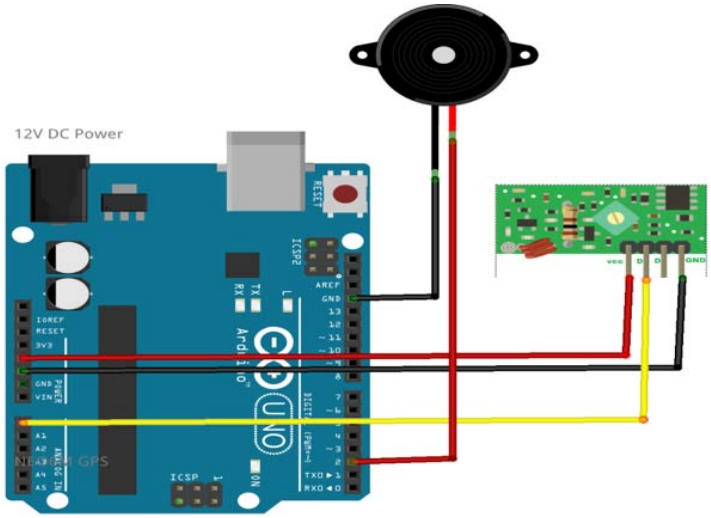


2. Receiver Section– The Receiver side uses Arduino Uno with RF receiver for data processing. As shown in the figure, on the receiver side the RF receiver is connected to a 5V DC power supply from Arduino. The Arduino is powered from a 9V DC power supply

externally. The output of the RF receiver is fed to the Arduino Analog pin.

The Buzzer is connected to the Digital pin of Arduino as shown.





Main Construction

We connected a IR sensor to the Arduino board as Vcc of the sensor to the vcc of the Arduino uno, Ground to the ground and the output of the sensor to the Analog pin one (A1) of the Arduino Pro Mini.

We used a 5 volt buzzer for alerting. We connected buzzer to ardunio pins and interface it to ardunio through our program to buzz when there is eye

blinking. Transistor's emitter connected to the ground and collector connected to the negative pin of the buzzer and vibrator motor. Positive terminal of buzzer are further connected to the vcc of the Arduino Board. Base of the buzzer connected to the pin D3 of the Arduino uno.

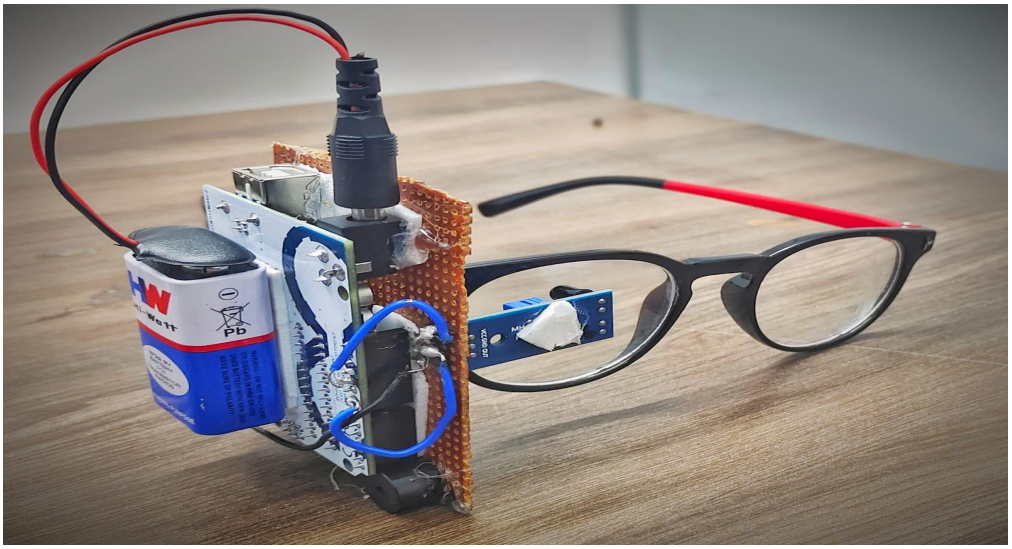
Here We have used a PCB for making the circuit, to solder all the components and then finally connecting it to glasses. We stick the sensor over the Arduino board using hot glue and solder it with short flexible wires. After next to it, We made a buzzer unit, in which the buzzer and battery is included, which we mount on the left stick of glasses near ear.

All these after soldering on the PCB are mounted on the left stick of the glasses by hot glue.

Also, the sensor is sticked to the frame such as it will remain close to the eye.the distance between the eye and the sensor will not more than 15 to 20mm.

After soldering and sticking all the components on frame, our drowsiness detection system is ready and these are some pics.

After connecting all the components After a successful hardware connection for both the transmitter side and receiver side, we have uploaded the code to Arduino uno that is connected to the receiver side.



Result and Conclusion

A system is developed to monitor drowsiness and alcohol detection. It is non-intrusive in nature thus does not cause any annoyance to the driver. Information about the head and eye positions are obtained by using many self-determined algorithms. When the eyes are closed exceeding a certain period of time then automatic alert is sent. In case of extreme conditions the engine will be switched off. We have used image processing which achieves high accuracy and reliable detection of drowsiness. When coming to alcohol consumption, buzzer sounds immediately if anyone with alcohol consumption enters into the vehicle. Thus we have addressed major causes for the fatal crashes of vehicles and embedded kits for drowsiness detection are developed and will be placed in vehicles.

References:->

1. K.Satish, A.Lalitesh, K. Bhargavi, M.Sishir Prem and Anjali.T, International Conference on Communication and Signal Processing, July 28 - 30, 2020, India