CHAPTER 1

INTRODUCTION

Driving involves the performance of a particular sequence of actions with situational awareness, as well as, quick and accurate decision making. Situational awareness is critical in driving, as direct attention is required to process the perceived cues. Monitoring attention status, therefore, is one of the most important parameters for safe driving.

Fatigue slows down human response time, which leads to inability in safe driving. In a survey in Canada, it has been reported that 20% of fatal collisions involve fatigue. In another survey, it is reported that in Pakistan 34% of road accidents were related to fatigue. According to a US survey, 20% of fatal crashes were due to a drowsy driver. In the EU, 20% of commercial transport crashes are reported to be due to fatigue. All the statistics and numbers are alarming and seek serious research community attention to address the issue.

Due to these factors, research in the field of driver's state monitoring has been developing very rapidly, especially for things like driver workload estimation, driver activity identification, secondary task identification and driving style recognition. Many techniques have been used in the past. Some of these methods have been implemented by various multinational companies for driver assistance. Fatigue symptoms include: yawning, slow reaction time, eyelid closure, loose steering grip, etc. Humans may exhibit multiple symptoms and levels of fatigue, therefore one symptom may not singly and accurately be employed for fatigue detection.

This project presents a brief review of existing techniques used until now in the field of fatigue detection in drivers, and also based on developing a novel architecture using deep learning methods to detect drowsiness, using spatiotemporal features of a person's face. The technique is developed such that it is accurate as well as robust under various real-life scenarios.

CHAPTER 2

LITERATURE SURVEY

This chapter focuses on the review of standard literature surveys highlighting the importance of Driver Drowsiness Detection System. The brief review of some of the significant papers are as follows:

Drowsiness Detection with Machine Learning by Grant Zhong, Rui Ying, He Wang, Aurangzaib Siddiqui, Gaurav Choudhary [UTA Real-Life Drowsiness Dataset (UTA-RLDD)] This project build a detection system that identifies key attributes of drowsiness and triggers an alert when someone is drowsy before it is too late. For the training and test data, the project 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. This project uses the Convolutional Neural Network (CNN), Long Short-Term Memory (LSTM) Network, Transfer Learning for the Drowsiness Detection.

Driver Drowsiness Detection by Authors : V B Navya Kiran, Raksha R, Anisoor Rahman, Varsha K N, Dr. Nagamani N P[International Journal Of Engineering Research & Technology (IJERT)] NCAIT – 2020 (Volume 8 – Issue 15). The developed system is a real time system. It uses image processing for eye and face detection. HAAR based cascade classifier is used for face detection. An algorithm to track objects is used to track the eyes continuously. In order to identify the drowsy state of the driver, the PERCLOS algorithm issued [2]. The paper focuses on developing a non- intrusive system which can detect fatigue and issue a warning on time. The system will monitor the drivers eyes using a camera. By developing an algorithm, the symptoms of driver fatigue can be detected early enough to avoid accident. When the signs of fatigue have been identified output in the form of sound and seat belt vibration is provided to alert the driver. Warning will be deactivated manually rather than automatically. This paper uses a faster algorithm than PERCLOS. This system will detect drivers fatigue by the processing of the eye region. After image acquisition, the first stage of processing is face detection. If eyes are blinking visual, non-visual, and vehicular features into one. The last idea is to develop wearable hardware such as smart watches in order to detect drowsiness.

Driver Drowsiness Warning System Using Visual Information for Both Diurnal and Nocturnal Illumination Conditions by MarcoJavier Flores,JoséMaría Armingol,Arturo de la Escalera [EURASIP Journal on Advances in Signal Processing] 2010, Article number: 438205 (2010). This paper presents the drowsiness detection system of the IVVI (Intelligent Vehicle based Visual on Information) vehicle . The goal of this system is to automatically estimate the driver's drowsiness and to prevent drivers falling asleep at the wheel. This paper is laid out as follows. It presents an extensive review on the state of the art considering different lighting conditions. A general framework of the proposed method is also presented. There are two systems, one for diurnal and another nocturnal driving. Both have a first step for face and eye detection, followed for a second step for face and eye tracking. The output of both systems is a drowsiness index based on a support vector machine. A deeper explanation of both systems is presented in this paper where the similarities and differences of both approaches are highlighted, and the results are shown. Finally, in the last sections,the conclusions are presented.

Drowsy Driver Detection System by Kodali Sahithi at Macquarie University. This project is developed to implement one such Drowsy Driver Detection System. This system detects the eyes of the driver and alarms if the driver is sleepy. A driver is termed sleepy, if he/she closes the eyes for more than a certain period of time. Through this system, we can reduce the number of accidents in a great number thus helping the society in a significant way. This project is implemented in two ways namely; Webcam based and using Convolutional Neural Network. Both the implementations tend to show good results in detecting the drowsiness of the driver.

CHAPTER 3

PROBLEM STATEMENT AND OBJECTIVES

PROBLEM STATEMENT

Drowsy Driving has been one of the major causes behind the dangerous accidents occurring these days in the world. Drowsy Driving refers to the combination of driving and lack of sleep. In this busy world, it has become difficult to get sufficient sleep due to hectic schedules. Lack of Sleep leads to Sleep deprived driving which is prone to more fatal accidents compared to drunk driving. According to the Statistics, around 2,50,000 number of drivers fall asleep daily while driving. About a quarter of the accidents in the world are due to sleep deprivation.

One such solution which can curb the number of accidents due to drowsiness is by detecting if the driver is sleepy and alarming. This project is developed to implement one such Drowsy Driver Detection System. This system detects the eyes of the driver and alarms if the driver is sleepy. A driver is termed sleepy, if he/she closes the eyes for more than a certain period of time. Through this system, we can reduce the number of accidents in a great number thus helping the society in a significant way.

This project is based on Webcam implementation, that tends to show good results in detecting the drowsiness of the driver

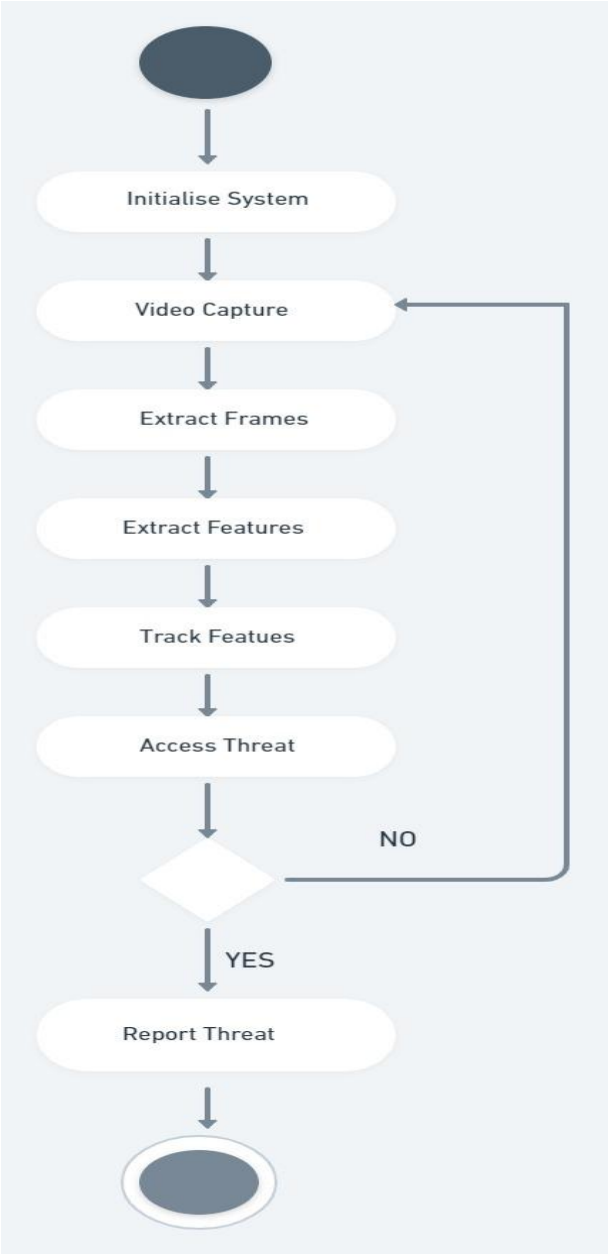
OBJECTIVES

- To develop a drowsiness detection system by monitoring the eyes; it is believed that the symptoms of driver fatigue can be detected early enough to avoid a car accident.
- Detection of fatigue involves the observation of eye movements and blink patterns.
- To increase traffic safety and to reduce the number of traffic accidents, numerous universities, research centers, automotive companies and governments are contributing to the development of ADAS for driver analysis using different technologies.
- To provide a cost efficient approach of drowsiness detection systems that can be implemented in cheap cars/trucks.

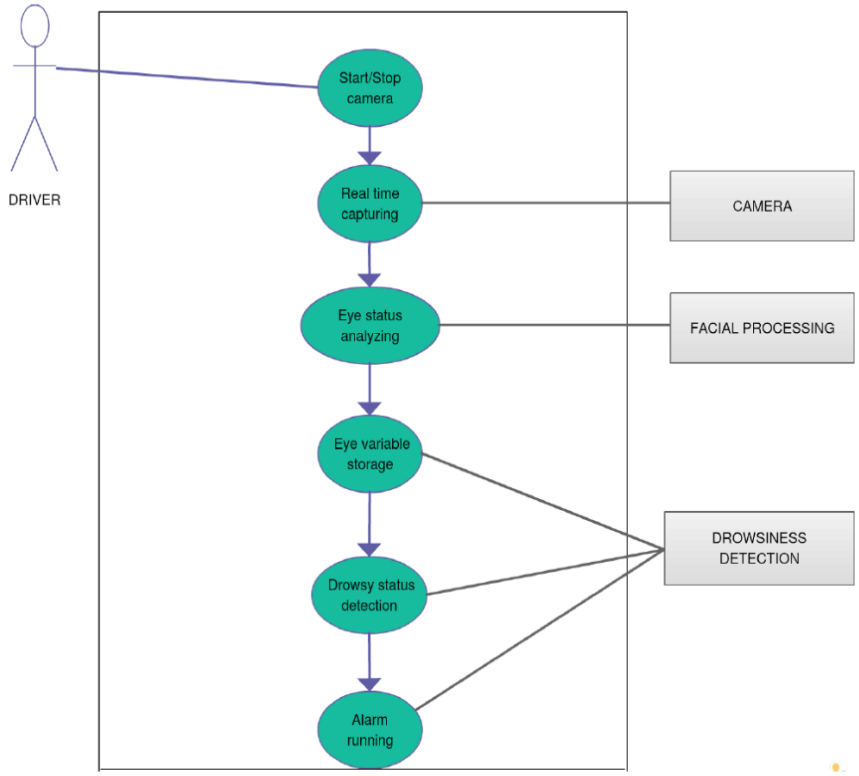
CHAPTER 4

METHODOLOGY

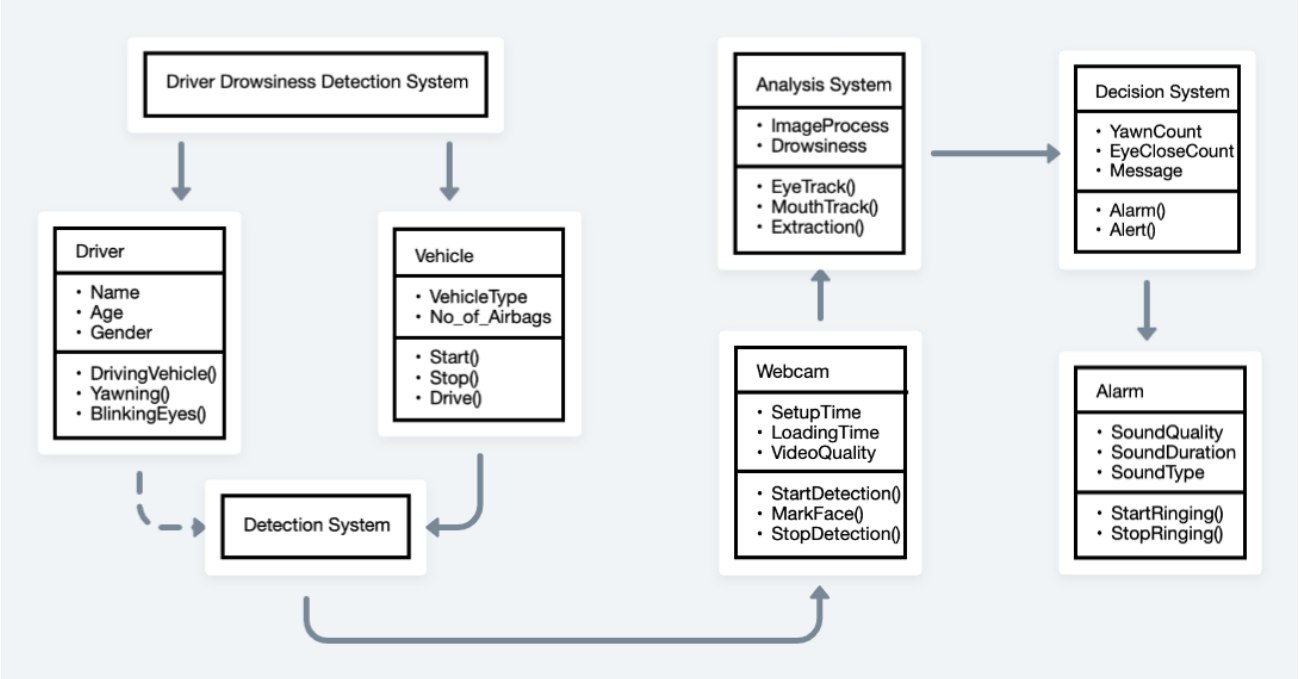
ACTIVITY DIAGRAM



USE CASE DIAGRAM



CLASS DIAGRAM



CHAPTER 5

TOOLS AND TECHNOLOGIES

TOOLS

SOFTWARE REQUIREMENTS:

- **OpenCV**

OpenCV is a library which enables different functions related to Computer Vision. It includes various modules and methods related to Image Processing, Video Processing etc. Installing this library helps in working with images and videos easily.

- **Python**

Python is one of the most used programming languages in the field of Data Science. It is a general purpose high level programming language which can handle the complexities in Machine Learning, Deep Learning models by providing vast library support.

- **Libraries:**

Numpy: Prerequisite for Dlib
Scipy: Used for calculating Euclidean distance between the eyelids
Playsound: Used for sounding the alarm
Dlib: This program is used to find the frontal human face and estimate its pose using 68 face landmarks.
Imutils: Convenient functions written for Opencv.

- **JupyterLab**

This framework provides various Data Science tools including Python through Jupyter, Deep Learning libraries like numpy, dlib, imutils, cv2, OpenCV etc on a single platform. These packages and libraries can be imported and used as required after installation.

HARDWARE REQUIREMENTS:

- **WebCam**

The Webcam based Implementation involves the concepts of Computer Vision. These Computer Vision operations can be performed using the OpenCV library. The methods provided by OpenCV library are extensively used in the Image and Video Processing. This implementation utilizes these OpenCV libraries and Feature Extraction concepts to detect drowsiness in the driver.

TECHNOLOGIES

- **Image Processing**

In computer science, digital image processing is the use of computer algorithms to perform image processing on digital images.

- **Machine Learning**

Machine learning is the scientific study of algorithms and statistical models that computer systems use in order to perform a specific task effectively without using explicit instructions, relying on patterns and inference instead. It is seen as a subset of artificial intelligence. Machine learning algorithms build a mathematical model based on sample data, known as "training data", in order to make predictions or decisions without being explicitly told.

CHAPTER 6

IMPLEMENTATION

- The Webcam based Implementation includes various concepts like
  - Feature Extraction
  - Detection of Region of Interest
  - Eye blink and Yawn normalization
  - Alarm Alert

  to detect the drowsy driver and build the detection system.
- OpenCV library is extensively used to detect each image or frame in a video.
- Each functionality used is discussed in detail further in this section.

CHAPTER 7

ROLE OF OPENCV

- OpenCV library provides all the Computer Vision functions required for Image and Video processing in a single library.
- All the methods can be used by Importing the package in the coding environment. It provides methods to read,write and display images.
- Each image is converted into numbers which are known as Pixel values with each number representing the pixel intensity.
- Reading and writing the images is crucial in implementing this project and this functionality is made easy by the OpenCV library.

CHAPTER 8

FEATURE EXTRACTION

- After the detection of images and performing image processing i.e change color of the images as required, perform rotation and resizing if required we need to extract the features.
- Here, we need to obtain the facial landmark points. This can be termed as a subset of shape prediction problems.
- Our main objective is to determine the important facial features using the shape predictor methods provided and then focus on the region of Interest according to the project goals.
- The Region of Interest in this project is Eyes and Mouth to determine whether the person has sleepy eyes or yawning constantly.

CHAPTER 9

DLIB FACIAL LANDMARK DETECTOR

- To detect the facial landmarks we utilized the Facial Landmark Predictor provided by Dlib Library. Dlib provides the inbuilt algorithm to detect the facial landmarks points.
- This predictor starts by using a training set of manually labelled facial landmarks on an image. It specifies the (x,y) coordinates of the facial structure with each specific facial feature denoted with their indexes.
- An ensemble of regression trees are trained on this training data to estimate the facial landmark positions.
- The predictor used in the project was trained on a 68 point iBUG 300-W dataset .This pre-trained detector is used to estimate the location of 68 (x,y) coordinates used to map the facial structure.
- These indexes of the coordinates can be visualized as below.

CHAPTER 10

EXPECTED OUTCOME

A new method is proposed for driver drowsiness detection based on eye and mouth state. This determines the state of the eye that is drowsy or non- drowsy and whether the person is yawning or not. Face and eye regions are detected using Predict and Detection algorithms. We will make use of openCV library features for converting each image into pixel values to detect the state of the driver's face. An EAR equation could be used to classify the driver as sleep or non-sleep.

The system works well even in case of drivers wearing spectacles and even under low light conditions if the camera delivers better output. Information about the head and eyes position is obtained through various self-developed image processing algorithms.
During the monitoring, the system is able to decide if the eyes are opened or closed. When the eyes have been closed for too long, a warning signal is issued. Processing judges the driver’s alertness level on the basis of continuous eye closures.

The future Improvement for this project can be Implementing the Alarm sound when the person is Highly Drowsy when the indication of Drowsy alarm is displayed. We can also implement an algorithm such that the car slows down if the person continues to drowsy even after the alarm stops.

CHAPTER 11

CONCLUSION

In this way the Drowsy Driver Detection System can be implemented by WebCam. It also assists in a great way in reducing the number of accidents helping the society. The Implementation of this project not only helps the society but also helps in Continuous Professional Development thus helping in reaching the end goal of Data Science related engineering. It completely meets the objectives and requirements of the system. The framework has achieved an unfaltering state where all the bugs have been disposed of. It takes care of the issue of stressing out for individuals having fatigue-related issues to inform them about the drowsiness level while driving. The model can be improved incrementally by using other parameters like blink rate, yawning, state of the car, etc. If all these parameters are used it can improve the accuracy immensely.Same model and techniques can be used for various other apps like Netflix and other streaming services that can detect when the user is asleep and stop the video accordingly. It can also be used in applications that prevents users from sleeping.