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# Driver Drowsiness Detection System

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**ABSTRACT :** In recent years, drowsiness is the main cause of the accidents due to lack of sleep, tiredness and so on. In order to reduce the case of vehicle accidents caused by drowsiness of the driver is to detect them and warn them using an alarm. Many techniques, such as eye retina detection, have been used to detect sleepiness by facial features. Here in this paper, we propose a method for detecting the driver's drowsiness by detecting the person's closed eye for a few seconds. In this report, we propose a more accurate method for detecting drowsiness, by. The main contribution for this project is the drowsiness detection and warning, which is based on the person's open or closed eye. This project discusses on how to detect the eyes of the driver from the real time environment using the webcam represents the dashboard camera in a car. By using the real time detection, author use the built-in laptop webcam to detect the eyes of the demonstrator. The drowsiness detection system will detect the open and closed eye. The designed system will detect the face area and the coordinate of the eye. Detecting the face area is narrow down to detect eyes within face area. Both left and right eyes will be framed out once it found. The parameters of the eyes the eyes will be captured, whether it is closed or open. If the eyes are found closed for 20 consecutive frames, it is confirm that the driver is in drowsiness condition.

## I.INTRODUCTION

Drowsiness is the state where person have strong desire to sleep. It is the state where person has the high desire to sleep. It has two definite meanings, referring both to the state foregoing falling asleep and chronic condition referring to being in that state independent of the daily rhythm. While performing the tasks that needed the constant concentration such as driving can be dangerous if it is done in a drowsiness state. Person can experience drowsiness if they had a sufficient fatigue and this can leads to road accidents.

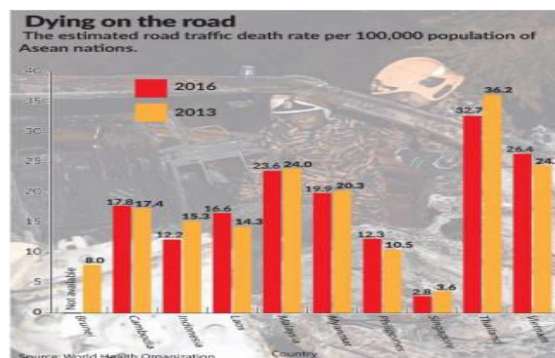


Fig. 1: The statistic of road accidents of Asian Nations in 2013 and 2016

The major challenge in the field of accident-avoidance system faced by the developer and researcher is in developing the technologies for detecting or preventing drowsiness among the drivers. Solutions need to be done in order to counteract the presence hazards of drowsiness on a road. The purpose of this project is to develop the simulation of drowsiness detection system. The focus of the project is to design a system that will detect the drowsiness by detecting the closed eyes of the driver. By monitoring the state of the eyes, it is believed can detect the early symptom of the

driver's drowsiness, to avoid car accidents. The process of detecting the drowsiness between drivers is to detect the open and closed of the eyes.

Humans have always invented machines and devised techniques to ease and protect their lives, for mundane activities like travelling to work, or for the purpose of aircraft travels. With the advancement in technology, modes of transportation kept on advancing and our dependency on it started increasingly exponentially.

## II.LITERATURE REVIEW

Fatigue is a safety problem that has not yet been deeply tackled by any country in the world mainly because of its nature. Fatigue, in general, is very difficult to measure or observe unlike alcohol and drugs, which have clear key indicators and tests that are available easily. There are many products out there that provide the measure of fatigue level in the drivers which are implemented in many vehicles. The driver drowsiness detection system provides the similar functionality but with better results and additional benefits. Also, it alerts the user on reaching a certain saturation point of the drowsiness measure. Many researchers have written research papers on driver drowsiness detection systems. But at times, some of the points and observations made by the system are not accurate enough. Hence, to provide data and another perspective on the problem at hand, in order to improve their implementations and to further optimize the solution, this project has been done.

**Adrian Rosebrock proposed a Drowsiness Detection with Open-CV (Using Eye Aspect Ratio) [1]** .A real-time algorithm to detect eye blinks in a video sequence from a standard camera is proposed. Recent landmark detectors, trained on in-the wild datasets exhibit excellent robustness against a head orientation with respect to a camera, varying illumination and facial expressions. We show that the landmarks are detected precisely enough to reliably estimate the level of the eye opening. The proposed algorithm therefore estimates the landmark positions, extracts a single scalar quantity – eye aspect ratio (EAR) – characterizing the eye opening in each frame.

### Relevance to current Research

In this paper, the author proposed robust real-time facial landmark detectors that capture most of the characteristic points on a human face image, including eye corners and eyelids, are available, most of the state-of-the-art landmark detectors formulate a regression problem, where a mapping from an image into landmark positions or into other landmark parametrization is learned. And the proposed SVM method that uses a temporal window of the eye aspect ratio (EAR), outperforms the EAR thresholding.

Burcu KirSavas, Yasar Becerikli proposed a Real Time Driver Fatigue Detection Based on SVM Algorithm in 2018 [2]. SVM based driver fatigue prediction system is proposed to increase driver safety. The proposed system has five stages: PERCLOS, count of yawn, internal zone of the mouth opening, count of eye blinking and head detection to extract attributes from video recordings. The classification stage is done with Support Vector Machine (SVM). While the Yaw-DD dataset is used during the training phase of the classification, real-time video recordings are used during the test phase.

### Relevance to current Research

In this paper, the author proposed a system to investigate the effects of fatigue and 8 insomnia on drivers physical transient behaviours, and to simulate drowsy drivers as a result of research. In this system, behavioural detection model is used for detecting fatigue drivers.

T. Vesselenyi<sup>1</sup>, S. Moca<sup>1</sup>, A. Rus<sup>1</sup>, T. Mitran<sup>1</sup>, B. Tătaru<sup>1</sup> proposed a Driver drowsiness detection using ANN image processing in 2017 [3]. The study regarding the possibility to develop a drowsiness detection system for car drivers based on three types of methods: EEG (Electroencephalography) and EOG (Electrooculography) signal processing and driver image analysis. The EEG method monitors the brain activity through a sensor placed on a specific part of the scalp, The EOG method tracks the eye movements by measuring the signals from the muscles which are acting on the eye. The eye image analysis can monitor the opened or the closed state of the eye.

### Relevance to current Research

Artificial neural networks are extensively used for the image classification. Deep learning is a subset of machine learning in artificial intelligence that has networks capable of learning unsupervised from data that is unstructured or unlabelled. Deep Belief Networks, Restricted Boltzmann Machines and Deep Auto encoders are all methods belonging to the Deep Learning. These methods are used in a wide range of applications.

Venkata Rami Reddy Chirra, Srinivasulu Reddy Uyyala and Venkata Krishna Kishore Kolli proposed a Deep CNN: A Machine Learning Approach for Driver Drowsiness Detection Based on Eye State in 2019 [4]. Whole face region may



not be required to detect the drowsiness but only eyes region is enough for detecting drowsiness. At first step by using the Viola-jones face detection algorithm face is detected from the images. Once the face is detected, Viola-jones eye detection algorithm is used to extract the eye region from the facial images. it is the first algorithm used for face detection. For the face detection the Viola-Jones algorithm having three techniques those are Haar-like features, Ada boost and Cascade classifier.

**Relevance to current Research**

In this work, Viola-Jones object detection algorithm with Haar cascade classifier was used and implemented using OPEN CV with python. Haar cascade classifier uses Haar features for detecting the face from images.

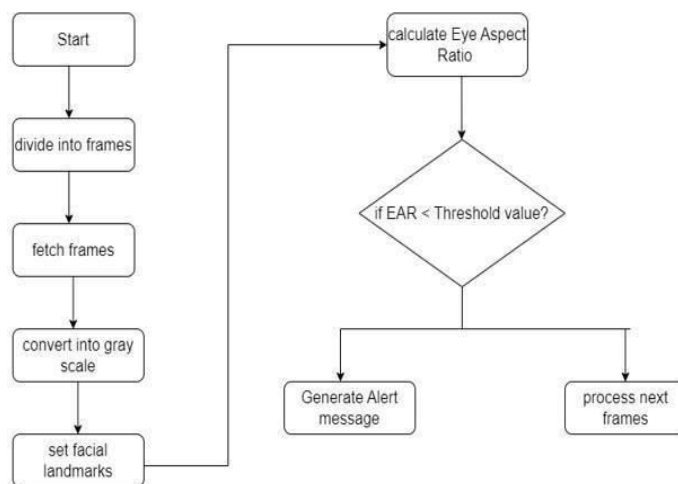
**III.METHODOLOGY OF PROPOSED SURVEY**

**ResearchDesign**

The designing of the proposed solution consists of system overview which provides the working of system and the architectural model that gives the detailed explanation of working of the system.

**a. SystemOverview :** Drowsiness system designed to detect signs of drowsiness in a person by analyzing their images captured by a camera. The system is based on computer vision and machine learning techniques, using the Open-CV library and image processing algorithms to extract features from the ear(Eye aspect ratio) images and detect the level of drowsiness.

**b. Architectural Design :**In order to make sure the project is in the right path; detailed architectural plays an important role as a guide for the project to complete and working well as planned. This project is involving many software such as Anaconda Navigator, Python Editors etc.



**Fig.1 Architectural Design for Drowsiness Detection System**

In this project, I have used python for drowsiness detection.The system deals with a specific part of the body which is theface.

The main components are:

- Setting the threshold EAR value
- Diving the video into frames.
- Fetching the frames
- Converting the fetched frames into grayscale
- Setting up the facial landmarks using the Dlib library
- Caluclating the Eye Aspect Ratio (EAR)
- Comparing the calculated EAR value with the threshold EAR value
- Generating the alert message if calculated EAR value is Less than the threshold EAR value.

The working is, when the user runs the program, the webcam that is placed in front of the driver starts detecting the face and then eyes. Then the program will extract the data from the webcam and then detect if the eyes are closed or opened. If the eyes are closed then the system will play sound so that the driver is awoken. If the eyes are opened then the system will go on repeating the program. The process will go on.

This represents the whole system overview and the architecture of the drowsiness detection system using OpenCV and Dlib.

### Population Of Study

Sleep is a neurobiological need with predictable patterns of sleepiness and wakefulness. Sleepiness causes auto crashes because it impairs performance and can ultimately lead to the inability to resist falling asleep at the wheel. Critical aspects of driving impairment associated with sleepiness are reaction time, vigilance, attention, and information processing.

Although evidence is limited or inferential, chronic predisposing factors and acute situational factors recognized as increasing the risk of drowsy driving and related crashes include:

- *Sleep loss.*
- *Driving patterns*, including driving between midnight and 6 a.m.; driving a substantial number of miles each year and/or a substantial number of hours each day; driving in the mid-afternoon hours (especially for older persons); and driving for longer times without taking a break.
- *Use of sedating medications*, especially prescribed anxiolytic hypnotics, tricyclic antidepressants, and some antihistamines
- *Untreated or unrecognized sleep disorders*, especially sleep apnea syndrome (SAS) and narcolepsy.
- *Consumption of alcohol*, which interacts with and adds to drowsiness.

Although no driver is immune, the following three population groups are at highest risk, based on evidence from crash reports and self-reports of sleep behavior and driving performance.

- Young people (ages 16 to 29), especially males or females.
- Shift workers whose sleep is disrupted by working at night or working long or irregular hours.
- Lorry/Truck drivers who work for long hours.

### Instrument for Data Collection

Driver drowsiness detection systems can use web cameras, mobile cameras and usage of various built-in models like dlib to detect the facial features through the images being captured from the camera where drowsiness can be detected through yawning frequency, eye-blinking frequency, eye-gaze movement, head movement and facial expressions.

### Technologies used for Implementation

- Image processing
- Open-CV
- NUMPY
- SCIPY
- IMUTILS
- DLIB

### Sampling Techniques

Selected necessary sampling techniques for the project, such as 1) Alertness, 2) Low Vigilance, 3) Drowsiness.

1) **Alert** : One of the first three states highlighted in the KSS table in Table. 3.1. Subjects were told that being alert meant they were completely conscious so they could easily drive for long hours.

2) **Low Vigilant** : As stated in level 6 and 7 of Table. 3.1, this state corresponds to subtle cases when some signs of sleepiness appear, or sleepiness is present but no effort to keep alert is required. While subjects could possibly drive in this state, driving would be discouraged.

3) **Drowsy** : This state means that the subject needs to actively try to not fall asleep (level 8 and 9 in Table. 3.1).

1-Extremely Alert
2-Very Alert
3-Alert
4-Rather Alert
5-Neither Alert or Sleepy
6-Some signs of sleepiness
7-Sleepy, but no difficulty remaining awake
8-Sleepy, some effort to keep alert
9-Extremely Sleepy, fighting sleep

Table. 3.1 KSS Table

This dataset consists of 180 RGB videos. Each video is around 10 minutes long, and is labeled as belonging to one of three classes: alert (labeled as 0), low vigilant (labeled as 5) and drowsy (labeled as 10). The labels were provided by the participants themselves, based on their predominant state while recording each video. This type of labeling takes into account and emphasizes the transition from alertness to drowsiness. Each set of videos was recorded by a personal cell phone or web camera resulting in various video resolutions and qualities. The 60 subjects were randomly divided into five folds of 12 participants, for the purpose of cross validation. The dataset has a total size of 111.3 Gigabytes.



Fig.. 3.3: Sample frames from the UTA-RLDD dataset in the alert (first row), low vigilant (second row) and drowsy (third row) states.

**Method of Data Analysis**

For our training and test data, we used the [Real-Life Drowsiness Dataset](#) created by a research team from the University of Texas at Arlington specifically for detecting multi-stage drowsiness. The end goal is to detect not only extreme and visible cases of drowsiness but allow our system to detect softer signals of drowsiness as well. The dataset consists of

around 30 hours of videos of 60 unique participants. From the dataset, we were able to extract facial landmarks from 44 videos of 22 participants. This allowed us to obtain a sufficient amount of data for both the alert and drowsy state. For each video, we used [OpenCV](#) to extract 1 frame per second starting at the 3-minute mark until the end of the video.

Each video was approximately 10 minutes long, so we extracted around 240 frames per video, resulting in 10560 frames for the entire dataset.

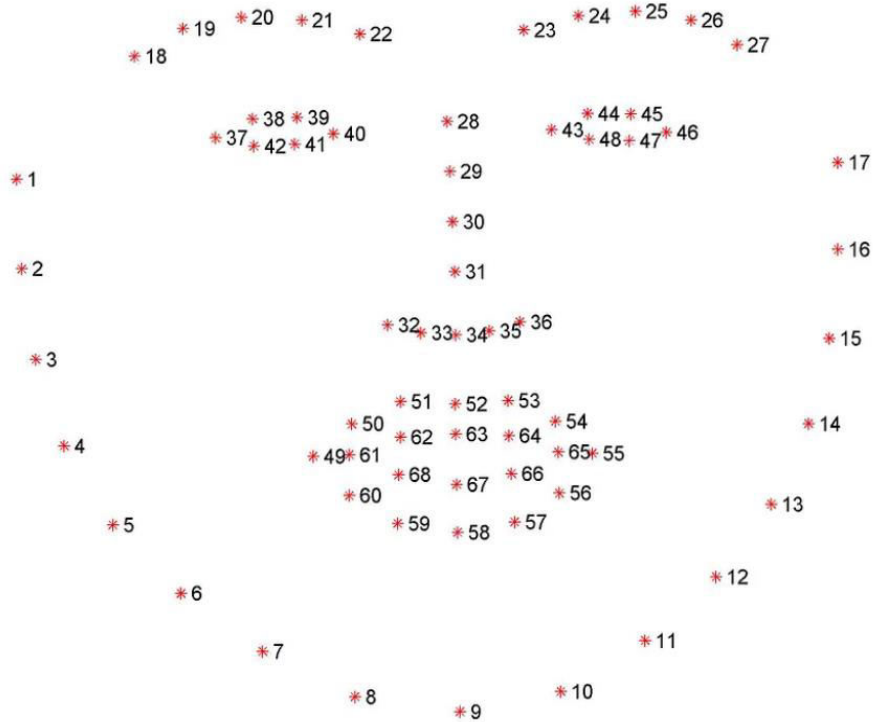


Fig. 3.4 Facial Landmarks from OpenCV

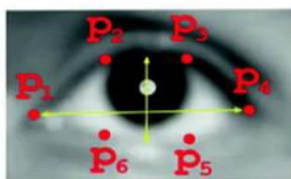
There were 68 total landmarks per frame but we decided to keep the landmarks for the eyes and mouth only (Points 37–68). These were the important data points we used to extract the features for our model.

**Feature Extraction**

As briefly alluded to earlier, based on the facial landmarks that we extracted from the frames of the videos, we ventured into developing suitable features for our classification model. While we hypothesized and tested several features, the four core features that we concluded on for our final models were eye aspect ratio, mouth aspect ratio, pupil circularity, and finally, mouth aspect ratio over eye aspect ratio.

*Eye Aspect Ratio (EAR)*

EAR, as the name suggests, is the ratio of the length of the eyes to the width of the eyes. The length of the eyes is calculated by averaging over two distinct vertical lines across the eyes as illustrated in the figure below.



$$EAR = \frac{\|p_2 - p_6\| + \|p_3 - p_5\|}{2\|p_1 - p_4\|}$$

Fig. 3.5 Eye Aspect Ratio (EAR)

Our hypothesis was that when an individual is drowsy, their eyes are likely to get smaller and they are likely to blink more. Based on this hypothesis, we expected our model to predict the class as drowsy if the eye aspect ratio for an individual over successive frames started to decline i.e. their eyes started to be more closed or they were blinking faster.

#### IV.CONCLUSION AND FUTURE WORK

drowsiness detection is an important problem with many applications in transportation, healthcare, and workplace safety. While dlib provides a powerful set of tools for detecting drowsiness based on facial features, there are several other techniques and strategies that can be used to improve the accuracy and reliability of these systems. By using multiple sensors, collecting more data, considering environmental factors, developing personalized models, integrating with existing systems, and addressing ethical and privacy concerns, we can develop effective and responsible drowsiness detection systems that can help prevent accidents and injuries

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