DRIVER DROWSINESS DETECTION SYSTEM

A PROJECT REPORT

for

TECHNICAL ANSWERS TO REAL WORLD PROBLEMS (ITE3999)

in

B. Tech – Information Technology and Engineering

by

SAKINA HUSSAIN BANDOOKWALA (18BIT0027)

KUSHAGRA AGARWAL (18BIT0231)

PRIYAL BHARDWAJ (18BIT0272)

Under the Guidance of

Dr. E. VIJAYAN

Associate Professor, SITE

VIT®

Vellore Institute of Technology

(Deemed to be University under section 3 of UGC Act, 1956)

School of Information Technology and Engineering

June, 2021

DECLARATION BY THE CANDIDATE

We hereby declare that the project report entitled **"DRIVER DROWSINESS DETECTION SYSTEM"** submitted by us to Vellore Institute of Technology University, Vellore in partial fulfillment of the requirement for the award of the course **Technical Answers to Real World Problems (ITE3999)** is a record of bonafide project work carried out by us under the guidance of **Dr. E. Vijayan.** We further declare that the work reported in this project has not been submitted and will not be submitted, either in part or in full, for the award of any other course.

Place: Vellore

Signature

Date: 2021-06-03

Priyal Bhardwaj

Digitally signed by Priyal Bhardwaj
Date: 2021.06.03 15:30:47 +05'30'

Vellore Institute of Technology
(Deemed to be University under section 3 of UGC Act, 1956)

School of Information Technology & Engineering [SITE]

CERTIFICATE

This is to certify that the project report entitled **"DRIVER DROWSINESS DETECTION SYSTEM"** submitted by **Sakina Hussain Bandookwala (18BIT0027), Kushagra Agarwal (18BIT0231) and Priyal Bhardwaj (18BIT0272)** to Vellore Institute of Technology University, Vellore in partial fulfillment of the requirement for the award of the course **Technical Answers to Real World Problems (ITE3999)** is a record of bonafide work carried out by them under my guidance.

Dr. E. Vijayan

GUIDE

Associate Professor, SITE

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Driver Drowsiness Detection System

Abstract

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. Hence, 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 and mouth according to the specified algorithm and gives warning if required. Driver drowsiness detection systems help prevent accidents by alerting the driver whenever the system finds signs of drowsiness through the use of eye and yawn detection. The system will detect if a person's eyes are closed for a few seconds as well as the number of blinks. At the same time, it will also perform mouth detection to detect yawning.

Keywords – Drowsiness, Eye Detection, Yawn Detection, Alarm/Alert

I. INTRODUCTION

Sleeping is one of the basic needs of the human being, lack of sleep causes the body to react inefficiently, reducing reaction time and produce low alertness and lose of concentration which reduces the ability to perform activities based on care that is necessary in the case of driving a car. Over the years the driver Drowsiness is one of the major causes of car accidents in the world. According to the World Health Organization's Global Road Safety Report, there were 1.6 million deaths worldwide in 2019, of which 1,72,485 were road deaths in India. Life is precious and that is why we must give it priority. Therefore, the increase in safety standards will benefit vulnerable road users (pedestrians, cyclists and motorcyclists) as well as users and non-hazardous vehicles.

Various programs are being developed to solve this problem but they cannot use it. Previously a specific alarm system was developed but that does not work properly and is not useful for all types of transportation. The level of traffic jams that occur due to the negligence of the driver and having cheap but productive driving assistance that warns the frame could end up being a good way to overcome the death toll and property. On the roads of India, about 140,000 people are bitten by dust each time a road collapses, caused by poor safety and regulations and poor driving conditions. Similarly, motorists in medium and large business vehicles drive for more than 12 hours by extension, making them prone to creating problems.

Many researchers are working on the development of monitoring systems using specific techniques. The best detection techniques are based on physiological phenomena like brain waves, heart rate, pulse rate and respiration. These techniques are intrusive, causing annoyance. A driver’s state of vigilance can also be characterized by indirect behaviors of the vehicle like lateral position, steering wheel movements. Although these techniques are not intrusive, they are subjected to several limitations as the vehicle type, driver experience, geometric characteristics and state of the road. People in fatigue show some visual behavior easily observable from changes in their facial features like eyes, head and face.

The most accurate way to measure a driver's drowsiness is to measure the driver's condition. Therefore, it is very important to get the driver's sleep to save life and property. This project aims to create a drowsiness detection system. In this paper a novel algorithm to detect drowsiness based on eyelid movements and yawning is proposed. Haar classifiers are used to detect mouth region. The mouth geometrical features and eyelid movement is processed, in parallel, to detect drowsiness. The fusion of these data allows the system to detect both drowsiness and inattention, thus improving the reliability of existing unidimensional features-based algorithms. This program is a real-time system that captures image continuously and measures the condition of the eye and state of mouth using a specified sensor and provides a warning if needed. Although there are several ways to measure drowsiness but this method does not completely disrupt what does not affect the driver in any position, as a result it gives a certain driver position. With sleep identification each end is considered. So, when the blink rate of the eye and yawn exceeds a certain amount, the driver is considered drowsy and is alerted through an alarm. The emergency contact is also alerted of the situation through sms along with the location of the driver.

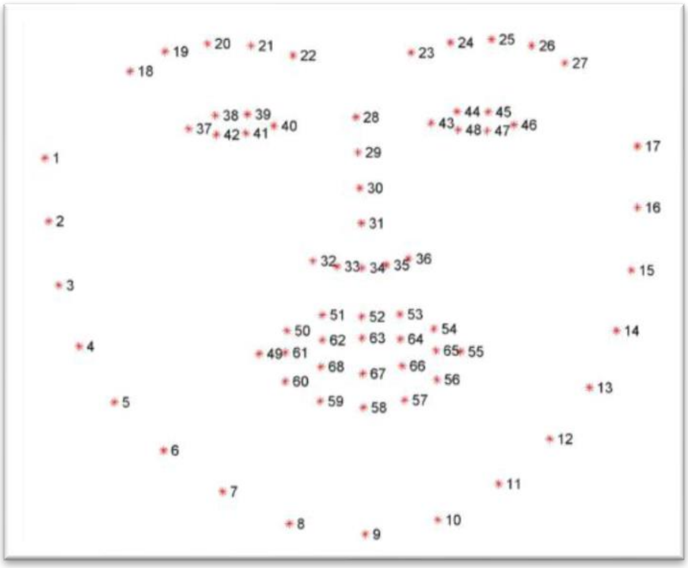
II. DESCRIPTION OF METHODOLOGIES

Proposed Approach:

- First of all, we have captured video from the camera and detected face from the video frames.
- From the extracted frames, we will derive the eyes from the face. This will be used in calculating the time for which eyes are closed.
- After that we have calculated Eyes Aspect Ratio (EAR) and compared that to threshold ratio. If the EAR is less than the threshold then an alert message will be displayed upon the screen.
- Along with Eye detection, the program will also detect mouth and keep a counter for number of yawns in a fixed interval of time. Yawn will be detected in a similar manner to blink detection.
- We have calculated Mouth Aspect Ratio (MAR) and compared that to threshold ratio. If the MAR is greater than the threshold, then it will be counted as a yawn and the yawn counter will increase. If the yawn counter crosses the threshold value, then an alert message will be displayed upon the screen.
- Also, apart from the message upon the screen, we will be sending a message on the phone of the emergency contact of driver along with the location of the driver.

Eye Detection

- In the system we have used facial landmark prediction for eye detection.
- The facial landmark detector included in the dlib library is an implementation of the One Millisecond Face Alignment with an Ensemble of Regression Trees paper by Kazemi and Sullivan (2014).



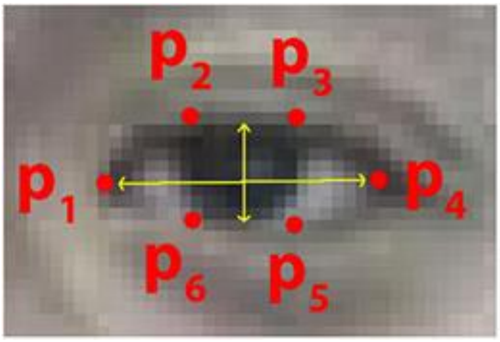
- This method starts by using:
    1. A training set of labeled facial landmarks on an image. These images are manually labeled, specifying specific (x, y)-coordinates of regions surrounding each facial structure.
    2. Priors, of more specifically, the probability on distance between pairs of input pixels.
- The pre-trained facial landmark detector inside the dlib library is used to estimate the location of 68 (x, y)-coordinates that map to facial structures on the face.
- We can detect and access both the eye region by the following facial landmark index shown below:
    1. The right eye using [36, 42].
    2. The left eye with [42, 48].
- These annotations are part of the 68 point iBUG 300-W dataset which the dlib facial landmark predictor was trained on.
- Regardless of which dataset is used, the same dlib framework can be leveraged to train a shape predictor on the input training data.

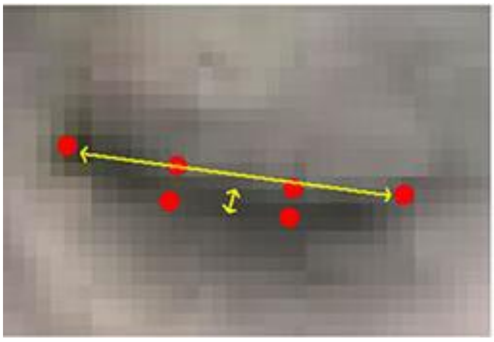
Eye Aspect Ratio (EAR)

- For every video frame, the eye landmarks are detected. The eye aspect ratio (EAR) between height and width of the eye is computed.

  EAR = ||p2 − p6|| + ||p3 − p5|| • 2||p1 − p4||

  where p1, . . ., p6 are the 2D landmark locations.





- The EAR is mostly constant when an eye is open and is getting close to zero while closing an eye.
- Aspect ratio of the open eye has a small variance among individuals, and it is fully invariant to a uniform scaling of the image and in-plane rotation of the face.
- Since eye blinking is performed by both eyes synchronously, the EAR of both eyes is averaged.

Eye State Detection

- Finally, the decision for the eye state is made based on EAR calculated in the previous step. If the distance is zero or is close to zero, the eye state is classified as "closed" otherwise the eye state is identified as "open".
- The last step is to determine the person's condition based on a pre-set condition for drowsiness. The average blink duration of a person is 100-400 milliseconds (i.e., 0.1-0.4 of a second).
- Hence if a person is drowsy his eye closure must be beyond this interval. We have set an interval of 48 frames which is nearly 3 seconds. If the eyes remain closed for three or more seconds, drowsiness is detected and alert regarding this is triggered.

Yawn Detection

- Yawning is characterized by a widely opened mouth. Like the eye closure detection, the facial landmarks are used to detect an open mouth.
- Mouth Aspect Ratio (MAR) is the parameter used to determine if the subject's mouth is open.

- If MAR calculated from the frame is greater than the threshold, the subject is determined to be yawning.
- An alarm is raised if the subject has yawned more than the set boundary value consecutively.
- Small openings that in reality are taken as a result of talking, eating is ignored.

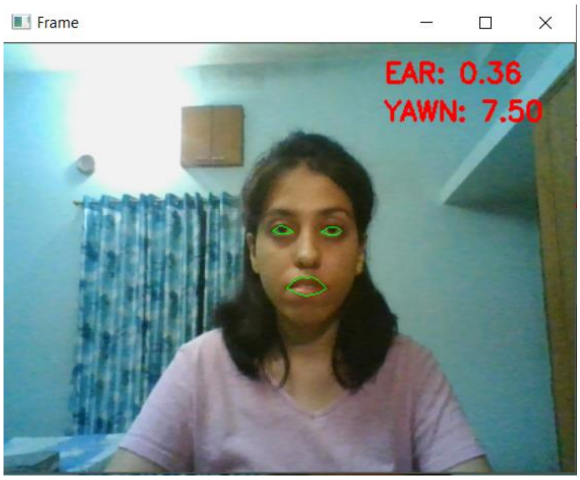
Drowsiness Detection

- The last step of the algorithm is to finally determine if the driver is drowsy or not.
- We will add up results of both the parameters, i.e., result from Eye state detection and Yawn Detection.
- If both the parameters cross the threshold value, we will sound an alarm to alert the driver.
- Along with alarm, we will also send a message to the emergency contact given by the driver which will contain the location of driver.
- If none of the parameter crosses the threshold value, then the system will keep repeating the process till the end of drive.

III. RESULTS & DISCUSSIONS

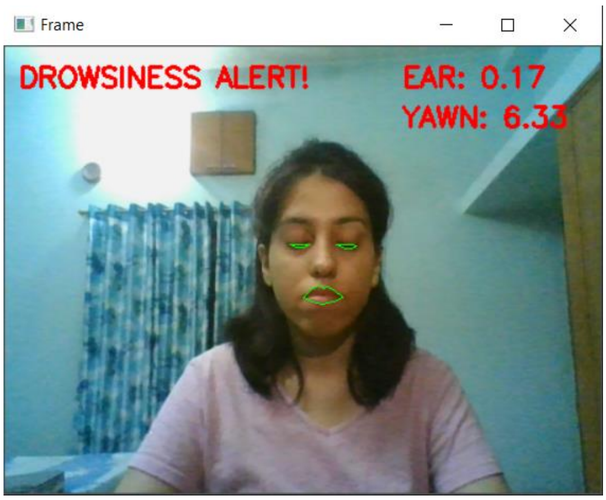
Following are the results we obtained for different scenario. When rate of eye blinking is more frequent than that of normal blinking then it displays message “Drowsiness Detected” and an alarm will sound. Similarly, when yawn is detected, it will display “Yawn Alert” and after frequent yawns it will sound the alarm. The delivery is then forwarded to Twilio which sends a message to the emergency number prepared at the beginning along with the location.

Eyes open, Mouth closed



This is the normal state of driver. No yawn or frequent blinking is detected. The system is continually monitoring the driver and calculating EAR and MAR at every frame.

Eyes closed

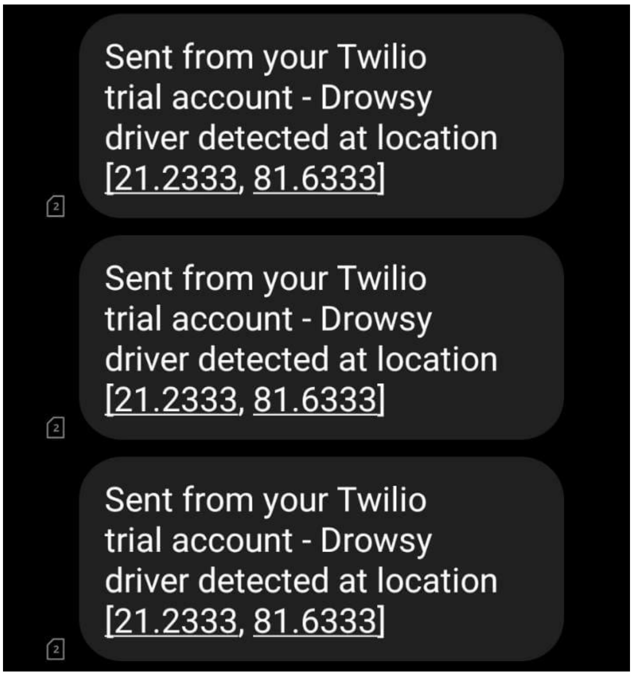


In this scenario, system has first identified that the eye is closed thus indicating to a blink. However, the blink count is high so it is displaying “Drowsiness Alert” and sounds an alarm.

Mouth open

In this scenario, system has identified a yawn based on the MAR and is displaying the "Yawn Alert" message. If the frequency of yawns in a fixed time interval is high, then the system will also sound the alarm.

Below is a sample of the message received on the mobile of emergency contact given by the driver. Message comprises of the location of the drowsy driver and can be further customised as per the driver choice.



Comparative analysis with other approaches

From the literature survey which we had done in the beginning of our project, we got to know various approaches to detect driver drowsiness. Some of those are:

1) Lane Detection system

In this approach, the system monitors the car’s position. If the car abruptly changes the lane or it changes lane way too fast, there may be possibility that the driver is drowsy and is not able to steer the car well thus, causing abrupt change in lane. If it detects such change, it sounds an alarm to wake up the driver and in some advanced systems, an auto correction system is also applied so that it will steer the car back into the right lane and direction.

Problems:

- There may be case in which driver is awake and has to change to lanes abruptly to maybe prevent some accident. In that case, this system will falsely sound the alarm.
- There may be roads which have lot of ditches in them and to prevent any damage to car, the driver has to constantly change the lane to avoid any damage to the car.

2) Sensitive Steering Wheel

In one of the papers, we got to know about another system that works on the grip pressure on the steering wheel. This system works by placing a sensor on the steering wheel to detect how much pressure is being applied on it. If it is above optimum level then the driver is assumed to be not drowsy and if the pressure is less than the optimum level, then driver is assumed to be drowsy. On detection of drowsiness, the system will either sound the alarm or flash it on some display to wake up the driver.

Problems:

- Experienced drivers tend to hold the steering lightly whereas the beginners or the new leaners tend to hold the steering more tightly. In such cases, this system may give some false results.
- Some drivers prefer to wear gloves while driving, this may also lead to varied pressure on the steering wheel.
- Other conditions such as sensitivity to factors like dirt, sweat and temperature may also change the pressure on the steering wheel.

3) Physiological sensors

Physiological signals (i.e., ECG, EEG, etc) have been commonly used to study drowsiness and sleep disorders. A conventional clinic measurement system requires the electrodes to be in contact with the human body by use of coupling gel. The system can be deployed in a vehicular environment to provide driver assistance. While drowsiness detection was the primary goal of this project, such a system can also be utilized for other beneficial purpose, e.g., health monitoring of drivers.

Problems:

- This interferes with the normal driver operation. All the wires from the sensors hinders the normal movement of a driver.
- It is not feasible for long term monitoring purposes. Time to time replacement of batteries or replacement of sensors due to various conditions does not help in an economical and long-term process.

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Appendix

Demo video: **Click Here**

Github Link: **Click Here**