Driver Drowsiness Detection

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Abstract— Driver fatigue is one of the major causes of accidents in the world. In recent years driver fatigue is one of the major causes of vehicle accidents in the world. A direct way of measuring driver fatigue is measuring the state of the driver i.e. drowsiness. So it is very important to detect the drowsiness of the driver to save life and property. This project is aimed towards developing a prototype of drowsiness detection system. This system is a real time system which captures image continuously and measures the state of the eye according to the specified algorithm and gives warning if required. Many of the accidents occur due to drowsiness of drivers. It is one of the critical causes of roadways accidents now-a-days. Latest statistics say that many of the accidents were caused because of drowsiness of drivers. Vehicle accidents due to drowsiness in drivers are causing death to thousands of lives. More than 30% accidents occur due to drowsiness. For the prevention of this, a system is required which detects the drowsiness and alerts the driver which saves the life. In this project, we present a scheme for driver drowsiness detection. In this, the driver is continuously monitored through webcam. This model uses image processing techniques which mainly focuses on face and eyes of the driver. Raspberry-pi processor is used for image processing. Image processing techniques such as Harcascade frontal face and Face landmark shake predictor are used for acquiring details of given eye object and further processing. This proposed system is used for Driver & Road safety system. In this system web cam capture driver face image. Then, face detection is employed to locate the regions of the driver's eyes, which are used as the templates for eye tracking in subsequent frames. The tracked eye's images are used for drowsiness detection in order to generate warning alarms. The proposed approach has three phases: Face, Eye detection and drowsiness detection. The role of image processing is to recognize the face of the driver and then extracts the image of the eyes of the driver for detection of drowsiness. The Haar face detection algorithm takes captured frames of image as input and then the detected face as output. It can be concluded this approach is a low cost and effective solution to reduce the number of accidents due to driver's Drowsiness to increase the transportation safety. We are developed drowsiness detection systems that recognize signs of possible drowsiness, alerting the driver to their condition. Though there are several methods for measuring the drowsiness but this approach is completely non-intrusive which does not affect the driver in any way, hence giving the exact condition of the driver. For detection of drowsiness the per closure value of eye is considered. So when the closure of eye exceeds a certain amount then the driver is identified to be sleepy. For implementing this system several OpenCv libraries are used including Haar-cascade. The entire system is implemented using Raspberry-Pi.

Keywords: Python, Raspberry-Pi, Open CV, Harcascade Frontal Face, Face Landmark Shake Predictor

I. INTRODUCTION

Now days, road accidents are major problem and its percentage increases per year. The major problem behind the road accidents are drowsiness of car driver and if the driver is alcoholic. To overcome this problem, different technologies are developed. These technologies are used for detecting drowsiness and also preventing the road accidents. Drowsy driving is one of the major causes behind fatal road accidents. One of the recent study shows that one out of five road accidents are caused by drowsy driving which is roughly around 21% of road accidents, and this percentage is increasing every year as per global status report on road safety 2015, based on the data from 180 different countries. This certainly highlights the fact that across the world the total numbers of road traffic deaths are very high due to driver's drowsiness. Driver fatigue, drink-and-drive and carelessness are coming forward as major reasons behind such road accidents. Many lives and families are getting affected due to this across various countries. The attention level of driver degrade because of less sleep, long continuous driving or any other medical condition like brain disorders etc. Several surveys on road accidents says that around 30 percent of accidents are caused by fatigue of the driver. When driver drives for more than normal period for human then excessive fatigue is caused and also results in tiredness which drives the driver to sleepy condition or loss of consciousness.

Drowsiness is a complex phenomenon which states that there is a decrease in alerts and conscious levels of the driver. Though there is no direct measure to detect the drowsiness but several indirect methods can be used for this purpose. Drowsiness of the drivers is one of the key issues for majority of road accidents. Drowsiness threatens the road safety and causes severe injuries sometimes, resulting in fatality of the victim and economical losses. Drowsiness implies feeling lethargic, lack of concentration, tired eyes of the drivers while driving vehicles. Most of the accidents happen in India due to the lack of concentration of the driver. Performance of the driver gradually deteriorates owing to drowsiness. Real time drowsy driving detection is one of the best possible major that can be implemented to assist drivers to make them aware of drowsy driving conditions. Such driver behavioral state detection system can help in catching the driver drowsy conditions early and can possibly avoid mishaps. Detecting the drowsiness of the driver is one of the surest ways of measuring driver fatigue. There are 4 main factors due to which driver gets fatigue. These are sleep, work, time of day and physical condition. According to our body clock, we can do maximum work during day time and take rest (sleep) during night. Suppose the car driver works during day and travels a car during night without taking rest

then, human body clock affects on him. Next is the work. The type of work (light/heavy) also affects on car driver during night. Because of heavy work, he becomes fatigue and wants rest. If he does not take proper rest and travels car then car driver becomes drowsy. And the last one is the physical condition of the car driver. If the person is weak or ill and he takes medicines then, medicines affect on his body and car driver becomes drowsy. A Driver Drowsiness Detection System has been developed, using a nonintrusive machine vision based concepts. The system uses a small monochrome security camera that points directly towards the driver's face and monitors the driver's eyes in order to detect fatigue. In such a case when fatigue is detected, a warning signal is issued to alert the driver. This report describes how to find the eyes, and also how to determine if the eyes are open or closed. The system deals with using information obtained for the binary version of the image to find the edges of the face, which narrows the area of where the eyes may exist. Once the face area is found, the eyes are found by computing the horizontal averages in the area. With this paper, we are presenting technique to detect driver drowsiness using of Open CV, raspberry pi and image processing. Several studies have shown various possible techniques that can detect the driver drowsiness. To detect driver eye condition and possible vision based on eye closure is well suited for real world driving conditions, since it can detect the eyes open/ closed state non-intrusively using a camera. In Real Time Driver Drowsiness System using Image Processing, capturing drivers eye state using computer vision based drowsiness detection systems have been done by analyzing the interval of eye closure and developing an algorithm to detect the driver's drowsiness in advance and to warn the driver by in vehicles alarm. This section motivates how face is detected and how eye detection is performed for automotive application and their detection is necessary for assessing driver drowsiness.

II. LITERATURE REVIEW

In computer science, image processing is the use of computer algorithms to perform image processing on images. As a subcategory or field of digital signal processing, image processing has many advantages over analog image processing. It allows a much wider range of algorithms to be applied to the input data and can avoid problems such as the buildup of noise and signal distortion during processing. Since images are defined over two dimensions digital image processing may be modelled in the form of multidimensional system.

1) Ovidiu Stan et.al. Says in the paper "Eye-Gaze Tracking Method Driven by Raspberry PI Applicable in Automotive Traffic Safety" that This paper comes as a response to the fact that, lately, more and more accidents are caused by people who fall asleep at the wheel. Eye tracking is one of the most important aspects in driver assistance systems since human eyes hold much information regarding the driver's state, like attention level, gaze and fatigue level. The number of times the subject blinks will be taken into account for identification of the subject's drowsiness. Also the direction of where the user is looking will be estimated according to the location of the user's eye gaze. The developed algorithm was implemented on a Raspberry Pi board in order to create a portable system. The main determination of this project is to conceive an active eye tracking based system, which focuses on the drowsiness detection amongst fatigue related deficiencies in driving. [1]
2) Kulkarni S. S. et.al. Says in the paper "Application of raspberry pi based embedded system for real time protection against road accidents due to driver's drowsiness and/or drunk and drive cases" that Present work deals with the application of raspberry pi CPU based sensing system to the detection of driver's lethargy and alcoholism in order to avoid the road accidents. The embedded system consists of 5 megapixel digital camera, alcohol detection sensor and the buzzer interfaced to the microcontroller. The embedded system is controlled by Raspbian operating system. The system detects real time situation of the driver's vigilance and control over the vehicle. If alcoholic and / or drowsiness tests are positive, it switches on the alarm, (ii) turn off the vehicle's engine via microcontroller based program controlling ignition power source and (iii) sends a SMS to the person close to the driver's location. [2]
3) The Real-time Driver Drowsiness Detection for Android Application Using Deep Neural Networks Techniques, 2018, Procedia Computer Science, Elsevier In this publication, an advanced approach is devised for real-time drowsiness detection. It is based on deploying a deep neural network toan Android application which achieves high accuracy. The most significant achievement of this work is the usage of lightweight model which is obtained from a heavy baseline model. The model achieves an accuracy of more than 80%.[3]
4) In Real-Time Driver-Drowsiness Detection System Using Facial Features, 21 August 2019, IEEE Access In this work, a system DriCare is introduced, which is responsible for detecting the drivers' weariness status, such as yawning, blinking, and duration of eye closure, using video images, without equipping their bodies with devices. Basically, in DriCare, features of both eyes and mouth are captured and accordingly the device could alert the driver by generating a fatigue alarm. It achieved an accuracy of 92%.[4]
5) Real time driver drowsiness detection using a logistic regression- based machine learning algorithm, 2016, IEEE Explore: An approach that detects the driver's drowsiness by making use of heart rate variation is proposed. An advanced logistic regression-based Machine Learning algorithm is used. The model requires minimal time for predictions and achieves an accuracy above 90%.[5]

III. PROBLEM STATEMENT

Many of the road accidents will occur due to drowsiness of the driver. This project is to develop a driver drowsiness detection system by using recognize signs of possible drowsiness, alerting the driver to their condition. Drowsiness can be detected by monitoring the driver through continuous Image stream with a pi camera. The general objective is to create a model that will indicate whether a person is feeling

drowsy or not. The model takes image for every second and check for eye blinking and calculate the time for eye closed by Harcascade frontal face and Face landmark shake predictor algorithm. If the blinking is high and eye is closed for certain amount of time then it will indicate driver through a sound.

IV. OBJECTIVES

The objectives are as follows:

1) The objective of this work was to implement a surveillance system to the vehicular driver based on artificial vision techniques and implemented in a smartphone in order to detect and alert when the driver have drowsiness signs.
2) To achieve this objective it was analyzed other works related with detecting drowsiness in drivers, the drowsiness symptoms in vehicle drivers.
3) We identify the technical parameters and algorithms that allow to process signals of the state of drowsiness.
4) In this work we present a developed drowsiness detection algorithm, the interface in which the state of drowsiness is displayed and the necessary adjust to get the correct functioning of the implemented system.
5) To alert the driver in case it is found that he is getting drowsy.
6) To alert the employer of the vehicle using GSM Module in case the driver is found drowsy.

V. METHODOLOGY

1) Face Detection:

This module takes input from the camera and tries to detect a face in the video input. The detection of the face is achieved through the Haar classifiers mainly, the Frontal face cascade classifier. The face is detected in a rectangle format and converted to grayscale image and stored in the memory which can be used for training the model.

2) Eye Detection:

Since the model works on building a detection system for drowsiness we need to focus on the eyes to detect drowsiness. The eyes are detected through the video input by implementing a haar classifier namely Haar Cascade Eye Classifier. The eyes are detected in rectangular formats.

3) Drowsiness detection:

In the previous module the frequency is calculated and if it remains 0 for a longer period then the driver is alerted for the drowsiness through an alert from the system

VI. APPROACH

There are different methodologies developed for detecting the driver drowsiness and also preventing the road accidents.

A. Vehicle Based Approach

It is one of the techniques to find out driver drowsiness. The technique continuously monitored position of lane, steering wheel position and pressure on acceleration pedal. If it crosses the threshold values then it indicate that the driver gets drowsy.

B. Behavioral Based Approach

This approach includes yawning (opening area of mouth), eye closure, eye blinking frequency and head pose. This can be done by placing camera in front of the car driver. The camera continuously captures images of the car driver. The car driver's image is further processed for detecting drowsiness of the driver.

VII. EXISTING SYSTEM

The current drowsiness detection systems include the usage of the devices that detect the respiration rate, heart rate, blood pressure, etc. These devices can cause the driver to be uncomfortable for driving. Cannot be assured that the drivers wear these devices all the time while driving. May get lost or improper functioning which may lead to low accuracy in the result. The existing system does not produce good results in low light conditions. If the light conditions are dark or too low it is unable to detect the face and eyes of the driver which results in lower accuracy.

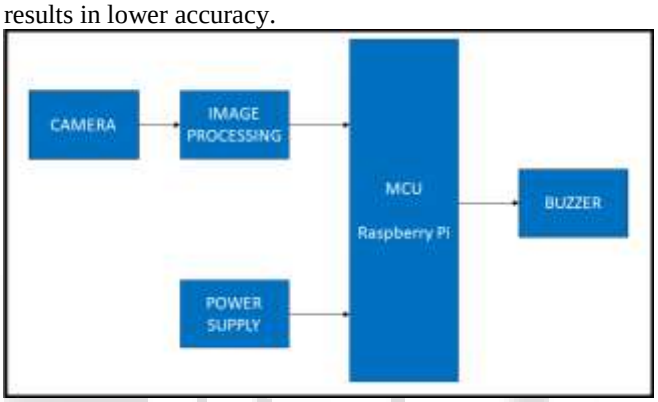

Fig. 1:

VIII. PROPOSED SYSTEM

Drowsiness detection techniques are generally classified into three groups: methods based on the condition of the driver, the method based on the performance of the driver, and the combined of the previous method. The method based on the condition of the driver is divided into two categories, namely: a technique using physiological signals and image-based techniques. To develop a system which deals with driver drowsiness and fatigue detection based on visual information. The system uses driver's face movements and eye locations to determine the state of driver's eyes and if drowsy. This system will be able to work under low-lighting conditions with the help of a webcam installed on the dashboard. Instead of showing a warning sign, our system will sound a loud alarm which can not only alert the driver but the rest of the co-passengers as well. Our proposed system consists of open source web camera for capturing real time images of car driver. For further processing on that image, we need to send the image to Raspberry-pi system board. The Raspberry-pi system is loaded with Raspbian OS and Python packages for Open CV (Computer Vision). Haar features are used to calculate required part of the eye (pupil and iris). Further, Hough transform is used for edge detection of pupil and iris. Pupil and Iris area is calculated and then it compares with threshold value. If it exceeds the threshold value then driver drowsiness condition is detected and alarm indicated by buzzer.

IX. BLOCK DIAGRAM:

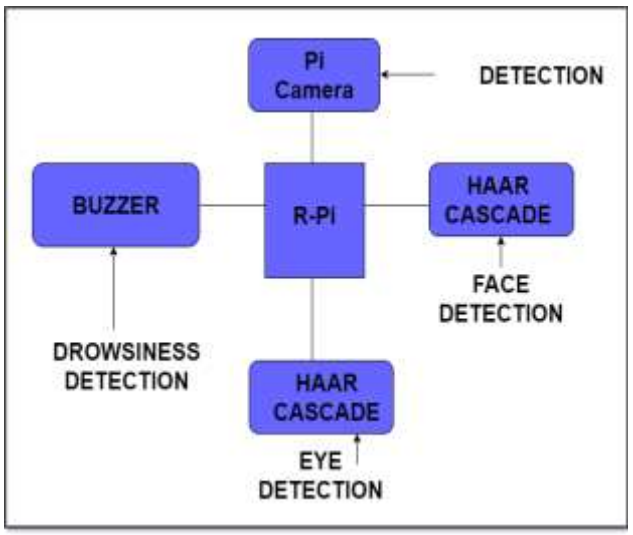

Fig. 2:

A. System Architecture:

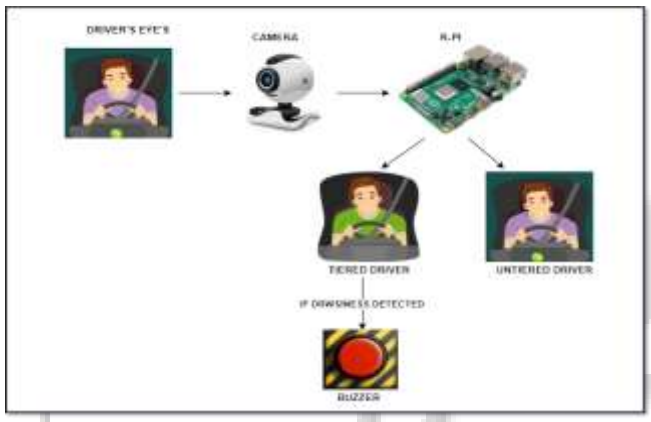

Fig. 3: System Architecture

This is the architecture for detecting the drowsiness of the driver. First of all the system captures images through the webcam and after capturing it detects the face through haar cascade algorithm. It uses haar features which can detect the face. If the system founds it as face the it will proceed for next phase i.e eye detection. The eye is also detected using haar cascade features and it is used for blink frequency. Camera is used to monitor the status of the driver. We are using the raspberry pi processor this is the heart of the drowsiness detection system. Alarm is beeped when system sends the signal.

X. MODULE

Our system uses an algorithm to analyze both the driver's face and eyes. Our developed system consists of 3 modules, which are Camera, Raspberry Pi and an alarm

1) Webcam - It is used for capturing the image in real time and monitors a stream for faces. In order to effectively capture the face, the webcam is placed onto the vehicle dashboard and is approximately 20cm away from the driver's face. At this distance, the webcam captures the most of the driver's face. The captured video is sent to the Raspberry Pi for further processing.
2) Raspberry Pi - The Raspberry Pi is a small single-board computer. Python is main programming language for Raspberry Pi. It performs a processing of the input video stream so to compute the level of fatigue of the driver. The analysis is based on calculating a number of frames of the Data stream where the driver eyes are closed. Video segments whose average eye state point exceeds the threshold value are detected as drowsy.
3) Alarm - When the drowsiness index exceeds a pre-specified Parameter or when the signal falls below the specified threshold it activates an alarm signal. Loud Alarm is buzzed to alert the driver indicating that he is drowsy and is dangerous to drive in this state and that he must take a break.

ALGORITHM'S

A. Haar Cascade Frontal Face:

Haar like features are complete set of 2-D Haar functions. These Haar functions are used to encode a specific object in given image. Haar functions consist of two or more rectangular regions, which are enclosed in a template. Haar features are used to detect human frontal faces in digital photographs and to detect cardiac structures from magnetic response imaging (MRI).Haar features give more accurate and faster response than other object detectors. The result of Haar feature function consists of K rectangles. The main advantage of Haar features is that, it provides a very attractive trade-off between accuracy and evaluation's speed. Haar features are differing according to the template, by no of rectangles and orientation of the rectangles. The Haar features are mainly Edge features, Line features and Center-surround feature.Haar-like features are digital image features used in object detection. Or we can say that these are rectangle shaped dark and light areas having similar kind of features like our face. So basically we move those features throughout our face to find the output of each feature.

For example:

All faces share some similar properties

1) The eyes region is darker than the upper-cheeks.
2) The nose bridge region is brighter than the eyes.

So this features of face are used for developing haar like features.

Each feature is related to a special location in the face.

Output of Rectangle features:

We will move the related kind of rectangle throughout the face to get different values.

1) Value = Σ (pixels in black area) - Σ (pixels in white area).
2) Three types: two-, three-, four-rectangles, Viola and Jones used two-rectangle Features.

Haar-Cascade algorithm:

- Step 1: Load the required XML classifiers
- Step 2: Load our input video in grayscale mode
- Step 3: Find the faces in the image. If faces are found, it returns the positions of detected faces as Rect (x,y,w,h)
- Step 4: Get the locations and create a ROI (Region of interest) for the face and apply eye detection on this ROI
- Step 5: End

B. Face landmark shake predictor

1) Facial landmark prediction (FLP) algorithm:

Every Human Face has 68 distinct points on his face. The position on each of these 68 facial points is stored in a matrix. So, with the help of this algorithm, the positions of both left eye and right eye can be obtained.

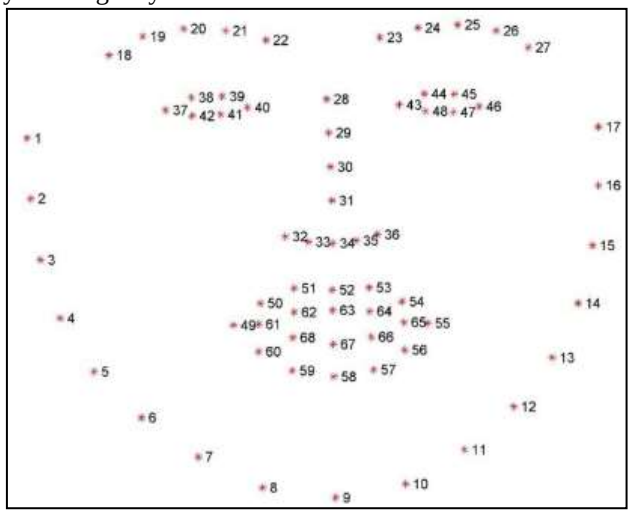

Fig. 4: 68 points of FLP Algorithm

XI. CONCLUSION

We have successfully interface Raspberry-Pi camera with the processor. Raspberry-Pi camera is properly initialize, images are captured. Image is further used for Haar feature extractions. Haar cascade Face region, Eye region and Open eye region is calculated. Drowsy driving can be as deadly as drunk driving. Drivers drowsiness not only putting themselves in danger, but they are a risk to everyone else on the road. Drivers who are tired and sleepy have delayed reactions and make bad decisions. In this paper, we presented the conception and implementation of a system for detecting driver drowsiness based on vision that aims to warn the driver if he is in drowsy state.

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