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DESIGN AND IMPLEMENTATION OF DRIVER ASSISTANCE SYSTEM (DAS) USING RASPBERRY PI TO ENHANCE DRIVER SAFETY

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Abstract - *This paper gives a new approach for the real time detection of car driver drowsiness, rear end collision and alcoholic intoxication and more number of accidents are causes due to these reasons. Survey of traffic shows that driver drowsiness may be a contributory factor, around 31% of all road accidents are causes due to drunk and drive. The development of new technologies for detecting driver drowsiness is a major challenge in the field of accident avoidance systems. Aim of the project is to develop a prototype and avoid accidents by driver assistance system(DAS) using raspberry pi to enhance driver safety.*

Key Words: *Drowsiness, rear end collision, intoxication, fatigue, hazard, MQ3, Haar Cascade classifier.*

1. INTRODUCTION

Introduction deals with the important reason for accidents and how we can stay away from accidents, various techniques developed to avoid accidents. The goals and motivations for this proposed project is to develop cost effective system that can be implement in all range of cars and it should save people.

The driver fatigue results in over 50% of the road accidents each year[1]. Using new technology to detect driver fatigue/drowsiness is an exciting challenge that would help in preventing accidents. In the past various efforts have been reported in the literature on approaches for drowsiness detection of automobile driver. In the last decade alone, many countries have begun to pay great attention to the automobile driver safety problem. Most of the times, even if the vehicles are flawless, the human errors may result in the deadly consequences. Drivers lose their control on the vehicle when they are feeling sleepy or when they are consuming alcohol and also if suddenly any vehicles or any other objects come close to vehicle, that may also causes rear end collision. Road accidents cause damage to property as well as life. Thus there is need of development of methods for avoiding hazardous effects of drowsiness on roads while driving, alcohol consumption while driving and rear end collision.

1.1 METHODOLOGY

This section shows the steps towards achieving the objective of detection of drowsiness and alcoholic intoxication. Detection of drowsiness can be done in several ways like remotely measuring the heart rate or facial expression of the person to be tested. This work is the combination of face detection, eye region detection and eye closing rate detection in real time environment. Open CV is open source software for creating computer vision related task and it is available as an extension for C, C++, Java and Python programming languages. Making a computer vision application in real time is a challenging task and it needs efficient processing power. Raspberry-pi is an ARM11controller based small sized open source CPU with 512 MB RAM and supports 700 MHz processing speed. It supports interfacing of various low level and high level peripherals including digital camera and GPIO's. It can work with light weight Linux based operating system Raspbian which is loaded with Python-IDLE programming software. Open CV linux version is installed to Raspberry-pi. Open CV is packed with a trainer as well as detector.

In the below block diagram figure.1 it clearly shows the sensors and IC's used in the proposed design, they are:

- Alcohol sensor which is going to detect whether the driver is drunk or not if he drunk then automatically ignition will off.

Raspberry pi camera is also interfaced to raspberry pi board, which will detect the drowsiness of the driver and continuously monitor the driver and give alert if felt drowsy.

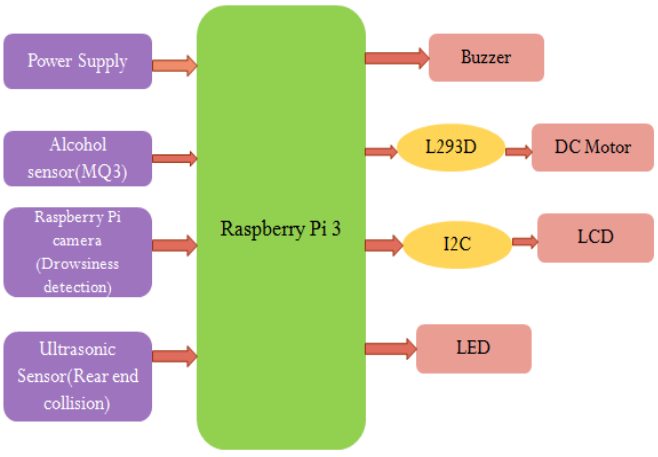

Figure 1: Block diagram of proposed system

This is how all sensors work in the real time, in the future model if needed GSM and GPS can also be interfaceable to the board.

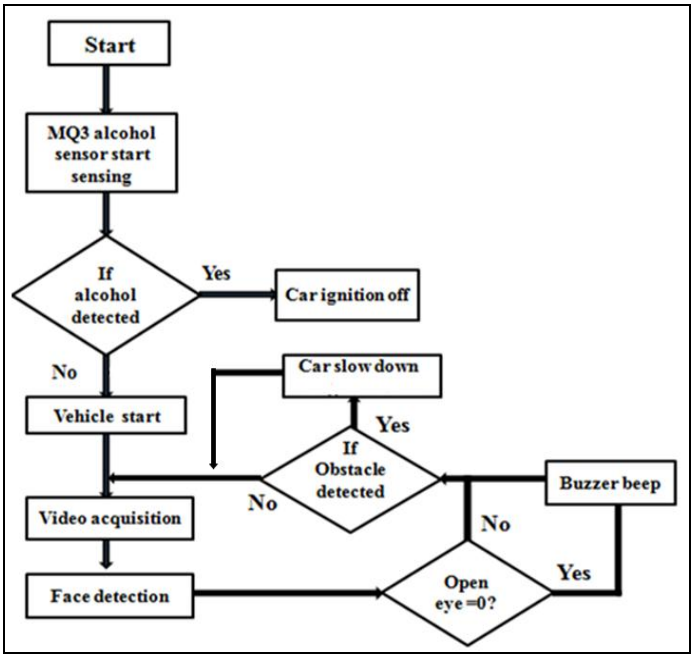

Figure 2: Flow chart of proposed model

In the above flow chart of proposed system fig.2 explain full flow of the design from the starting to till end.

- Initially when car start,this proposed model check for alcohol consumption by driver, if he drunk then automatically ignition will turn off that means car will stop/car will not start.

Then in parallel both ultrasonic sensor and raspberry pi camera start working camera start capturing the image of the driver to detect whether driver feel drowsy or not, if so then give quick alert to driver and at the same time ultrasonic sensor start giving distance measurement, if any obstacles come in front of the car at particular distance then automatically vehicle slow down.

1.2 Drowsiness Detection Technique

Face detection is a complex computer vision task due to the dynamic nature of human faces and high degree of variability of them. According to research, there are multiple categories of technologies that can detect driver fatigue.

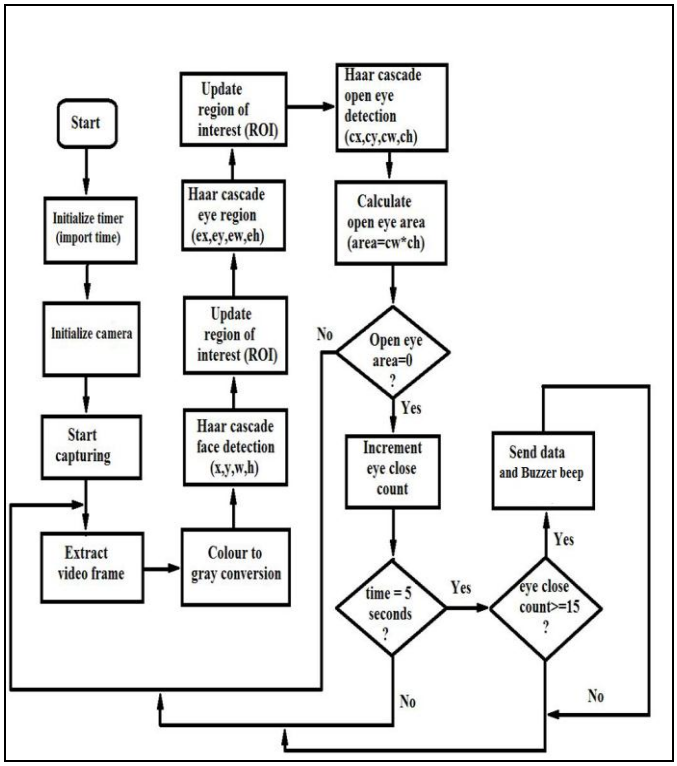

Figure 3: Raspberry pi python programming algorithm for drowsiness detection

$$\mathrm{EAR} = \frac{\|p_2 - p_6\| + \|p_3 - p_5\|}{2\|p_1 - p_4\|}, \qquad (1)$$

Above equation.1 will give exact value of eye aspect ratio when a eye is close and open, when driver feels drowsy or eye is blinking then EAR value falls to approximately zero.

- Here in the below figure 4 it shows the visualization of eye land marks when eyes are open and closed along with that it shows plotting the eye aspect ratio over time.

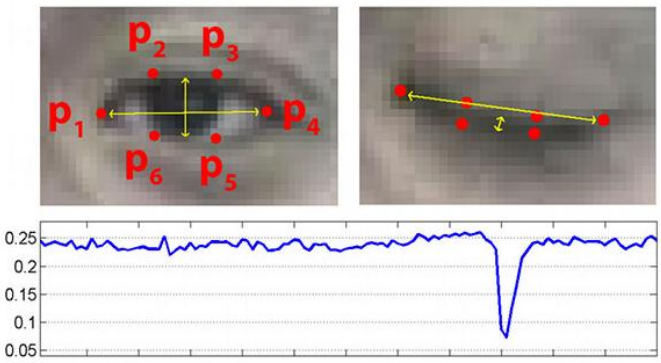

Figure 4: visualization of eye landmarks when eyes are open and closed. Graph plotting EAR over time

```
Drowsiness detection with OpenCV
def eye_aspect_ratio(eye):
    # compute the euclidean distances between the two sets of
    # vertical eye landmarks (x, y)-coordinates
    A = dist.euclidean(eye[1], eye[5])
    B = dist.euclidean(eye[2], eye[4])

    # compute the euclidean distance between the horizontal
    # eye landmark (x, y)-coordinates
    C = dist.euclidean(eye[0], eye[3])

    # compute the eye aspect ratio
    ear = (A + B) / (2.0 * C)

    # return the eye aspect ratio
    return ear
```

Figure 5: Eye aspect ratio(EAR) calculating formula

The return value of EAR will be approximately constant when the eye is open, then value will rapidly decrease towards zero during drowsy or during a blink. EAR is computed between width and height of the eye

Table 1: Example values for EAR detection using formula.

Distance between two eye points	When a eye is open	When a eye is close
Dist(P2 to P6)	1	0
Dist(P3 to P5)	1	0
Dist(P1 to P4)	3	3
Eye Aspect Ratio	0.33	0

From the above table it is easy to analyze how eye aspect ratio is going to calculate by using the above formula as show in the figure 5.

1.3 Alcohol Detection and Rear end collision detection

Sensitive material of MQ-3 gas sensor is SnO2,which has lower conductivity in clean air. When the alcohol gas is present, conductivity of sensor is more high, along with the gas concentration rising. MQ-3 gas sensor has high sensitivity to Alcohol, and has good resistance to worry of smoke, vapour and gasoline.

The sensor is going to use in order to detect alcohol with different level of concentration, its cost also very low and suitable for any applications.

Character

* It has good sensitivity to alcohol gas.
* Long duration and less cost
* Circuit is also simple driver circuit.

Application

* Vehicle alcohol detector
* Handy alcohol detector

Ultrasonic sensor(hc-sr04) is used to detect the obstacles and avoid the accident. It has 4 pin vcc, gnd, trig and echo. It gives upto 4 metre information and need to stop vehicle at the distance of 1 metre before any vehicle which is ahead.

1.4 Hardware Requirements

A. Pi camera

In this system, the video acquisition is considered as first stage because without the image processing drowsiness can not be detected. It is the process of getting an video from source, usually using a camera. The image which is obtained is purely unprocessed i.e., it takes the video as it is.

B.Raspberry pi

The Raspberry Pi 3 has four inbuilt USB ports are used to connect mouse, keyboard or anything that need to connect to the Raspberry Pi.Providing power to Raspberry pi is very easy, just plug any USB power supply into the micro-USB port.

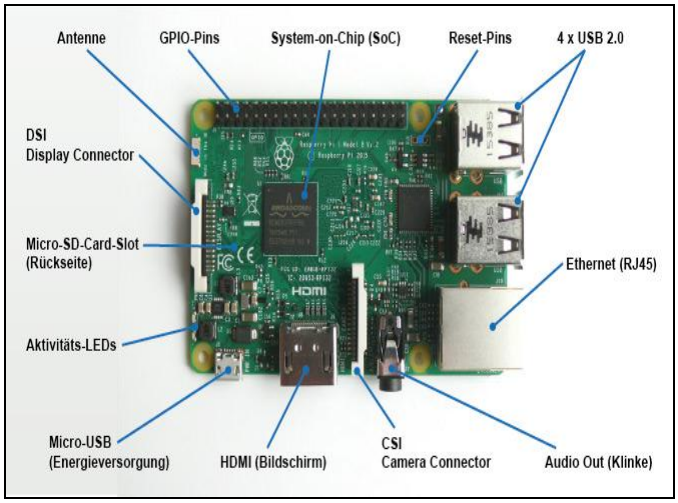

Figure 6: Raspberry pi board

There is no power button in Raspberry pi board so it will start boot when it connect to power supply, to turn it off simply remove power.

C. Ultrasonic sensor

Ultrasonic sensor(hc-sr04) is used to detect the obstacles and avoid the accident .It has 4 pin vcc, gnd, trig and echo. It gives upto 4 meter information and need to stop our vehicle at the distance of 1 metre before any vehicle which is ahead.

D. Alcohol sensor(MQ3)

Sensitive material of MQ-3 gas sensor is SnO2, which with lower conductivity in clean air. When the target alcohol gas exist, The sensor's conductivity is more higher along with the gas concentration rising.

E. Motor driver IC

L293D is a motor driver IC that can control two DC motors at a time .Input 00 and 11 stop the motors whereas logic 01 and 10 starts the rotation of the motors in clockwise and anticlockwise directions, respectively.

Here driver should control single motor when alcohol test fails and ultrasonic sensor display rear end distance is less.

1.5 Interfacing of all hardware to Raspberry pi board.

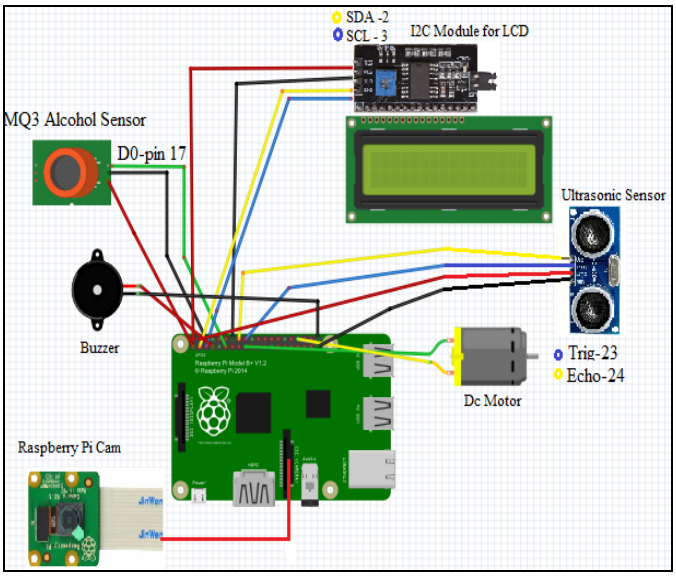

Figure 7: Interfacing of all components of proposed model to Raspberry-pi board

Initially interface all the important sensors and raspberry pi camera to pi board then connect buzzer, LCD, DC motor to see their outputs.

2. Experimental results

The result shows the working of proposed algorithm. The Raspberry pi program is built using python language which can be transferred to Raspberry pi. At this moment the program can detect face region and eye region with green oval Fig 8 shows the detection of eye and open eye region. On the other hand in Fig 9 as the eyes of the person are closed and hence an alert message is given along with that buzzer will beep that helps driver to wakeup suddenly from drowsiness.

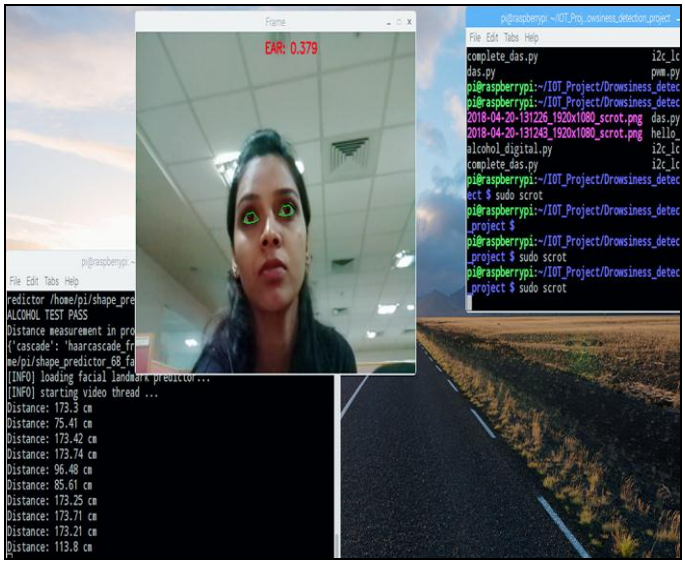

Figure 8: Open eye detection

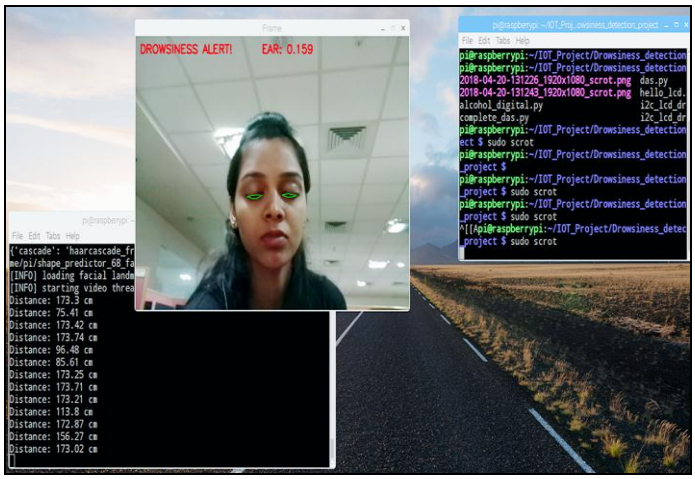

Figure 9: Closed eye detection

In the below fig 10 it clearly shows the ultrasonic sensor values. In this proposed model both drowsiness and ultrasonic sensor will run paralely.

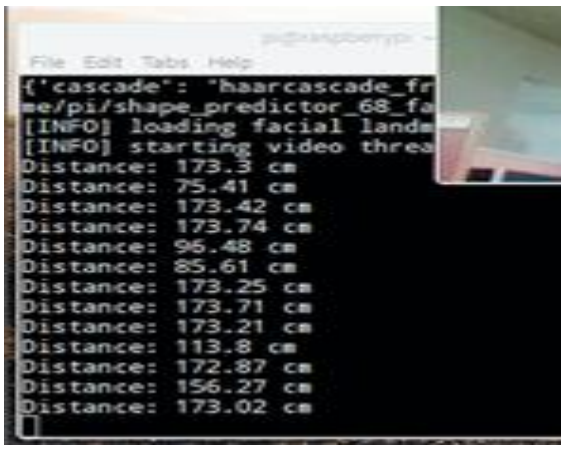

Figure 10: Ultrasonic sensor values

3. CONCLUSIONS

In this study, finally it conclude that it is very difficult to avoid accidents but some how that accident ratio or percentage can be reduced to some less number by using these type of new technologies, by using this method accurate test results will get and driver get some alert while driving regarding rear end collision as well as drowsiness. The goal at the end of this project is the practical demonstration of an alcohol detection system which is suitable for following installation in a vehicle. The adoption of non-regulatory, voluntary approaches to the implementation of advanced vehicle technology makes it critical that policy and public acceptance issues be addressed concurrent with the technology development. This is particularly important when it comes to the implementation of technologies to prevent alcohol-impair drivers from getting behind the wheel. The universal public fully understand the dangers of drinking and driving, having lack of sleep.

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