Mini Project Report on

Driver Drowsiness Detection using Deep Learning

Submitted in partial fulfillment of the requirement for the award of the degree of

BACHELOR OF TECHNOLOGY

IN

COMPUTER SCIENCE & ENGINEERING

Submitted by:

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CANDIDATE'S DECLARATION

I hereby certify that the work which is being presented in the project report entitled **"Driver Drowsiness Detection using Deep Learning"** in partial fulfillment of the requirements for the award of the Degree of Bachelor of Technology in Computer Science and Engineering of the Graphic Era (Deemed to be University), Dehradun shall be carried out by the under the mentorship of **Mr. Ankit Tomar, Assistant Professor**, Department of Computer Science and Engineering, Graphic Era (Deemed to be University), Dehradun.

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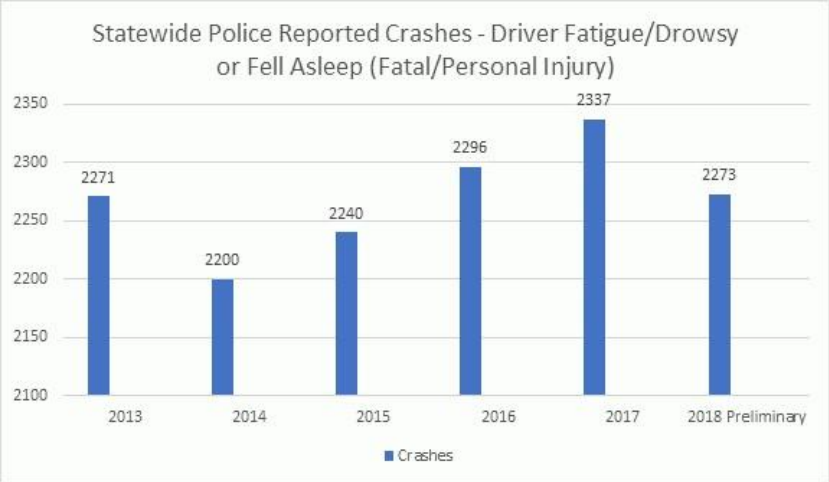
Chapter 1

Introduction

1.1 Introduction

Driving while feeling drowsy is a major reason of motor vehicle accidents. According to National Highway Traffic Safety Administration (NHTSA), in 2017, driving while feeling sleepy led to at least 91,000 crashes, resulting in roughly 50,000 injuries and 800 deaths.

Driving while feeling sleepy significantly increases the risk of car accidents. Research shows that sleep deprivation/insomnia leads to psychic impairment that is similar to drunkenness, making a person less attentive to environment.



Source: Institute for Traffic Safety Management and Research(ITSMR)

Figure 1: Statistic of Road Accident because of Driver Fatigue from 2013 to 2018 (New York)

Figure 1 shows the statistic of police reported fatal crashes in New York State from 2013 to 2018 where the main reason was fatigue/drowsiness/sleepiness. It keeps increasing every year and by the year 2017, 2337 cases were reported.

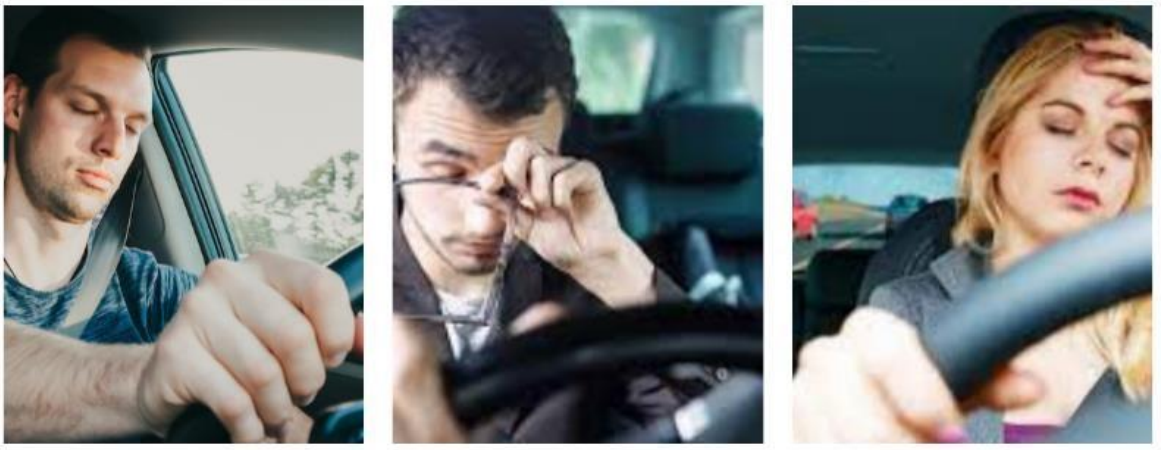


Figure 2: Examples of drivers feeling sleepy/drowsy while driving

The development for technologies for detecting and preventing drowsiness while driving is a major challenge in the field of accident-avoidance system.

The major aim of this project is to solve the same problem. The focus is placed on designing a system that will monitor the open and close state of driver's eyes. It is believed that whenever driver's eyes will be in a closed state for a longer than usual time, this project will detect it as a drowsy state and start to play an alerting alarm to wake him/her up. This could lead to a lot of prevention from accidents.

Analysis of face through webcam or images is a popular research area with applications such as face recognition system, human identification and tracking for security purposes. This project is mainly focused on the localization of eyes and face. After getting the position of eyes on face, this project looks for the state of eyes and according to it, check for drowsiness.

1.2 Problem Statement

Electroencephalography (EEG) and Electrocardiography (ECG) are two currently used driver drowsiness detection system. They work properly with efficient accuracy but the problem arises with the usage as they are not comfortable to wear during driving. Moreover, they require complex computation and expensive equipment.

Driver Insomnia Detection using ML is a way more comfortable approach as it just requires to setup a webcam in front of driver and it will do its job efficiently by playing alarm whenever required.

This project can save lots of lives. Hence, it is a very, very useful project.

Chapter 2

Literature Survey

There are various researches regarding Driver Insomnia Detection that can be used as a reference for developing a real-time Driver Insomnia Detection. Different researches have used different approaches for detection.

2.1 Drowsiness

Antoine Picot et al, [1] stated that drowsiness is where a person is in the middle of awake and sleepy state. This leads the driver to not giving full concentration to their driving. Hence, the vehicle can no longer be in control due to the driver being in a semi-conscious state.

2.2 Electroencephalography (EEG) for Drowsiness Detection

Figure 3: Driver drowsiness estimation using EEG signals

Electroencephalography (EEG) is a technique that measures the electrical activity oh Human Brain. As shown in Figure 3, it is used to measure the heartbeat, eye blink and some physical movement such as head movement. It is used on human or animal to get the brain activity. It uses a hardware which place sensors around the head area to sense all electrical brain activities.

One of the disadvantages of this method is that it is very sensitive to noise/sound around the sensors. For example, when the person is under the EEG experiment, the surrounding area should be completely silent. The sound or any noise will distract the sensors that detect the brain activity. Other major disadvantage is that even if the result might be correct or accuracy is high but it is not suitable to use for real driving application. When a person is driving vehicle and he/she is wearing something on his head with full of wires and when he/she

moves his/her head, the wire might strip off. Even though it is inconvenient to be used for real-time driving but for experiment purposes, it is one of the best methods so far.

2.3. Drowsiness detection using face detection system

Drowsiness can be detected by using face area detection [2], [3] and [6]. The methods to detect drowsiness within face area are vary due to drowsiness sign are more visible and clearer to be detected at face area. From the facial region, we can detect the eyes' location. From eyes detection, author in [2] stated that there are four types of eyelid movement that can be used for drowsiness detection. They are complete open, complete close, and in the middle where the eyes are from open to close and vice versa [2]. Figure 4 is an example of the image taken for detecting eye state (open or close).

Figure 4: Open and Closed State of Eyes

The algorithm processes the images captured in grey-scale method; where the color from the images is then transformed into black and white [4] [5]. Working with black and white images is much easier as only two parameters are there to be measured.

Chapter 3

Methodology

Here, the method that has been taken in order to reach the objectives of the project is explained and a closer look on how the project is implemented is shown.

3.1 Research Methodology

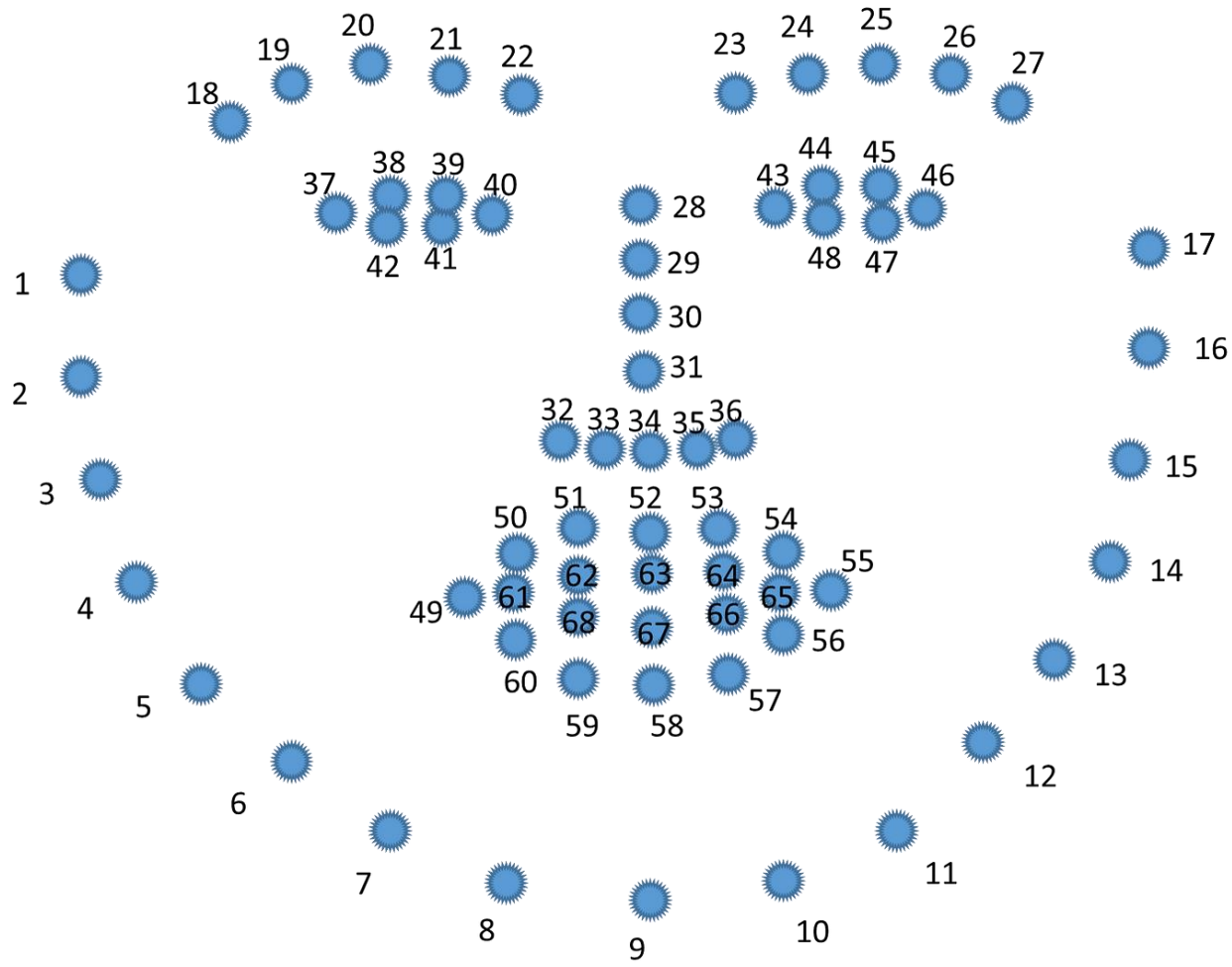


Figure 5: Landmarks using dlib

3.1.1 Background Study

Before starting this project, basic information of the related topic was collected and studied to ensure and understand what the project is all about. In this stage, the background study helped

in understanding the seriousness of driving a motored vehicle in drowsiness condition. It is proven that driving the vehicle in fatigue and drowsiness condition is a major factor to road accidents.

3.1.2 Literature Review

In this stage, it involved the study of the previous research done related to this project. A thorough observation was done on the existing method to detect the drowsiness. Study of different parameters used by previous researches and their drawbacks is done. By focusing on the parameters which is detecting eyes and face, helps to narrow down the perspective of this project.

3.1.3 Data Collection

The dataset used in this project is collected from as a live product from the camera itself. Also a functionality to capture a video and then implementing the detection system is also available.

3.1.4 Data Preprocessing

The Images that are captured is converted into gray scale images and the frames are separated. Faces and the respective eye landmarks are marked using open cv functionality cv2.circle or cv2.rectangle.

3.1.5 Model Selection

In order to detect if the eyes are active, drowsy or sleeping. We have to compute the Euclidean distance between the landmarks of left eye (37,38,39,40,41,42) and respectively for the right eye landmarks (43,44,45,46,47,48).

Now after calculation if the ratio is more than 0.25 then it represents active eyes, between 0.25 and 0.21 represents drowsy else sleepy.

```
dist = numpy.linalg.norm(a-b)
```

This works because the **Euclidean distance** is the **l2 norm**, and the default value of the `ord` parameter in `numpy.linalg.norm` is 2. For more theory, see *Introduction to Data Mining*:

> The Euclidean distance measure given in Equation 2.1 is generalized by the **Minkowski** distance metric shown in Equation 2.2,
>
> $$d(\mathbf{x}, \mathbf{y}) = \left(\sum_{k=1}^{n} |x_k - y_k|^r \right)^{1/r}, \qquad (2.2)$$
>
> where r is a parameter. The following are the three most common examples of Minkowski distances.

Figure 6: a. Euclidean method in numpy

3.156 Evaluation

The project was able to achieve an accuracy of around **98%.** Callback can be easily implemented after we reach a certain accuracy.

This is the kind of result we are getting because of the usage of dlib library.

3.2 Technology Used:

3.2.1 Python

Python is a high level, general purpose programming language which is is widely used in data science and for implementing deep learning algorithms.

3.2.2 JUPYTER Lab

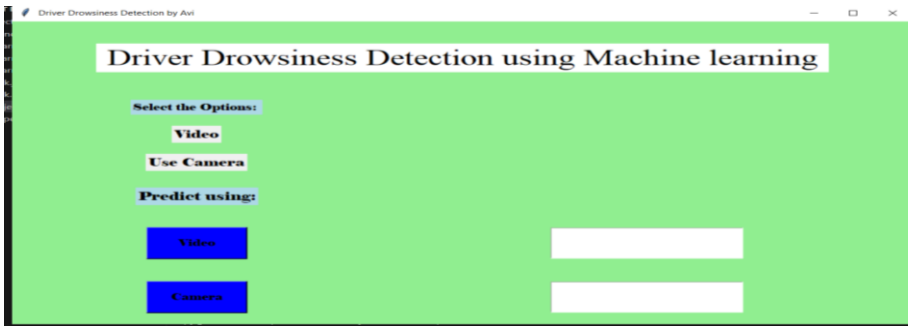
Project Jupyter is a nonprofit organization used to develop open-source software, openstandards, and services for interactive computing across lots of programming languages.

3.2.3 Dlib

It's a landmark's facial detector with pre-trained models, the dlib is used to estimate the location of 68 coordinates (x, y) that map the facial points on a person's face . These points are identified from the pre-trained model

3.2.4 Open CV

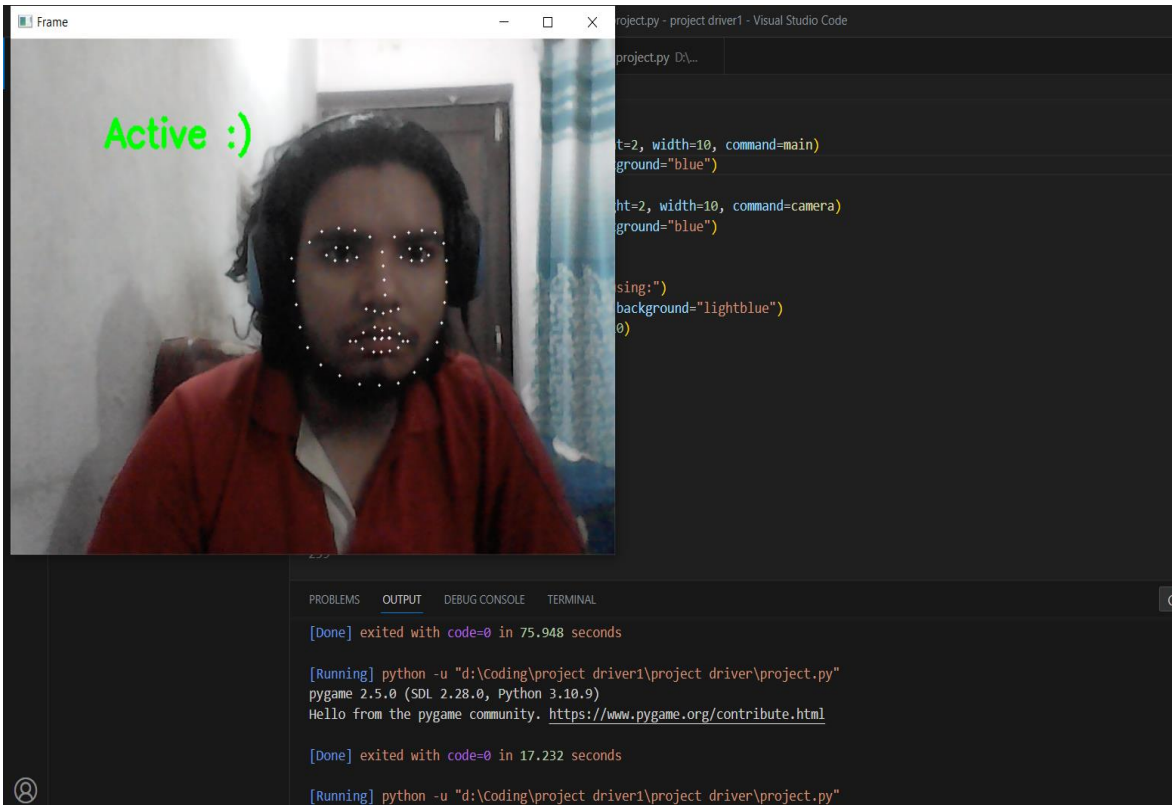
OpenCV is a cross-platform library using which we can develop real-time computer vision applications. It mainly focuses on image processing, video capture and analysis including features like face detection and object detection.



Chapter 4

Result and Discussion

Implementation of drowsiness detection with Machine Learning was done. It includes successful runtime capturing of video with camera. Captured video is divided into frames and each frame is analyzed. Successful detection of face followed by detection of eye is performed. If closed state of eyes is detected for more than usual time, then it is classified as drowsy condition and an alarm is played to wake the driver up else it is regarded as normal blink and the loop of analyzing the eye state of driver is carried out again and again.
The model works with an accuracy of 95%.



Chapter 5

Conclusion and Future Work

5.1 Conclusion

This project completely meets the objectives and requirements of the problem. A quantitative demonstration of the dlib classifiers and regression-based facial landmark detectors are done and are precise enough to efficiently estimate the images of face and a state of open eyes.

5.2 Future Work

This model is designed for detection of sleepy state of eye and give an alert signal in the form of an alarm. But the response of driver after getting warning may not be enough to prevent the accident. If a driver gets slow in responding to the alert signal, then accidents may occur. Therefore, to avoid this, we can design and implement a motor driven system and synchronize it with the alert signal so that the car will automatically slow down after getting the alert signal. We can even provide the driver with an Android application that will provide all the information of his/her drowsiness/sleepiness level during the journey. The driver will know about his/her Normal state, Sleepy state, the number of blinking of eyes according to the number of frames captures.

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